https://erjm.journals.ekb.eg
ISSN: 1110-1180

DOI: ---------

ERJ
Engineering Research Journal
Faculty of Engineering
Menoufia University

Bridging the Gap Between Social Inclusion and Technology for Smart, Sustainable Urban Development

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Abstract
The imperative for sustainable urban development becomes progressively crucial as the global urbanization process gains momentum. This research investigates the intricate relationship between human-centered planning, social inclusion, and technology-driven solutions in developing livable and resilient cities. The paper used a mixed methods methodology, integrating qualitative and quantitative evaluations of data sourced from the Science Direct database. The qualitative analysis includes NVivo and Atlas.ti software to identify prominent themes. In contrast, the quantitative analysis utilizes chi-square and logistic regression methods to evaluate the influence of various factors on urban livability and the quality of life for people. The results emphasize the need to include human-centered planning and encouraging social inclusion as key factors in fostering dynamic and equitable urban environments.Technology-driven solutions, particularly in smart cities, augment urban services and infrastructure. The paper contributes to the continuing scholarly conversation surrounding sustainable urban development. It also presents practical suggestions for policymakers, urban planners, and stakeholders to foster the development of inclusive and resilient urban environments.

Keywords: *Human-centered; Quality-of-Life; Urban Design; Urban Planning and Management*

1 Introduction

Urban areas are widely acknowledged as catalysts for economic development. They are centers of innovation, trade, and cultural activity, drawing individuals from diverse backgrounds to pursue improved possibilities. Urban areas are essential for stimulating economic development. They are hubs of invention, fostering the growth of ideas and creativity. Cities' diversified population and enterprises provide an environment that promotes innovation, resulting in new technology, industries, and employment opportunities. Cities also serve as centers of trade. They are strategically positioned near intersections of trade routes, making them perfect hubs for commerce. This economic concentration enhances productivity and generates employment prospects.

Urbanization, the migration of individuals from rural regions to urban centers, is intricately connected to economic progress. As countries progress, their economies transition from predominantly agrarian to more industrial and service-based. This change frequently results in a substantial migration of people to urban areas.

Cities can stimulate economic development but also encounter substantial obstacles. These tasks involve handling rapid population expansion, guaranteeing sufficient housing and infrastructure, tackling environmental issues, and lessening socio-economic inequality. Nevertheless, these challenges also offer possibilities. Investing in sustainable urban infrastructure can generate employment opportunities and help tackle environmental concerns.Urbanization has a substantial effect on the environment through various means. Due to the dense presence of automobiles and industries, urban areas contribute substantially to air pollution. Smog is formed by the reaction of sunlight with airborne pollutants. Urbanization contributes to water pollution through challenges in garbage management and increased energy usage.

Urban areas are drivers for climate change as they alter precipitation patterns across hundreds of square kilometers. Predictions indicate that direct loss in vegetation biomass from regions with a high likelihood of urban growth will account for around 5% of the total emissions from tropical deforestation and land-use change. Urbanization can result in the depletion of freshwater resources through extraction, putting a strain on water availability. It additionally accelerates the depletion of highly productive farms. Urbanization frequently leads to deforestation and habitat loss, causing a reduction in biodiversity and changes in species distributions and interactions: harmful compounds, automobiles, and the depletion of habitat and food supplies by constraining animal populations.

Nevertheless, these difficulties offer opportunities for sustainable urban planning, including fostering economic growth, decreasing air pollution through improving energy efficiency, implementing alternative transportation systems, and prioritizing the maintenance of urban green spaces in urban design. The smartness of cities can contribute to their sustainability.

