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Research Paper

Soft Infrastructure in Smart Sustainable Cities

A Literature Review

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Abstract

Learning from the cases in Indonesia, the proliferation of advanced technologies has engendered a burgeoning interest in smart city promotion as a dominant developmental theme, and this has an association heavily with physical infrastructure development, while there are other things that need to be thought about. The methodology entails the scholarly works, procurement of data, classification of data, and integration of resultant discoveries. The objective of this article is to furnish a thorough and intricate comprehension of the soft infrastructure that upholds crucial infrastructure systems. Qualitative assessments scrutinize outcomes within multiple frameworks to gauge the efficacy of the supple infrastructure in promoting resilience. As a result, the occurrence of the theme of soft infrastructure in smart sustainable cities poses a novel challenge to continuously enhance their skills and expertise. The soft infrastructure in smart sustainable cities addresses business-spatial, cultural-political, and humane-innovation issues. Such resources can effectively address integrated regional challenges and well-conceived planning for cities.

Keywords: soft infrastructure; disrupted cities; smart city; sustainability; SDGs

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1. Introduction

The article discusses the concept of creating smart sustainable cities, which involves improving modern cities, including those in Indonesia, by building things like roads and buildings to make them grow faster. The main objective is to create well-arranged and organized cities. However, cities can become disrupted for various reasons, such as environmental impact, overuse, functional problems, and difficulties with management. The study provides evidence that urban and regional development requires more than just building infrastructure. Other important factors need to be considered and addressed as well.

These factors are very significant for the creation of a smart sustainable city development theme, where these factors relate to efficiency and socioecological issues as criticism of excessive physical infrastructure development; appropriate and justice issues as criticism of physical infrastructure development that excludes marginalized groups; the comprehensive and inclusive concept of infrastructure as a critique of infrastructure development in a peace meal manner without looking at the wider context of sustainability; rooted development theme issues as criticism of imported development theme; prevent infrastructure failure as a criticism of the existence of a "copyrighted work monument" (the physical infrastructure that is only used as a monument, not utilized); considering the soft infrastructure concept as a criticism of infrastructure development that overrides the role of stakeholders, local culture, and community cohesiveness.

The elucidated factors hold great significance in the establishment of a theme for developing a smart and sustainable city. These factors pertain to the domains of efficiency and socio-ecological concerns, which expose the loopholes in the prevalent unbridled physical infrastructure development. The inappropriate and unjust infrastructural systems, which exclude marginalized communities, also require attention. Additionally, a comprehensive and inclusive infrastructure development approach is imperative, which should be viewed holistically in the context of sustainability, instead of being implemented piecemeal. The notion of rooted development is also critical and relevant, highlighting the drawbacks of an imported development theme. The need to prevent infrastructure failure, specifically in terms of the existence of publicly funded infrastructure, which falls into disuse and becomes a mere 'copyrighted work monument,' is equally significant. Finally, it is pertinent to consider the essentiality of soft infrastructure, which emphasizes the role of stakeholders, local culture, and community cohesiveness in infrastructure development, thus critiquing the existing notion of infrastructure that ignores these fundamental aspects.

Firstly, the author quotes Rushton's classical book about the optimal location of facilities in the era leading up to the 1980s, he explains that planning for public facilities is not only related to physical development and the supporting population who need it, but also the existence of other measures that can be the key to the success of the implementation of the public facilities. Specifically, he said that within the period sometime recently computers became by and large available to analysts and understudies, the standards of the area were understood, and were taught by the component of building speculative situations with basic characteristics and hypothesizing rules of behavior to run the show in that (Rushton, 1979).

Buildings and structures that support city life are very important, but we often don't notice them because we think they are normal. They are really important for the non-stop and moving life in cities in many different ways. This process works in many different places, from inside our bodies to the whole world. It includes things like how food and water get to the city, and how we travel and communicate with people in other countries. It also involves dealing with different kinds of waste. The process of globalization is talked about a lot, but it depends on very big and complicated systems of things like roads and buildings. Cities are the most important parts of these systems because they use the most energy, food, water, transportation, and communication. But cities also cause the most pollution and waste (Graham, 2010).

When things go wrong with buildings, roads, or technology, it can teach us about how cities work and the government policies that govern them. We can learn more about this when things are not working properly than when everything is running smoothly. When things go wrong in transportation systems, we can learn about how people and things move around in society. Sometimes when traffic stops or something breaks in a city, we can see that the infrastructure (like roads and buildings) isn't just made by engineers who only care about efficiency. Instead, it's influenced by politics, the environment, and society,

and it helps keep global capitalism going. When we closely examine infrastructural problems, we can gain insight that goes beyond just figuring out ways to prevent them from happening again or lessening their impact. The changes also give us a chance to think about and understand modern city living in new ways (Graham, 2010).

On the opposite end of the spectrum, Graham posits that maintaining a functional, sustainable infrastructure related to energy, communications, water, or transportation necessitates persistent efforts to ensure its seamless operation. Infrastructure networks have become ubiquitous in contemporary society, leading some individuals to overlook their significance. Additionally, the author referenced the statements of Jane Summerton, a sociologist, who asserts that there is a widespread tendency to overestimate the competence and dominion of infrastructure networks. It is postulated that the growth trajectory of the aforementioned entities will persist in a specific direction. However, it should be noted that these systems exhibit discernible weaknesses in terms of strength, stability, and predictability, ultimately challenging preconceived notions regarding their effectiveness. They exhibit a heightened susceptibility and are capable of unpredictable transformations.

Infrastructure networks may appear permanent and stable at times, but they are always at risk of being unstable or fragile. The connections between computer points need to be taken care of regularly to stay working properly. For a lot of people who live in cities, especially in poorer areas in countries in the Southern Hemisphere, getting access to electricity, water, or communication services is a struggle they face every day. They have to find ways to make it work. For city people, infrastructure networks are not mysterious boxes that magically bring electricity, Internet, water, or food to any place. Instead, these groups of things and actions are very influenced by politics. People in these groups might try to resist or take control, and this could allow them to customize services in ways that go beyond what's normally allowed by laws or the market (Graham, 2010).

The importance of infrastructure development, as well as the role of computer technology today, is illustrated by Graham's explanation below. Slowly but surely based on the process, this phenomenon is also happening in Indonesia. Infrastructure networks, despite their appearance of permanence and stability, are innately vulnerable to potential instability or fragility. The regular maintenance of interconnections among computer points is imperative to sustain optimal functionality. Obtaining access to essential amenities such as electricity, water, and communication services, constitutes a significant challenge for numerous urban dwellers, particularly in impoverished regions of countries located in the Southern Hemisphere. This reality poses an ongoing daily struggle for affected populations. Efforts must be made to devise strategies to ensure its efficacy. For urban residents, infrastructure networks are not enigmatic compartments that mysteriously provide electricity, Internet connectivity, water, or sustenance to any given location. However, it can be observed that these collectives of entities and behaviors are highly influenced by the intricate interplay of political factors. Individuals belonging to such factions may exhibit a proclivity towards defiance and appropriation, thereby allowing them to tailor services beyond the confines of regulatory statutes or typical market practices (Graham, 2010).

The present study emphasizes conducting a thorough review of the literature to address inadequacies in the discourse surrounding the significance of infrastructure in urban development, as highlighted by previous scholars such as Rushton (1979) and Graham (2010). By doing so, the study aims to prevent any potential shortcomings in the utilization of infrastructure in urban contexts. One aspect addressed in this paper pertains to the inclusion of soft infrastructure in the development of city infrastructure, as underscored by Turner (2020). With the contemporary trend of smart city development, there is an increasing emphasis on the advancement of technology, highlighting the necessity for soft infrastructure to be seamlessly integrated into the overall development strategy. The perspective of urban planners regarding the smart city concept should encompass a broader range of considerations, including the diverse stakeholders, their respective roles, and competencies.