Urban expansion might increase poverty since local authorities may struggle to deliver services to all residents. Unchecked urban growth can worsen poverty if not well controlled. Urban expansion leads to a rise in the need for fundamental services, infrastructure, and cost-effective housing. Suppose local authorities fail to fulfill these requirements. In that case, it may increase poverty, especially among low-income households in informal settlements. Poorly planned urbanization can result in congestion, elevated crime rates, pollution, and heightened levels of inequality and social isolation. Well-directed and well-managed urbanization can lead to economic growth and provide prospects for poverty reduction. Urban planning must be inclusive and sustainable to ensure equitable distribution of benefits from urban growth and meet the needs of all people, which involves granting access to high-quality education, healthcare, and job prospects.

The smartness of cities seems sine qua non for the sustainability of a city. Technological improvements bring about significant changes in all elements of urban living, but their incorporation into sustainable practices is still lacking [1], [2], particularly in cities of the Global South. An evident element of this disparity is the inequitable allocation of technological advantages among metropolitan communities. Advanced technological solutions frequently prioritize rich communities, intensifying pre-existing social inequalities [3]. Areas with larger economic resources typically prioritize implementing smart infrastructure, energy-efficient buildings, and modern transportation systems. In contrast, marginalized groups are often left to contend with antiquated and unsustainable living circumstances [4], [5]. The swift rate of technological progress often surpasses society's capacity to adjust and integrate these developments responsibly [5]. The rapid technological developments challenge urban planners and policymakers, resulting in insufficient laws and control. This discrepancy might lead to unforeseen outcomes, such as heightened energy usage, apprehensions regarding privacy, and deterioration of the environment.

The digital gap amplifies the inequalities present in metropolitan societies. Disparities in technology and internet access persist, particularly among underprivileged communities who encounter obstacles to connecting. Smart cities, which depend on interconnected networks, exacerbate the exclusion of those lacking access to vital digital resources, depriving them of the advantages of technology urban growth. It is necessary to implement measures prioritizing the inclusion of all individuals in the digital realm, ensuring that technology is utilized as a means of empowerment rather than a cause of disparity to address this divide. Moreover, the disparity between technological and social urban sustainability also includes concerns about resilience and adaptability [6]. Although technology solutions prioritize enhancing efficiency and managing resources, they may not sufficiently tackle social and cultural aspects of sustainability. Achieving sustainable urban development necessitates an interdisciplinary approach considering many populations' distinct requirements and viewpoints. Incorporating social sciences, cultural studies, and community participation into technical solutions can augment their pertinence and efficacy.

The widening gap between technological advancements and promoting social urban sustainability is a substantial obstacle to our cities' and residents' welfare. Although This division contains various aspects, such as the ease of access, the incorporation of diverse groups, and the possibility of unforeseen outcomes.

To bridge this gap, it is necessary to make a focused and coordinated effort to ensure that technology advancements are accessible to all sections of society, thereby promoting fair and balanced urban development.

To close the gap, adopting a proactive strategy involving politicians and technologists working together to foresee probable issues and develop sustainable solutions before widespread implementation is essential.

To summarize, the increasing disparity between technological and social urban sustainability presents a significant obstacle that requires immediate and focused consideration. Adopting a comprehensive strategy emphasizing fairness, inclusiveness, and the careful incorporation of technology into the urban landscape is necessary to bridge this gap. Through cultivating cooperation among technology specialists, policymakers, and communities, we may construct urban areas that effectively utilize the potential of creativity while advocating for the well-being of society, the economy, and the environment.

2 Theoretical framework

Contemporary urban sustainability challenges include energy, circularity, environmental degradation, water, transportation, economic development, housing, gender empowerment and equality, safety and security, and resilience against natural disasters. Some scholars, such as Bibri and Krogstie [7] and Pozdniakova [8], argued that smart cities emerged as the solution to these issues. Technologies that could address current urban problems include (a) automated networks like cloud computing, (b) Big Data [9]; (c) Internet of Things [9]–[11], (d) Artificial Intelligence [12], [13], (e) automated industrial controls, (f) blockchain [14], [15], (g) mobile and communication satellite systems [16], and (h) wireless texting, and networking [17].