2. Methods

The utilization of qualitative methodology in the assessment of literature on soft infrastructure encompasses a process of analyzing and interpreting non-numeric information, including text, images, and videos, as a means of obtaining insights into the attitudes, perceptions, and experiences of individual

persons or groups. However, in practice, video data was not used as the main consideration in writing this paper. This approach proves to be highly advantageous in conducting a comprehensive analysis of literature relevant to the subject matter of soft infrastructure, encompassing an array of cognitive, emotional, social, and relational assets that reinforce the capacity of the community to withstand and recover from adverse circumstances. Qualitative data analysis tools, exemplified by processes such as content analysis, thematic analysis, and narrative analysis, may be employed to extract patterns, themes, and meanings from a given body of literature. The methodology entails the identification of pertinent scholarly works, procurement of data, classification of data through coding, and integration of resultant discoveries. The objective of this study is to furnish a thorough and intricate comprehension of the soft infrastructure that upholds crucial infrastructure systems. Qualitative assessments scrutinize outcomes within multiple frameworks to gauge the efficacy of the supple infrastructure in promoting resilience. The manuscript aims to present a structured and methodical synthesis of prior research, employing a predetermined search protocol that distinguishes it from conventional literature reviews. In general, utilizing the qualitative approach to evaluate the literature about soft infrastructure leads to a comprehensive and meticulous comprehension of the intricate and evolving characteristics of the soft infrastructure that reinforces crucial infrastructure systems. In practice, there are several tools used for writing this paper, such as a website to map, classify, and see trends in scholarly works.

2. Result and Discussions

This section discusses the findings ascertained through an in-depth scrutiny of the scholarly works concerning the discourse on soft infrastructure in smart sustainable cities. The present section is a reflection of the outcomes obtained from the literature review discussed in the preceding section. It is observed that six distinct sub-discussions have been identified, including Soft Infrastructure Issues, Smart Sustainable Cities Issues, the Relationship between Soft Infrastructure and Urban Development, Smart Sustainable Cities and Sustainable Development Goals, Clustering Research on Soft Infrastructure in Smart Sustainable Cities, and the concluding discussion on the Components of Soft Infrastructure in Smart Sustainable Cities.

Optimal Location of Facilities

In the early stages of formulating the principle of optimal facility location, the decisive factor in providing public facilities was perceived to be the geographic proximity and strategic positioning of said facilities. In this instance, there exists a correlation between the physical distance element and the expenses associated with the construction of hard infrastructure. Concurrently, the prioritization of public infrastructure development is directed towards physical public facilities.

The matter of efficiency concerning the provision of public facilities has recently gained the attention of erudite professionals. This can be observed in the discourse about a genetic algorithm intended for the identification of optimal locations for mining facilities, as put forth by Kumral (2004). In a different scenario, it is said that Witzgall has made noteworthy contributions to the fields of applied mathematics and operations research, with a particular emphasis on the optimization of facility location. During the period leading up to the 2010s, research about the ideal placement of public amenities began to incorporate the consideration of soft infrastructure, including the utilization and deployment of technology to enhance and improve public services. Thus, the study conducted by Shiode et al. (2012) delves into the significance of customers in the context of facility utilization.

It can be deduced that from the outset of the progress of the optimal facility location theory, paramount importance has been given to the notion of advancing a system of urban expansion hubs that depend on infrastructural components and technological advancements. Concurrently, the aspect concerning the evaluation of the level of efficacy of the network and growth centers toward enhancing the quality of life within the community has yet to be given deliberate consideration.

Disrupted Cities

A key issue in the debate around disrupted cities is the lack of investment in physical infrastructure for public amenities, as noted by Graham (2010). A thorough analysis of public amenities with a focus on geography and sociology is exemplified in the exploration of the development of a supermarket in Harlem which saw active involvement from the community leading to its triumph. The significance of local knowledge in designing public amenities post-2010s is highly valued, particularly in the context of traditional urban models that have the potential to promote social inclusivity and long-term sustainability within cities (Steinbrückner & Lewerentz, 2012). To increase effectiveness, it is possible to systematically observe the expansion of cities by utilizing specialized software. The previously mentioned study was conducted by a group of researchers in 2012. In the post-2010 era, hives for the development of smart cities have also become the subject of discussion in disrupted cities in the era after the 2010s. A study of world-class cities using a smart city approach in the form of runtime conflict detection and resolution challenges shows how projects with 'world-class cities' ambitions are speculative and will worsen issues like spatial inequality and environmental damage (Ma et al., 2016). Finally, innovative efforts are needed in managing urban development as the increasing population and climate emergency (Glass, 2012; Graham, 2010) are influential, as well as Allam and his colleagues (Allam et al., 2022).

Optimizing Optimization and Engineering Optimization

About the discourse surrounding the most suitable positioning of facilities, there exists a cohort of professionals who offer insight into this facet of optimization from a quantitative and engineering perspective. These insights often serve as technical considerations for optimization implementation in the field, encompassing matters such as the optimal positioning of facilities. At present, there exist no less than two scholarly publications that delve into the topic, these being Optimizing Optimization (Satchell, 2010) and Engineering Optimization (Rao, 2009). In the present discourse concerning the optimization of optimization, antecedent literature has underscored the importance of maximizing efficiency, leveraging resources, managing portfolios, and employing effective methods. Subsequent scholarly works have placed greater emphasis on optimizing efficiency and forecasting future estimations. In the discourse about engineering optimization, former literary works have underscored the significance of functions, algorithms, reduction, and the formulation of methodologies. Subsequent publications have placed greater emphasis on enhancing optimization through the development of methodologies and algorithms.

In general, Satchell explained that the comprehensive evaluation of optimization rarely encompasses a worldwide and impartial perspective on its practical components. Stephen Satchell has presented a sophisticated compilation of technical discussions related to optimization packages offered by developers, as well as current optimization practices and theories posited by scholarly researchers. This comprehensive assembly provides a valuable source of practical solutions that can be applied to the current economic landscape, which has been impacted by the aftermath of the liquidity bubble. The commercial sections of the discourse place emphasis on the algorithmic components in a manner that abstains from any sales-oriented approach, while the academic segments establish relevant frameworks and investigate potential avenues for advancement. Collaboratively, they proffer a perspicacious outlook that extends toward novel products, innovative methodologies, and original solutions within the realm of quantitative finance (Satchell, 2010).

Newer book on engineering design optimization (Martins & Ning, 2021), engineering optimization (Rao, 2009) provides a comprehensive guide for readers seeking to swiftly comprehend and implement a host of crucial optimization techniques utilized today throughout various industries. This academic text comprehensively addresses contemporary and traditional optimization techniques, commencing with fundamental concepts and systematically augmenting the reader's understanding with advanced principles and practical implementations. This exhaustive treatise encapsulates a comprehensive range of programming techniques encompassing nonlinear, linear, geometric, dynamic, and stochastic methodologies. It also delves into more specialized approaches, including multi-objective programming, genetic algorithms, simulated annealing, neural networks, particle swarm optimization, ant colony optimization, and fuzzy optimization. Each method is elucidated clearly and straightforwardly, thus rendering the more advanced techniques comprehensible even to novice readers. In addition,

engineering Optimization is a highly suitable course for advanced undergraduate and graduate students in mechanical, civil, electrical, chemical, and aerospace engineering due to its focal point on problem-solving and practical applications. Furthermore, the textual material serves as a valuable resource for practicing engineers across diverse industrial sectors by providing insights into the design of enhanced and cost-effective systems.