Nevertheless, smart cities come with issues of their own. Smart cities' security, data management, and ethical challenges are critically important [18]. In light of residents' awareness of and aptitude for using smart apps and solutions, even knowledgeable users have reservations about the usefulness, safety, usability, and effectiveness of smart city services [19].

Another group of scholars spotlight the city's sustainability by focusing on how much the city is inclusive, democratic, and accessible for all inhabitants. The right to the city is a superior form of right encompassing the entitlements to freedom, individualization, habitat, and inhabitation [20]–[23]. Human-centered and socially inclusive urban planning is the crux of a sustainable city [24].

Cities of the global south might not be able to acquire and use these technologies for various reasons, including personal elements, type of technology, digital training, rights, and infrastructures. Private-sector companies are behind the development and dispersion of smart city technologies, which may exacerbate disparities between individuals with access to them and those without access. El-Kholei and Yassein [25] examined attempts to develop smart, sustainable cities in the Arab region to conclude that a lack of technological infrastructure, high adult illiteracy, inadequate data collection methods, and constrained rationality hinder proper planning and decision-making in administration due to low political participation and low adult illiteracy rates. Establishing a smart, sustainable city in a nation where the majority are uneducated and underprivileged is impossible. They warned that these initiatives could result in the loss of public spaces, increased social segregation, and a corrupt democratic system.

A growing consensus is emerging on combining socially inclusive urban planning with technology-driven approaches to achieve urban sustainability. Scholars argue that putting people at the center of the planning process is crucial to establishing a smart and sustainable city. Engaging, enabling, and empowering citizens becomes essential to identify factors contributing to a smart and sustainable city. This approach can foster collaboration and coordination among diverse stakeholders, including governments, corporations, civil society, academia, and users. The paper offers valuable insights for scholars and practitioners to document and share best practices, bridging the gap between theory and practice in urban sustainability initiatives by intertwining human-centered planning with smart city technologies.

The paper explores the intricate relationship between socially sustainable cities represented by human-centered planning, social inclusion, and smart city initiatives driven by technological advances. By examining the interplay between these approaches, the paper aims to provide insights into how cities can effectively bridge the gap between social urban sustainability and technological advances for a thriving and sustainable urban environment, Figure 1. The researchers' principal tasks are:

1. To examine the impact of human-centered planning on cities' livability and the residents' quality of life.
2. To investigate the role of social inclusion in enhancing the livability and quality of life in urban environments.
3. To assess the likely benefits and challenges of technology-driven solutions, particularly in the context of smart cities, and their impact on urban development.

Our research hypothesis is that integrating Science, Technology, and Innovation methods into urban planning can assist in addressing the urgent sustainability issues that urban socio-technical systems are currently experiencing in the post-COVID-19 era. Smart cities can improve the efficient use of resources, enhance living standards, and reduce metropolitan areas' environmental impact by incorporating technology into modern urbanization. The foundation of a productive discourse should be rooted in social sustainability, which should also be interconnected with other aspects of sustainable development. Urban planning can facilitate incorporating social sustainability into the layout of metropolitan areas. The utilization of technology in contemporary urbanization is the fundamental basis for the future advancement of sustainable urban development. Smart cities depend on data to address economic and social concerns and attain sustainable development. Data plays a crucial role in facilitating effective urban planning and determining the future benchmarks required to fulfill the demands of our communities. [26].

For example, using Geographic Information Systems in urban planning can aid in identifying regions that necessitate infrastructure enhancement, such as roads, water supply, and sanitation [27].