Soft Infrastructure

The discussion of soft infrastructure is relatively new, the following is his review according to Colin Turner in Chapter 6 in the book The Infrastructured State. Territoriality and the National Infrastructure System (Turner, 2020). As Turner interpreted from Niskanen's presentation in 1991, soft infrastructure, was regarded as the fundamental institutional structure that forms the basis for the functioning of an economic, political, and/or social system. With time, the conception of soft infrastructure has undergone refinement to emphasize its function as a facilitator for the implementation and utilization of hard infrastructure. The domains of transportation, energy, and information are closely intertwined, with the former providing a foundation and structure for the latter's development, progression, and utilization. In recent years, the importance of soft infrastructure within national infrastructure systems (NISs) has become increasingly prominent. This is because NISs have evolved into complex polycentric systems with a combination of state and non-state ownership, and as such, shifts in the form and magnitude of flows within and between NISs have significantly influenced their utilization.

Smart Sustainable Cities

The Case of the United Nations Economic Commission for Europe (UNECE) defines smart sustainable cities as innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness while ensuring that they meet the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects (The United Nations Economic Commission for Europe [UNECE], n.d.). Through an examination of global publications accessed via the online platform www.lens.org, about the subject area of intelligent and sustainable urban centers, a visual representation in the form of a word cloud is hereby presented herein. The analysis of the word cloud suggests that smart sustainable cities are associated with the concept of innovation, which leads to the production of products that compete with one another. The results indicate that the majority of the keywords pertain to business (8,587), followed by engineering (6,160), as it pertains to the efficient and effective resolution of innovative challenges. The forthcoming keyword under consideration is 'smart city', which possesses a frequency of 5,043. The presence of this keyword indicates that the discourse surrounding smart cities is intertwined with that of smart sustainable cities. However, it should be noted that the conceptualization of smart cities has not necessarily incorporated thorough inquiries into sustainability. It may be posited that the discussion centering on smart sustainable cities is more closely aligned with the domains of business and engineering, in comparison to that of smart cities. An alternative inference that may be posited is that smart cities tend to conduct individualized analyses of cities in a specific context, whereas smart sustainable cities take into account a broader spatial framework that encompasses regional constellations. The topic of smart sustainable cities is intricately linked to the field of political science (4,584), due to its focus on the participation of relevant stakeholders and the governance policies at play. Subsequently, the secondary most salient term, with a count of 4,503, is sustainability. This tally suggests that the discourse about smart sustainable cities extends beyond the confines of individual cities within the regional grouping, and encompasses aspects of sustainability, governance, business, and engineering.

Soft Infrastructure in a Smart Sustainable City

The significance of soft infrastructure lies in its impact on the accomplishments of smart cities. Although hard infrastructure, such as roads, buildings, and utilities are critical components of urban development, it is the soft infrastructure that enables the smooth integration of technological advancements and the effective provision of services. Soft infrastructure comprises a diverse array of

elements, involving education, governance, social welfare, and community participation. To comprehensively reap the advantages of a smart city, municipalities are required to prioritize the development of both tangible and intangible infrastructure. Investing in soft infrastructure is regarded as imperative by cities to facilitate the development of a sophisticated workforce equipped with the requisite skills to harness cutting-edge technologies for addressing intricate issues. Furthermore, soft infrastructure plays a crucial role in ensuring equitable provision of resources and services to all individuals, irrespective of their socioeconomic status. In light of the rapid urbanization trend observed worldwide, it is imperative that modern cities put significant emphasis on the incorporation of soft infrastructure within their smart city planning endeavors. Furthermore, the improvement of soft infrastructure has the potential to augment the involvement and engagement of citizens in urban decision-making procedures. In order to effectively address the complicated challenges of the present world, the establishment of sustainable and resilient smart cities necessitates the paramount importance of soft infrastructure. Soft infrastructure is a crucial element within the context of smart cities in that it facilitates harmonious integration of technological advancements and enables proficient administration of services. The allocation of resources towards education, governance, social services, and community involvement has the potential to cultivate a proficient workforce that possesses the ability to employ sophisticated technologies for the purpose of tackling issues, while simultaneously guaranteeing just and equal access to resources and services for all members of society.

The implementation of this planning strategy holds the potential to bolster citizen participation and engagement in urban decision-making processes, ultimately paving the way toward the development of smart cities that are sustainable, resilient, and capable of effectively addressing multifaceted challenges. The integration of soft infrastructure with hard infrastructure has the potential to exert a substantial influence on the achievement of smart city initiatives.

Through prioritization of investment in hard and soft infrastructure, smart cities can capitalize on the most modern technological advancements to enhance their economic, environmental, and social efficiency. Consequently, municipalities are called to direct their efforts towards the enhancement of not only their tangible infrastructure but also towards the advancement of academic institutions, healthcare amenities, and other crucial provisions that can effectively augment the standard of living for their entire populace. The complete potential of smart cities can only be achieved with the existence of a sturdy and durable soft infrastructure. Thus, municipal planners and policy makers must accord topmost priority to the development of physical and non-physical infrastructure components for the efficient establishment and implementation of intelligent cities. The enhancement of the infrastructure in smart cities must be supplemented by the adequate preparation of human capital, given their crucial role in the implementation and utilization of sophisticated technologies to enhance societal well-being. To conclude, the implementation of a smart city approach focused on the welfare of its inhabitants and emphasizing the strengthening of intangible infrastructure can potentially drive a rise in citizen participation, enhance economic productivity, and improve overall standards of living across all resident groups. The integration of both tangible

Figure 1. World Cloud on Smart Sustainable Cities

Source: Analysis through www.lens.org (04/05/2023)

and intangible components of infrastructure is crucial for the effective development of intelligent urban areas. Moreover, urban centers need to pursue the establishment of an open data ecosystem that fosters intelligent mobility and facilitates other catalysts of intelligent city undertakings. In regard to the advancement of intelligent cities in the future, the establishment of energy-efficient smart cities is currently experiencing noteworthy traction. Integrating renewable energy sources with smart technologies represents a viable approach for mitigating energy-related challenges and decreasing carbon emissions in urban environments. By embracing a comprehensive and strategic planning approach, intelligent urban centers possess the capacity to effectively tackle the multifaceted issues that currently confront them. The strategic approaches towards developing smart cities may exhibit significant differences, stemming from various factors such as the level of governance - national or local, as well as concerning the type of city - new or existing. Furthermore, there exists variance between hard and soft infrastructure-oriented strategies, in addition to the choice between sector-based or geographically based strategies. To succeed, a smart city must attain equilibrium among all constituent parts of its ecosystem and adopt a comprehensive approach toward infrastructure development. Furthermore, it is imperative to uphold a worldwide outlook on the advancement of intelligent urban areas, particularly in light of their increasing size and intricate nature.

The acknowledgment of the current neoliberal rationale underlying the development of smart cities, which prioritizes technological consumption and the optimization of profits, is crucial. This line of reasoning has the potential to perpetuate inequalities and impede accessibility for specific segments of the populace. Henceforth, it is of pivotal significance to contemplate equity and inclusion as fundamental constructs in the advancement of smart cities. In the context of urban development, it is widely acknowledged that pedestrians occupy a crucial position in the spatial ecology of a city. Therefore, the provision of lucid information and signage for pedestrians is deemed imperative for the successful implementation of sophisticated infrastructure projects that cater specifically to their needs.

Infrastructure development relates to strategic activities with broad impact to encourage economic growth and infrastructure financing, as well as businesses related to consumers and producers. Therefore, it is not only the physical development of infrastructure that is focused but also the preparation of human resources that are relevant to needs. Another important thing is the discussion about the importance of government governance in ensuring the activities of its citizens so that they run more smoothly and with quality. The government's role cannot be separated from encouraging the creation of sustainable development with the support of the active participation of its citizens. The following are some relevant recent publications. Study by Portugal-Perez and his colleagues estimates the impact of aggregate indicators of “soft” and “hard” infrastructure on the export performance of developing countries. Although public infrastructure plays a critical role in attracting Foreign Direct Investment (FDI), identifying the effect remains a challenge largely due to the econometric challenges involved in cross-country analyses (Portugal-Perez & Wilson, 2012). Meanwhile, Chakrabarti and his colleague identified this effect by employing a unique dataset of FDI at the district level in India, which has become one of the largest destinations of FDI in recent years. Arguably, countries with good infrastructure will have lower trade costs and aim at shedding light on the role of infrastructure towards trade costs by grouping infrastructure into four types. These spaces provide support (moral, emotional, professional, financial) and facilities (infrastructure) to enable entrepreneurs to start and grow their businesses (Ramli & Ismail, 2014). Related to innovation in the field of business, Fuzi wrote a publication that aims to provide an empirical exploration of whether co-working spaces can promote entrepreneurship in regions with sparse entrepreneurial environments by creating the hard infrastructure particularly designed in such a way that the soft infrastructure necessary for entrepreneurship can also emerge (Fuzi, 2015). Because soft infrastructure is related to the business side, there are also related publications that discuss demand-side solutions, as a crucial class of mitigation options that go beyond technological specifications and cost-benefit analysis (Creutzig et al., 2016). Likewise the discussion on the government's role in promoting economic growth and the availability of resources, this is illustrated in the following publication. Lin and his colleagues explore the ideas of development and the role of the state in economic development and institutional change from the New Structural Economics perspective. Utilizing participatory action research methods at the intersection of industrial ecology and design (Lin & Wang, 2017). Other publications are about resources in a broader context, as written by Nogueira et al. (2020). He and his colleagues developed a new framework and a model for considering and allocating the variety of resources that organizations utilize when creating value for themselves, society, and the planet.

Sustainable Development Goals

The Sustainable Development Goals (SDGs) comprise a worldwide framework of 17 primary objectives and four pillars aimed at promoting sustainable development. The attainment of this objective necessitates concerted efforts from diverse stakeholders, encompassing governmental bodies, local communities, and commercial enterprises. In contemporary business practices, diverse corporations commonly adopt the Sustainable Development Goals (SDGs) as a pragmatic framework to guide their social responsibility initiatives. Numerous enterprises have utilized the Sustainable Development Goals (SDGs) as a framework to govern their business operations. In order to facilitate comprehension of the Sustainable Development Goals (SDGs), four overarching pillars have been identified to encompass the 17 distinct agenda points.

- Pillars of Social Development. This pillar includes points (1) No Poverty, (2) No Hunger, (3) Healthy and Prosperous Life, (4) Quality Education, and (5) Gender Equality. In essence, the goal is to achieve fair and equal quality fulfillment of basic human rights to improve welfare for the entire community.
- Pillars of Economic Development. This pillar covers (7) Clean and Affordable Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation, and Infrastructure, (10) Reducing Inequalities, and (17) Partnerships for Goals. In essence, the aim is to achieve quality economic growth through sustainable employment and business opportunities, innovation, inclusive industries, adequate infrastructure, affordable clean energy, and supported by partnerships.
- Pillars of Environmental Development. This pillar includes points (6) Clean Water and Adequate Sanitation, (11), Cities and Settlements, (12) Responsible Consumption and Production, (13) Climate Change Management, (14) Marine Ecosystems, and (15) Ecosystems Land. In essence, the aim is to achieve sustainable management of natural resources and the environment as a support for all life.

Pillar of Law and Governance. This pillar includes points (16) Peace, Justice, and Strong Institutions. In essence, the aim is to create legal certainty and governance that is effective, transparent, accountable, and participatory to create security stability and achieve a state based on law.

Soft Infrastructure Issues

The present study aims to analyze Colin Turner's scholarly contributions on the concept of soft infrastructure, as outlined in his 2020 publications, in the context of related research findings. In order to achieve this, an analytical tool provided by "Connected Papers" has been utilized to establish the interrelationships between various academic journals. The outcomes of this endeavor help in delineating the salient themes of the pertinent literature germane to soft infrastructure, alongside the sub-theme of derivative works concerning Turner's latest theoretical accounts on this subject.

- The literature from Prior Works spanning the years 1999 through 2010 demonstrates that during the initial phases of discourse surrounding soft infrastructure, attention was directed towards studentification, particularly in urban centers. Subsequently, attempts were made to draw connections between studentification and gentrification. The provided literature suggests that the primary apprehension regarding soft infrastructure pertains to competencies, agents of change, spatial configurations, and their representation, efficacy, and management of urban municipalities.
- Scholarly journals derived from soft infrastructure expound upon the correlation between a stakeholder, namely the phenomenon of studentification, and the revitalization of the locale in a deliberate and enhanced manner, initiated at the neighborhood level. In this instance, the discourse concerning soft infrastructure may be linked to the enduring notion of the neighborhood unit as well as planned unit development. This is due to the fact that it strives to effectuate change at the micro-level, to transform the locale. A variety of cases has been discussed, encompassing regions such as Latin America (specifically Chile), Asia (in particular Malaysia), and Canada. The present study infers that the derivative works shed light on the phenomenon of regional transformation, which can be attributed to the proactive and

affirmative endeavors of stakeholders in establishing an innovation ecosystem. This innovation ecosystem is considered to yield favorable implications, including but not limited to the optimization of benefits and efficacy in the process of regional development planning.

Meanwhile, based on the results of an analysis of recent publications on soft infrastructure, it can be interpreted that there are the following important points:

- Discussions on soft infrastructure are becoming increasingly significant in countries in Asia that have limited records of providing infrastructure, especially in terms of management models and opportunities for cross-country infrastructure development to promote regional economic growth in a more equitable manner. Not only road infrastructure, but also telecommunication, energy, and air traffic infrastructure (Setunge & Kumar, 2010). In addition, other publications explain that specifically for the ASEAN context, infrastructure development is inseparable from business considerations, namely in the case of ASEAN in terms of global direct distribution and integration (Bhattacharyay, 2010), where there are market and global supply chain factors in it (Su et al., 2011).
- Discussions about infrastructure are not only in the realm of technical engineering such as road construction, improving public services, and business development opportunities (Ghosal, 2013), but there are also broader considerations because infrastructure development is closely related to urban economies, the strategic side planning and cultural policies are important factors for finding systemic problems (Raymond & Falk, 2018) or even better implementation of infrastructure planning (Chen et al., 2011), Another related matter is the about under-utilized infrastructure to bring benefits to a region, such as the case of under-utilized power which considers the information to enhance the Asian tourism sites and attractions (Pearce & Wu, 2015).
- Soft infrastructure touches on the power role of community members, especially in understanding the characteristics of citizens and encouraging empowerment, not only in urban areas but in rural areas with the main activity being agriculture (Nesamvuni et al., 2016). Another side of power that is closely related to soft infrastructure is related to conflicting policy preferences, resource allocation, and administrative tensions (Dolšak & Prakash, 2018). This can also be input in the use of technology, especially the development of computer technology, due to the fact that soft computing techniques are tolerant of imprecision, intended on approximation, focus on uncertainty, and are based on partial truth (Rath & Pati, 2020).

Smart Sustainable Cities Issues

The discourse of smart sustainable cities is a manifestation of the dialogue pertaining to smart cities, which posits that a city imbued with a smart ethos can progress autonomously in relation to its surroundings. Additionally, the terminology of "smart" is ordinarily assumed to encompass a sustainable disposition. The correlation between the growth and advancement of a city and its interaction with the encompassing region is unequivocal. Such interdependence arises because a city cannot suffice its citizens' necessities solely from within its boundaries, nor can it autonomously produce by-products resulting from urban development, such as waste and garbage. In the event that a city's development is executed without considering the interactions with its proximate environs, for a comprehensive and far-reaching outlook, it is a judicious decision to employ the terminology "smart cities" in reference to the interconnected surrounding areas, rather than "smart city" as individual entities. The proliferation of technology, stemming from the advent of "smart city" initiatives, often necessitates considerable financial resources and can impose significant strain on energy consumption, surpassing available capacity. The inclusion of the term "sustainable" in relation to smart cities underscores the assurance that contemporary advancements in products, enabled by technology, are conscientious of sustainability throughout the entirety of the modeling, development, implementation, maintenance, and monitoring processes while taking into consideration the unique societal circumstances.