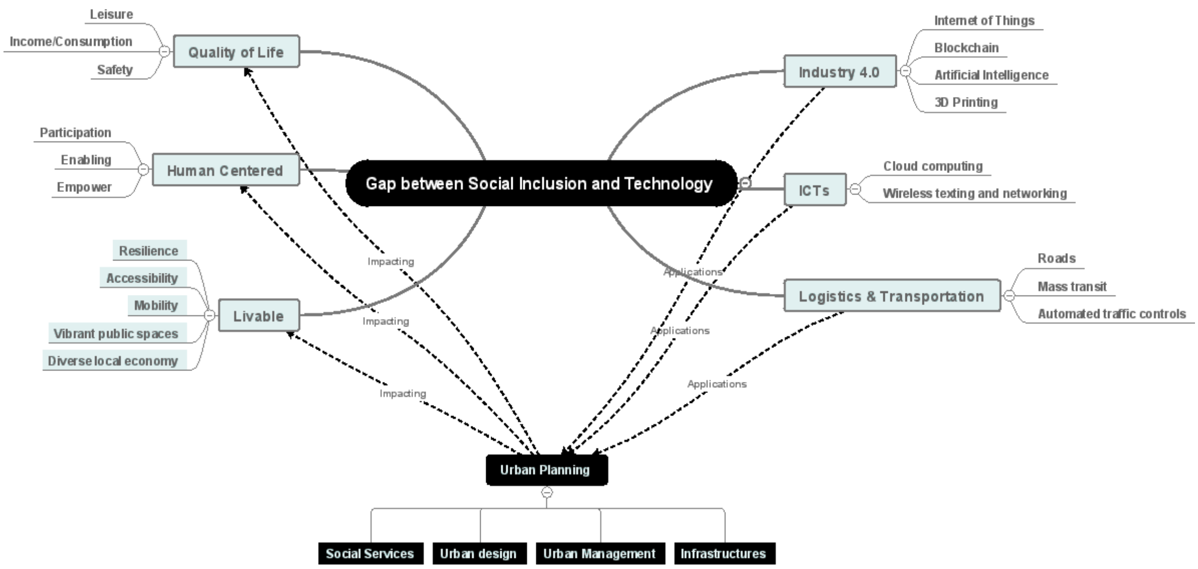

Figure 1- Theoretical framework based on contemporary literature. Authors' elaboration through Wondershare MindMaster

To establish sustainable communities, it is crucial that social sustainability serves as the foundation for productive discourse and is interconnected with other aspects of sustainable development. Urban planning is crucial for incorporating social sustainability into the layout of metropolitan areas [28]. Urban planners can develop public places encouraging social interaction and active participation within the community [29].

3 Material and methods

3.1 Research design

The researchers employed an Exploratory Sequential Design (ESD), a well-established approach in mixed-methods research that allows the mixing of qualitative and quantitative data analysis to understand the research topic (Creswell, 2013; Creswell, 2014; Wisdom & Creswell, 2013). The authors conducted the qualitative inquiry first, followed by the quantitative analysis to validate the taxonomy mentioned earlier.

The qualitative analysis started by exploring the data using Atlas.ti and NVivo, applications for qualitative inquiry. The results of the qualitative analysis were exported to SPSS[1] as variables measured on a nominal scale to compute frequencies and then used in non-parametric statistical analyses. Figure 2. is a diagram exhibiting the ESD research design of the paper.

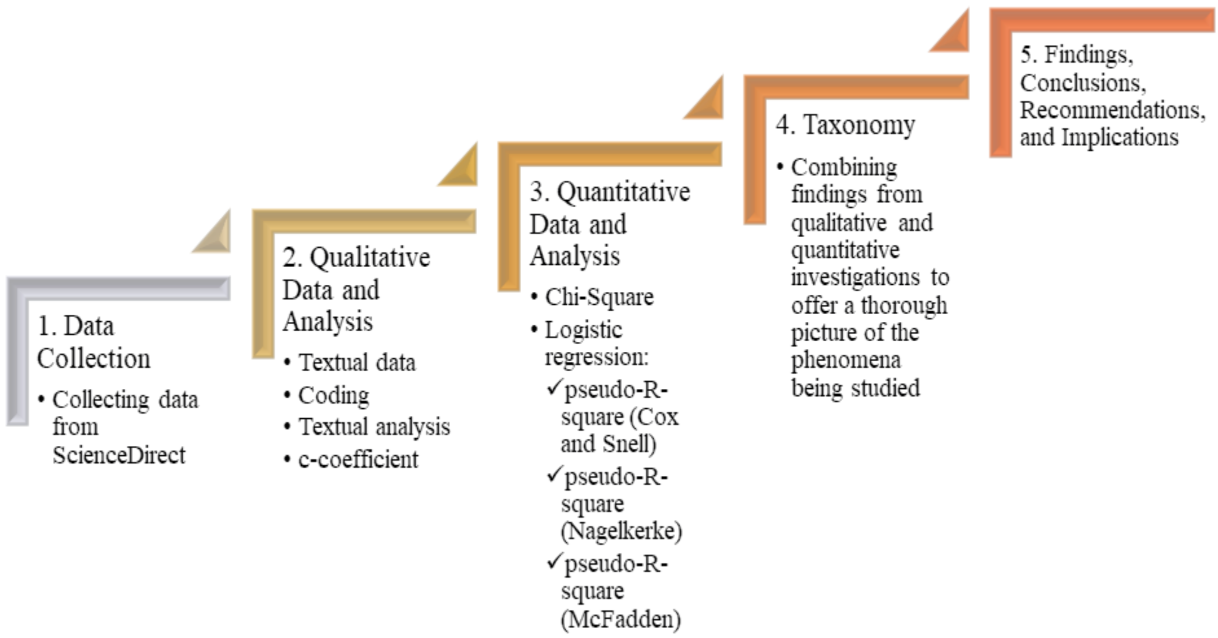

Figure **2.** Exploratory Sequential Design applied in the paper (adapted from Riley [33])

3.2 Data collection

ScienceDirect is the source of data used in the inquiry.[2] It houses nearly 18 million pieces of information from this publisher's 30 thousand e-books, four thousand academic journals, and more. A comprehensive search query encompassed the period from 2016[3] to December 2022.

The following keywords were selected to capture the main themes of interest: (a) 'smart cities AND livable cities,' (b) 'humane cities AND urban design,' (c) 'human-centered OR smart cities AND urban spatial design strategies,' (d) 'smart cities AND social inclusion,' (e) 'urban form AND livability AND smart cities,' (f) 'urban livability AND quality of life AND smart cities,' (g) 'public space design,' and (h) 'human-centric spaces AND smart cities.' Including various keywords ensured a broad scope and wide-ranging coverage of related literature—the search yielded 1,006 publications that entered the analysis annexed to the paper.

3.3 Data analysis

3.3.1 Qualitative inquiry

The authors conducted cluster analysis on the top 50 words prevalent in the selected documents to identify key themes and concepts. The authors generated a code matrix that includes the number of grounded quotations (Gr) similar to the frequencies observed in descriptive statistics, which the researchers employed to carry out the co-occurrence analysis—then calculated the c-coefficient, Eq.1, which shows the strength of the relationship between every two codes [34].

Equation 1

$$c = \frac{[n_{1-2}]}{[(n_1 + n_2) - n_{1-2}]}$$

where c is the coefficient per co-occurrence between the two codes.

n_{1-2} is the commonly shared quotation from the texts between the two codes.

n_1 is the number of quotations from the texts per Code 1.

n_2 is the number of quotations from the texts per Code 2.

3.3.2 Quantitative analysis

The quantitative analysis builds on the results of the qualitative inquiry. The researchers applied the following non-parametric statistical techniques: chi-square and logistic regression. The Chi-square ($\chi 2$) statistic is a metric that quantifies the disparity between the observed and expected frequencies of the results of a group of occurrences or variables computed using Eq. 2. It is a valuable tool for examining differences in categorical variables, particularly those measured on a nominal scale.

Equation 2

$$\chi 2 = \sum (O_i - E_i)/E_i$$

where $\chi 2$ = chi squared

O_i = observed value

E_i = expected value

The logistic regression or logit model is a statistical tool commonly used for classification and predictive analytics. Logistic regression is a statistical method that calculates the likelihood of an event (y) occurring or an association between two variables measured on a nominal scale by utilizing a set of independent variables (X) within a dataset, Eq. 3.