As an illustration of the latest discussion on smart sustainable cities, several important points can be drawn, including:

- The development of the smart city concept should be in accordance with the planning process, consideration of the environment, as well as environmental technologies (Gabrys, 2014). In addition, it is appropriate for the smart city concept to be explained more clearly (Höjer & Wangel, 2015) through indicators and development sectors and their impacts, thus choosing the smart city concept will be more valuable when it is selected as one of the urban development scenarios (Ahvenniemi et al., 2017).
- The development of the concept of smart sustainable cities is relevant for anticipating future cities, so it requires the involvement of various fields of knowledge (interdisciplinary), including research at higher education (up to the doctoral level) regarding research gaps that have not been studied on the theme of smart sustainable cities, especially the broad research the field of sustainability transition and sustainability science where ICT is seen as a salient factor given its transformational, disruptive, and synergetic effects as an enabling, integrative, and constitutive technology. The research idea to fill in the gap is to investigate and analyze how to advance and sustain the contribution of sustainable urban forms to the goals of sustainable development with the support of ICT of pervasive computing (Bibri, 2018b). The next research Bibri is to develop state-of-the-art sensor-based big data applications enabled by the IoT for environmental sustainability and related data processing platforms and computing models in the context of smart sustainable cities of the future (Bibri, 2018a).
- The gap regarding sustainability is still interesting to talk about in the realm of smart cities, especially when formulated in computer modeling because the smart theme is very closely related to the theme of modern city development (Yigitcanlar et al., 2019). Therefore, it is appropriate that the smart city concept can provide guidance for city managers and policy makers to select the indicators and standards that best correspond to their assessment needs and goals, and align with their stage in Smart sustainable city implementation (Huovila et al., 2019).

Soft Infrastructure and Urban Development

General information about the relationship between soft infrastructure and urban development can be found in the writings of Brian H. Roberts from the University of Canberra in one of the Cities Alliance reports entitled Connecting Systems of Secondary Cities. The report contains a description of the roles and functions of secondary cities in regional constellations, in which there are inter-regional urban linkages. In this publication, advancements in the physical accessibility domain, attributable to the augmentation of transportation infrastructure systems, do not ensure a concomitant rise in local and regional populace, nor do they necessarily lead to ameliorated economic performance, as evidenced by the ESPON report of 2016. The importance of establishing physical connectivity cannot be overstated; however, the complementary soft infrastructure of social and digital networks also holds great significance. The dichotomization of connectivity into discrete hard and soft components, though valuable, fails to acknowledge the criticality of interdependence existing between the two. These two concepts are not mutually exclusive. The scope and dimension of both rigid and pliant infrastructure ought to be ascertained in consideration of eventual exigency, technological advancement, vulnerability, and other foreseeable transformations. The improvement of connectivity as a means of aiding the economic growth of secondary cities and larger urban centers requires policy-makers to grasp the interdependence between hard and soft connectivity components. Effective facilitation of the development of these elements by governments is critical to the integration of said components. In addition, soft infrastructure has a broader meaning than just software, because soft infrastructure touches the physical side, it also anticipates the city of the future by including the virtual side in it. Another interesting thing about this soft infrastructure is that there is attention to the side of people in general, but an increase in the innovation ecosystem and the competence of community members.

In the context of the latest academic journals, there are several highlights that connect soft infrastructure and urban development, here are some important points:

- Soft infrastructure relates to efforts to improve urban problems not only from the physical side but touches on the financing side, such as urban infrastructure issues such as environmental

improvement, also relates to the adequacy of basic infrastructure services, such as water in developing and the developed countries (Hiraishi & Tadenuma, 1998).

- Soft infrastructure encourages the development of models, including the agent-based model to formulate innovations in terms of efficiency in the provision of public services and related actors, as well as innovation management model tools for the adequacy of infrastructure provision (Setunge & Kumar, 2012).
- The discussion on soft infrastructure is relevant to the role of technology in improving the quality of life of city residents, such as telecommunication networks and trends in convergence technology (Yigitcanlar & Han, 2010).
- The discussion on soft infrastructure also relates to the realm of policy as well as the need to analyze a framework to measure soft assets (Grigg, 2012).

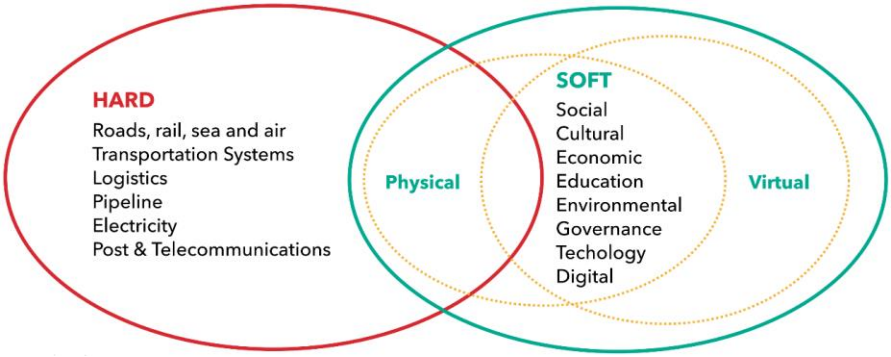

Figure 2. The framework of the interrelationship between hard and soft connectivity and network infrastructure

Source, Cities Alliance, 2019.

Smart Sustainable Cities and Sustainable Development Goals

As stated in the literature review, the SDGs in Indonesia are grouped into four pillars, namely the pillars of social development, the pillars of economic development, the pillars of environmental development, and the pillars of law and governance. Based on the grouping of SDGs in Indonesia, the author proposes the following framework. Social development is very contextual to the condition and diversity of natural and human resources in Indonesia along with various problems that must be resolved. Meanwhile, economic development places more emphasis on innovative efforts to increase economic added value, both comparative and competitive advantages to solve challenges and various kinds of social problems that exist in the pillars of social development. Meanwhile, environmental development places more emphasis on various innovations to improve the quality of human life, especially efforts to fulfill basic needs without damaging the environment. Meanwhile, law and governance development are binding for all pillars because sustainable development must be agreed upon in an appropriate legal framework and governance.