Equation 3

$$y = e^{(b_0 + b_1 X)}/(1 + e^{(b_0 + b_1 X)})$$

Pseudo-R-Squared coefficients show fit for models where the dependent variable is nominal or ordinal, rendering R2 inapplicable. Interpreting a pseudo-R-Squared value is contingent upon its comparison to another pseudo-R-Squared value of the same category, using identical data and forecasting the same outcome. In this scenario, the superior pseudo-R-Squared value signifies the model that provides a more accurate outcome prediction.

4 Results

4.1 Exploring the data

To start the coding process, the authors ran a cluster analysis using the top 50 words that prevail in the set of documents, Fig. 3 Words of the same color and in the same clade show a strong association among them and suggest the codes to which they can belong. Some words of different colors might cluster together in the same clade, showing linkages worth investigating. For example, policy (blue) clustered with words in brown, i.e., implementing and changing; thus, the authors coded them as livable, human-centered, management, and urban design. The authors coded the words in green, such as models, applications, design, and infrastructure, under the smart city, design, management, and technology.

Based on the cluster analysis outcomes and the researchers' intuition, the study identifies five explanatory or independent codes, namely: (a) human-centered, (b) management, (c) social inclusion, (d) technologies, and (e) urban design, along with three dependent codes, namely: (a) livable, (b) quality of life, and (c) smart cities.

4.2 Intensive inquiry

Based on the readings, the researchers identified five explanatory codes:[4] (a) Human-centered with 5,008 Gr, (b) Management with 4,121 Gr, (c) Social inclusion with 2,880 Gr, (d) Technologies with 4,612 Gr, and (e) Urban Design with 6,641 Gr.

Table 1 shows significant relationships among the independent variables as the c-coefficients approach 0.5 and beyond. Meanwhile, the researchers identified three dependent codes: a) Livable with 5286 Gr, (b) Quality of Life with 4,349 Gr, and (c) Smart cities with 5,838 Gr. Results suggest that jointly counted Gr between Livability and Quality of Life and Smart Cities is 4,334 and 5,053, resulting in c-coefficients of 0.82 and 0.83, respectively, implying a strong relationship.

The common grounded quotations between the quality of life and smart cities reached 4,288 with a c-coefficient of about 0.73 points toward a substantial relationship, Table 2. A significant relationship exists among the eight codes, i.e., the dependent and independent codes, as Table 2 shows where c-coefficients are all above 0.5.

However, some independent codes are more influential than others. Human-centered is key for the residents of a livable and smart city to enjoy a higher quality of life. The c-coefficients of human-centered with livable, quality of life, and smart cities reached 0.94, 0.85, and 0.84, respectively.

Planning and managing an urban area are essential for quality of life, where the c-coefficient reached 0.94, suggesting a meaningful role in a city's livability and smartness. The c-coefficient reached 0.78 with the former and 0.71 with the latter, Table 2. Social inclusion significantly influences the quality of life, where the c-coefficient reached 0.66. It has the least impact on livability and smart cities, where the c-coefficients are 0.54 and 0.48. Technology positively influences the quality of life and livability as the c-coefficient reached 0.88 and 0.83. The influence on smart cities is slightly less, where the c-coefficient approached 0.78.

The impact of the independent codes on the three dependent codes seems equal. Reading the network, Figure 3, from the left side to the right, the inputs from social inclusion and technologies are crucial for urban design.