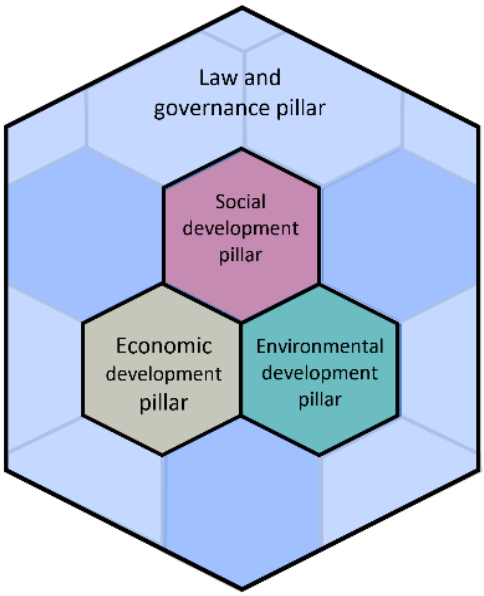

Figure 3. Smart Sustainable Cities and Four Pillars Sustainable Development Goals

Source: Analysis, 2023

Taking a cue from Europe, UNECE has directed its focus towards smart cities and has conceived the idea of sustainable and intelligent urban settlements for people of

all generations. The Indonesian context can be enhanced by the combination of this concept with the four pillars of the SDGs. The ECOSOC (United Nations Economic and Social Council) established the UNECE (United Nations Economic Commission for Europe) in 1947. The primary goal of UNECE is to facilitate economic integration across Europe as a whole. The UNECE encompasses 56 countries throughout Asia, North America, and Europe as its member states. Nevertheless, the UNECE welcomes the participation of any United Nations member countries who express interest in their activities. More than 70 professional organizations and NGOs from around the world are involved in the operations of UNECE. For the case in Europe, UNECE is not like Indonesia which previously grouped the SDGs into four pillars, They immediately chose certain SDGs (eight selected SDGs) to be included as the essence of sustainable and smart cities for all ages, namely: SDGs 03, good health and well-being; SDGs 06, clean water and sanitation; SDGs 07, affordable and clean energy; SDGs 08, decent work and economic growth; SDGs 09, industry, innovation and infrastructure; SDGs 11, sustainable cities and communities; SDGs 12, responsible consumption and production; and SDGs 13, climate action;

The interpretation that can be drawn from the selection of the SDGs when compared to conditions in Indonesia is that the effort to create a better quality of life by carrying out the theme of sustainable and smart cities for all ages, is an inclusive side in solving urban problems, in addition to trying to solve problems These are based on strategic basic points, such as relating to public health (SDG 03) because they are influenced by the experience of a pandemic, provision of basic needs in the form of clean water (SDG 06) as well as energy (SDG 07). Interventions on these three things are expected to create a better working ecosystem so that it has a positive impact on economic growth (SDG 08), as well as various innovations that can increase the problem of providing innovative infrastructure and have a positive impact on the growth and development of environmentally sound industries (SDG 09). Cities are considered engines of growth and agents of change as centers of civilization, so that smart, inclusive, and sustainable efforts can start in urban areas and spread to the surrounding areas as a reflection of equitable development (SDG 11). One more SDG that was chosen was for reasons of urgency because it is to anticipate climate change and various kinds of disasters, namely climate action (SDG 13). In addition, it seems that because Europe already has adequate law and governance, and there is also an agreement to jointly carry out a partnership in resolving common problems, SDGs 16 and 17 were not selected.

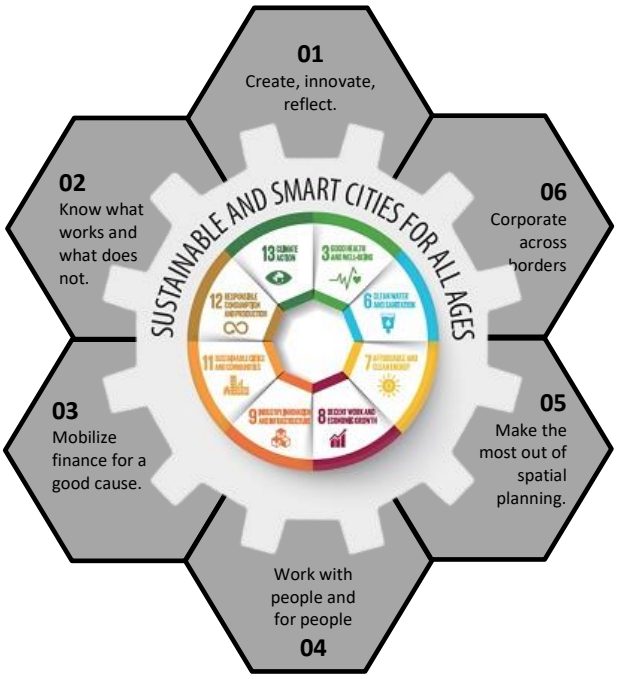

Figure 4. The Challenge in Developing Sustainable and Smart Cities for All Ages

Source: UNECE, and Analysis, 2023

Although the national development planning system policy does not mention the obligation to use smart city terms, the idea of a smart city is becoming more popular in Indonesia because it uses technology to solve problems. Urban planners need to redefine the idea of what a smart city is. They should focus on supporting citizens to learn and come up with new ideas to solve problems in Indonesian cities. A sustainable city needs to focus on three important things: sustainability, inclusiveness, and resilience. Based on this, there will be eight suitable chosen SDGs. Adding the word sustainable to a smart city to make it a smart sustainable city is important to show that it is not just about technology, but also about taking care of the environment and serving the public's needs. This includes eco-consciousness and eco-friendliness, viability, continuity, feasibility, and maintainability. The UNECE publication uses the term

"smart sustainable cities" which aligns with eight specific goals. To achieve these goals, the following steps can be taken:

- Create, innovate, reflect. This first step shows that the assumption of a smart city is not one city as a single entity, but a complex urban system that is represented in a metropolitan area. Metropolitan areas are compelled to establish a robust facilitating circumstance. The process of innovation entails a degree of uncertainty and risk, leading to a state of indeterminacy whereby it becomes impracticable to predict with certainty the outcome of a particular endeavor. The aforementioned statement denotes a significant deviation from the conventional approach to governance, which is primarily founded upon the formulation of quinquennial plans, regulatory frameworks specific to technology, banking on the status quo of the existing economic landscape, and adherence to the entrenched legal, institutional, and cultural heritage. Such a paradigm shift warrants closer scrutiny and analysis. Cities are encouraged to shift their approach from a hierarchical framework to a decentralized one, emphasizing innovation. In this new paradigm, the city conceives of itself as a facilitator, overseeing ongoing developments, and proactively intervening when beneficial. Additionally, it assumes responsibility for monitoring and assessing the outcome of its interventions in a thorough and ongoing manner. Despite the prevalence of "best practices," it remains uncertain whether they are universally applicable or viable in disparate contexts, particularly in situations where the motivating factors that undergird their success are absent.
- Know what works and what does not. It is of notable significance that policies ought to be formulated to facilitate comprehensive evaluation. This evaluation ought to deliberate upon the efficacy of measures implemented, shortcomings in their implementation, and the capacity to discontinue unsuitable ones, thus circumventing unprofitable and perpetual situations. In the process of deliberating potential avenues for urban development, it bears equal significance for cities to identify and navigate routes to be avoided. It is imperative to refrain from adopting fresh major decisions solely based on past practices and prevailing infrastructure. The phenomenon frequently arises whereby maintaining established customs perpetuates an ineffective state of affairs and facilitates the reinforcement of unsustainable methodologies.
- Mobilize finance for a good cause. Public procurement drives sustainable development by creating demand for innovative solutions. Local policies can encourage sustainable activities and discourage unsustainable ones, such as transport fees, parking charges, congestion fees, taxes, and development costs. City responses to sustainability challenges are limited by fiscal capacities and autonomy. Although smart-city technologies are cost-effective, comprehensive policies require significant capital. Cities need sustainable revenue sources and can seek private sector help through partnerships for energy projects. National governments must provide sufficient resources for local and regional governments through effective taxation work with people and for people.
- Work with people and for people. People-smart cities prioritize consistent and purposeful interactions with citizens, the private sector, and stakeholders. To achieve Sustainable Development Goals, governance should prioritize fostering urban centers as hubs of idea propagation through adaptive multi-stakeholder approaches. Promote transformative thought and investment, empower and engage stakeholders in decision-making. This message aims to inform and work with the local community to ensure the successful implementation of new strategies. The main question regarding civic engagement is whether people can initiate change and shape cities according to their wishes, leading to empowerment and a sense of accomplishment. The inquiry is about whether residents have access/control over the urban environment or if these rights are monopolized by a select group. Make the most out of spatial planning.
- Make the most out of spatial planning. Spatial planning integrates sectors and urban systems into a localized SDG strategy. Planning is the one academic discipline that integrates specialized knowledge and provides a holistic context for society, and this context in Indonesia can be seen in Law no 25 of 2004 concerning the national development planning system. There is planning at the macro level to the micro level, there is also sectoral and spatial planning. Planning systems vary by country, but they usually have spatial planning instruments that are organized

hierarchically at different levels: national plans, regional plans, city plans, and building plans. National planning is crucial for reducing regional inequalities and improving connectivity, Regional planning guides land use, infrastructure, connectivity, and environmental management. Not only for the context of European countries, this is similar to what happened in Indonesia. Urban planning is vital for sustainable cities and involves considerations such as design, aesthetics, transit, services, and infrastructure. This is also similar to what happened in Indonesia Indonesia has new laws and regulations after the issuance of the Omnibus Law, not only regulations regarding the implementation of spatial planning but also how to guide the preparation and evaluation, as well as planning licenses.

- Corporate across borders. Cities face externalized issues that demand multi-level and horizontal cooperation. This includes coordinating territorial regions across municipal borders, transboundary cooperation among cities, exchanging information and learning, and standardization of product requirements and technological protocols. Various initiatives, projects, and processes transcend administrative boundaries (e.g. infrastructure or public transport). Geneva has a cross-border administration with a delegate from Swiss and French municipalities. They oversaw the Leman Express, Europe's widest cross-border regional railway network. The same thing happened in Indonesia, even during the era of President Joko Widodo There has been massive infrastructure development to expand connectivity between regions so that activities and logistics systems can be more competitive which in turn can accelerate national economic growth. Infrastructure development is no longer monopolized by Java Island but also by other regions in Indonesia, including plans to relocate the nation's capital to East Kalimantan Province.

Clustering Research on Soft Infrastructure in Smart Sustainable Cities

This section illustrates the clustering of research by analyzing worldwide publications about soft infrastructure in cities that are smart and sustainable. It is worth noting that while there is some discourse surrounding smart sustainable cities and their support systems, the amount of attention given to soft infrastructure pales in comparison to that of the former. When the analysis is compiled to classify studies on soft infrastructure in smart and sustainable cities, the amount of research remains significantly lower compared to the classification of research on smart and sustainable cities. Furthermore, this section introduces a suggested framework for the implementation of soft infrastructure in smart sustainable cities. As an initial description, with the support of www.lens.org (accessed on 05/05/2023), there are five keywords from the discussion on soft infrastructure in smart sustainable cities, followed by the number of publications: Political science (658), business (624), engineering (512), sociology (428), and geography (307). Meanwhile, to cluster research on soft infrastructure in smart sustainable cities, it is carried out using the open knowledge website (www.openknowledgemaps.org). Due to the limited number of publications on this theme, the grouping was made in two stages, the first with the theme of soft infrastructure and the second on smart sustainable cities.

- Categorizing topics on soft infrastructure. The six main research clusters that emerged were the city region model (including mainland and coastal cities), planning and development (including non-motorized vehicles), urban development and employability, political science and international relations; civil and structural engineering, including science and technology studies; as well as research on Asian tourism and autonomy.
- Categorizing topic on smart sustainable cities. The six main research clusters that emerged were a smart city, smart governance; data-driven smart sustainable cities, compact cities, ecocities; sustainable smart city, sustainable urban development; contextual participatory approach, intelligent transport, smart city; smart tourism city; as well as sustainable urbanism, urban computing, urbanism.

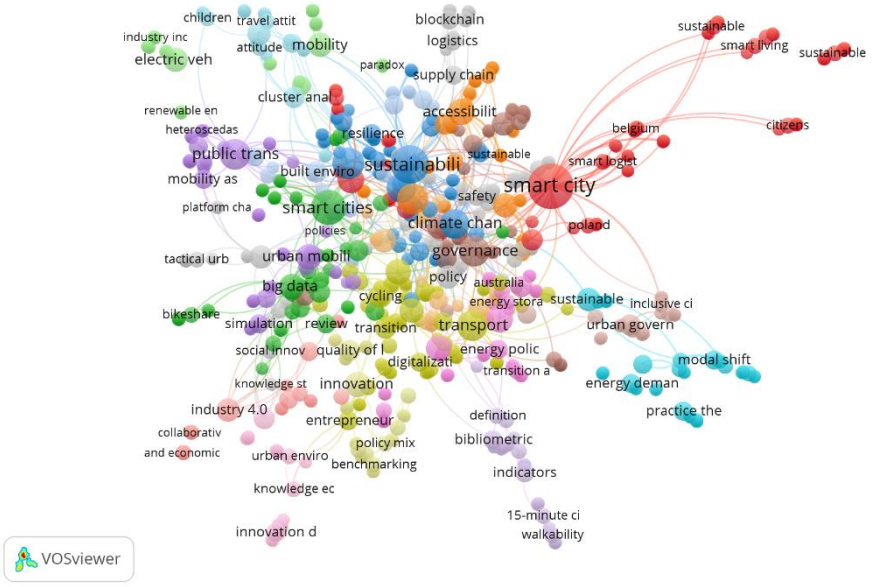

Figure 5. Mapping of publications about soft infrastructure in smart sustainable cities

Source: Analysis, 2023

To provide more adequate results, analysis is also carried out through the Vos viewer software, especially in mapping international publications with the theme of soft infrastructure in smart sustainable cities. The analysis was carried out by publications from 2010-2023 (there were 1,847 articles), which covered six scientific points of view: social sciences (330), decision sciences (95), environmental science (88), engineering (27), as well as economics, econometrics, and finance (16). The results of the analysis can be seen in the graph above. Based on these graphs, it can be concluded that the soft infrastructure in the smart sustainable cities theme cluster includes at least a discussion of (1). Smart city; (2). Sustainable development, (3). Bibliometrics, (4). Industry 4.0, (5). Big data, (6). Public transportation, (7). Sustainability, (8). Accessibility, (9). Climate change, (10). Smart cities, and (11). Logistics.

Components of Soft Infrastructure in Smart Sustainable Cities

The author recalled how the way people thought about managing land use changed in the mid-1990s. This was discussed in a book by Stuart Chapin and his colleagues called Urban Land Use Planning, 1995. The author thought about this while conducting a literature review on soft infrastructure in smart sustainable cities. The writer read a book about managing changes in how we use land because of new technology in the 2010s (Sutriadi, 2010). The book also introduced the term "smart city." In general, the management of land use change pertains to the handling of human activities that cause alterations to the natural environment. Addressing food security and climate change are enormously significant concerns to overcome on a global scale. Different data-driven resources can be utilized to measure and monitor alterations in land usage throughout time. Continued endeavors are being made to standardize worldwide information on alterations and maintenance of land, to comprehend the fundamental trends and changes more effectively. A recent publication focuses on the necessity for efficient management tactics to tackle the worldwide divide instigated by alterations in land use, emphasizing the significance of managing such changes.

In the fourth edition of the urban land use planning book (Kaiser et al., 1995) it is stated that there are three pillars in land use change management, namely social values, market values, and ecological values. This is an improvement from a new concept that has not been discussed in the third edition of urban land use planning (Rushton, 1979). In this land use change management concept, physical considerations (such as benchmarks for building public facilities based on the carrying capacity of the population) are not made independently but are included in social values, which can be interpreted that these physical factors must be able to give meaning to social side in an inclusive manner to create a higher quality of life. In short, social values are related to urban form, activity system, and neighborhood context; market value is related to redistribution of wealth and power, correcting market failure, public public-private partnership; Ecological values relate to environmental assets, environmental integrity, and preservation of nature. For the record, when there is a shift from space of place to space of flow, there will be a new variant of the details of each of these pillars (Sutriadi, 2010). This is what then makes the author relate the experience of exploring the concept of land use change management to the digital era with a discussion of soft infrastructure in smart sustainable cities. The author's experience as a city planner who pays attention to smart cities has changed several urban planning concepts, as well as the Pandemic Covid 19 era, The author seeks to propose the development of the concept of land use change management for city planners more extensively, including seeing groupings which discusses a combination of social values and market values, namely business-spatial concerns; a combination of market values and ecological values, namely cultural-political concerns; as well as a combination of ecological values and social values, namely humane-innovation concerns. This idea can be seen in the following figure.

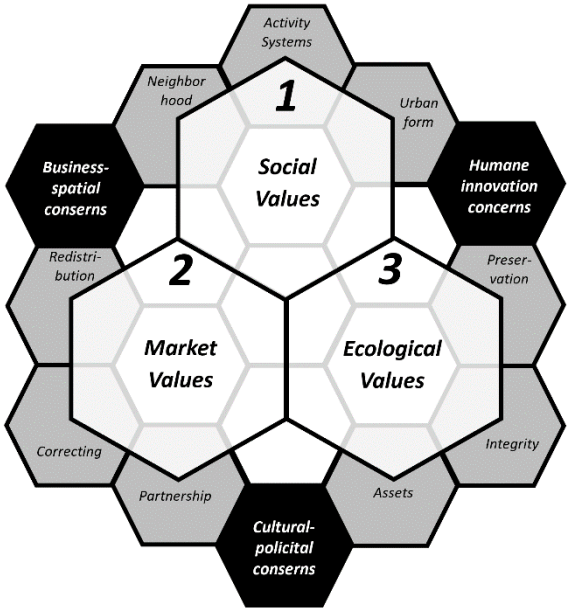

Figure 6. Proposing Soft Infrastructure in Smart Sustainable Cities

Source: Analysis, 2023

The analysis that produces the keywords from soft infrastructure in smart sustainable cities in the previous description both with the help of open knowledge and vos viewer, can then be regrouped into three keywords derived from the concept of land use change management in the post-pandemic era. The results of the new grouping can be seen in the following table.

Table 1. Re-Clustering Keywords in the Context of Soft Infrastructure in Smart Sustainable Cities

Mapping Method	Business and spatial concerns	Cultural and political concerns	Humane innovation concerns
Soft Infrastructure (open knowledge)	Civil and structural engineering	City region model Planning and development Political science and international relation Asian tourism	Urban development and employability
Smart Sustainable Cities (open knowledge)	Sustainable smart city, sustainable urban development Sustainable urbanism, urban computing, urbanism.	Smart city, smart governance Data-driven smart sustainable cities, compact cities, eco-cities Smart tourism city	Contextual participatory approach, intelligent transport, smart city.

Table 1 (cont.)

Mapping Method	Business and spatial concerns	Cultural and political concerns	Humane innovation concerns
Soft Infrastructure in Smart Sustainable Cities (vos viewer)	Sustainable development Smart city Industry 4.0 Accessibility Logistic	Big data Bibliometric Public transportation	Sustainability Climate change Smart cities

Source: Analysis, 2023

In addition, here are some keywords that emerged from the discussion on soft infrastructure in smart sustainable cities related to scientific fields: covid-19, internet of things, and public health (4); climate change, policy, well-being (3), active travel, capacity cloud computing, environmental governance, environmental monitoring, epidemiology, GIS, governance, health systems, nutrition, pandemic, physical activity, risk, security, smart cities, smart city, telemedicine, trust, urban planning (2); UK, 3d Ray Launching, abatement, action research, active filtration, advanced oxidation, affordance, age in place, agent-based simulation, aging, AI, air quality, ammonia emission, artificial synthetic pitches, assessment, attention, autonomous maritime vehicles, autopoiesis, baby pram, bayesian causal inference, bbmri.se, bias bicycle-sharing, big data, big data analysis, bike sharing biobanking, biobot, biocomposite, biodesign, biodiversity, bioeconomy, bioenergy, bioengineering, biohybrid, biomass potential, biometrics, biosensors, biotechnology, blind, blue exercise, breast cancer, built environment, carbon nanotubes, causal loop diagram, cavitation, change management, child, child health, child survival, children, cholesteric liquid crystals with spherical topology, cities, climate policy, cloud -based bim, coastal armouring, coastal management, coastal zone management, cognition, collection, community, commuters, complex systems thinking, complexity theory, computing methodologies, construction, construction and demolition waste (Cdw), construction components, consumption, cooperative vehicles coronavirus , cost, croplands (1).

Based on the keywords that appeared, it appears that the latest publications were influenced by the Covid-19 pandemic so discussions about health appeared in several keywords and were among the dominant ones. Other emerging knowledge is related to technological developments such as IoT and its derivatives. Meanwhile, representation related to urban planning is not the dominant keyword that appears, but when it is related to the discussion of urban planning, the dominant keywords such as COVID-19, IoT, public health, climate change, policy, and well-being are very relevant. with urban planning. There is also a non-physical side of the discussion or towards soft infrastructure, including starting to have many variations, especially those related to computer technology, and also related to well-being, policy, environmental governance, and environmental monitoring, as well as planning support systems such as IoT, cloud computing, GIS, smart cities, and smart cities.

Conclusions

This paper analyzes the role of urban planning in the 21st century which is influenced by various technologies as a form of innovation. This is a new challenge for increasing the competence of stakeholders in utilizing limited resources towards developing inclusive, intelligent, and sustainable cities.

According to the extant literature, the prevalent observation suggests that the quantity of scholarly work available concerning soft infrastructure in smart sustainable cities is relatively scarce, in contrast to the available abundance of publications elucidating diverse urban planning themes. Amidst the proliferation of technological advancements and the sweeping modifications to everyday lifestyles engendered by the global COVID-19 pandemic, discourse on soft infrastructure within the context of smart and sustainable cities has assumed a more diverse and interdisciplinary character. This discourse extends beyond the purview of engineering and advanced technological infrastructure and encompasses domains such as political science, business studies, and sociology. Indonesia's efforts to expedite development through infrastructure development across multiple regions necessitates a comprehensive comprehension of infrastructure for policymakers to devise efficacious policies, plans, and programs that address regional challenges and facilitate targeted growth.

Based on identifying keywords and grouping discussions about soft infrastructure in smart sustainable cities, it appears that regrouping can be done to enrich existing theories, such as land use change management theory (Kaiser et al., 1995), where land use change theory has also attempted to transform the classical approach which previously emphasized physical planning, to be based on three main pillars, namely social values, market values, and ecological values. The denser the urban population, the development of innovation, especially in the field of technology, which is reflected in research related to soft infrastructure in smart sustainable cities, the enrichment of the three pillars of land use change management can be carried out by adding a discussion which is an intersection between social values and market values, namely business-spatial concerns; intersection between market values and ecological values, namely cultural-political concerns; as well as the intersection between ecological values and social values, namely humane-innovation concerns.

Regarding the SDGs initiative, UNECE has created the idea of sustainable and smart cities for all ages to inclusively tackle urban issues. These are based on strategic basic points, such as relating to public health (SDG 03) because they are influenced by the experience of a pandemic, provision of basic needs in the form of clean water (SDG 06) as well and energy (SDG 07). Interventions to improve these factors will boost economic growth (SDG 08), Innovations can boost infrastructure and eco-friendly industries (SDG 09). Cities are catalysts for growth, change, and equitable development (SDG 11).

The occurrence of the theme of soft infrastructure in smart sustainable cities poses a novel challenge for urban planners to continuously enhance their skills and expertise. The UNECE, with its emphasis on spatial planning and its use as a measuring tool, is a pertinent entity for the development of planning resources that are capable of addressing business-spatial, cultural-political, and humane-innovation issues. Such resources can effectively address regional challenges and promote integrated and well-conceived planning for cities.

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