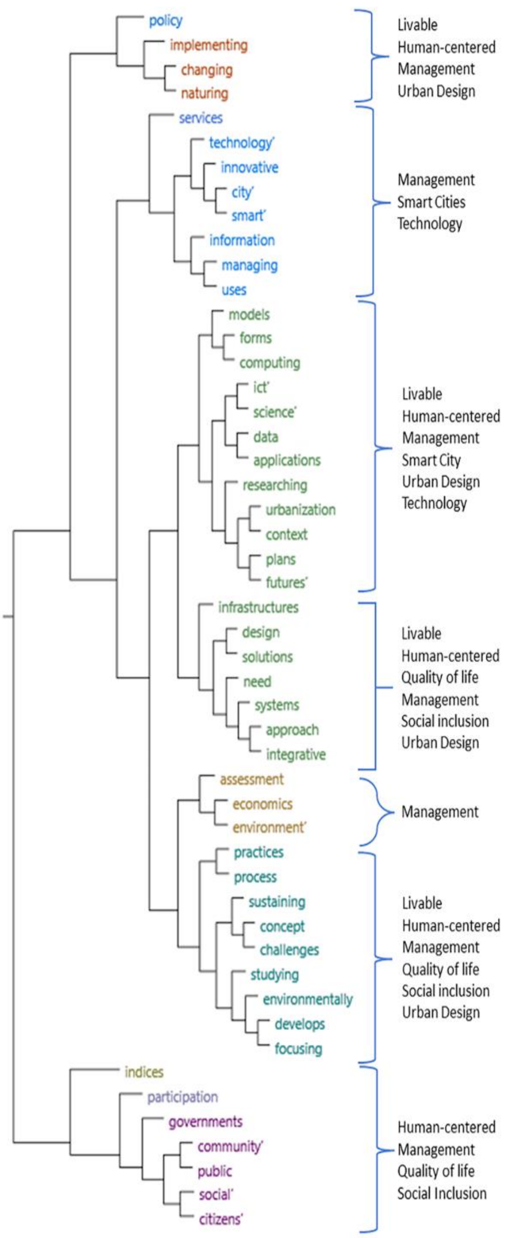

Figure 3. Codes generated from clustering similar words. Authors' elaboration through NVivo

Table 1. Explanatory code matrix. Authors' elaboration from Atlas.ti

Code		Human-centered Gr=5008	Management Gr=4121	Social Inclusion Gr=2880	Technologies Gr=4612	Urban Design Gr=6641
Human-centered Gr=5008	count	0.00				
	coefficient	0.00				
Management Gr=4121	count	4101.00	0.00			
	coefficient	0.82	0.00			
Social Inclusion Gr=2880	count	2880.00	2772.00	0.00		
	coefficient	0.58	0.66	0.00		
Technologies Gr=4612	count	4464.00	4119.00	2808.00	0.00	
	coefficient	0.87	0.89	0.60	0.00	
Urban Design Gr=6641	count	4999.00	4101.00	2880.00	4532.00	0.00
	coefficient	0.75	0.62	0.43	0.67	0.00

Table 2. Code matrix analysis Authors' elaboration from Atlas.ti

Independent Variables		Livable Gr=5286	Quality of Life Gr=4349	Dependent Variables Smart Cities Gr=5838
Human-centered Gr=5008	count	4999.00	4300.00	4951.00
	coefficient	0.94	0.85	0.84
Management Gr=4121	count	4116.00	4102.00	4121.00
	coefficient	0.78	0.94	0.71
Social Inclusion Gr=2880	count	2880.00	2880.00	2847.00
	coefficient	0.54	0.66	0.48
Technologies Gr=4612	count	4494.00	4206.00	4572.00
	coefficient	0.83	0.88	0.78
Urban Design Gr=6641	count	5183.00	4298.00	5763.00
	coefficient	0.77	0.64	0.86

It is a process that incorporates elements from architecture, landscape design, ecology, urban sociology, civil engineering, economics, politics, and other disciplines to develop thriving living environments for communities. Implementing urban plans requires effective administration. It implies planning, organizing, directing, and controlling resources to accomplish the elaborated plans' goals, using people's skills effectively, implementing monitoring systems, and evaluating outcomes. The three blue codes are the dependent variables. The network suggests that Smart Cities and Human-centered are important for the quality of life in a city, which in turn is central to its livability.

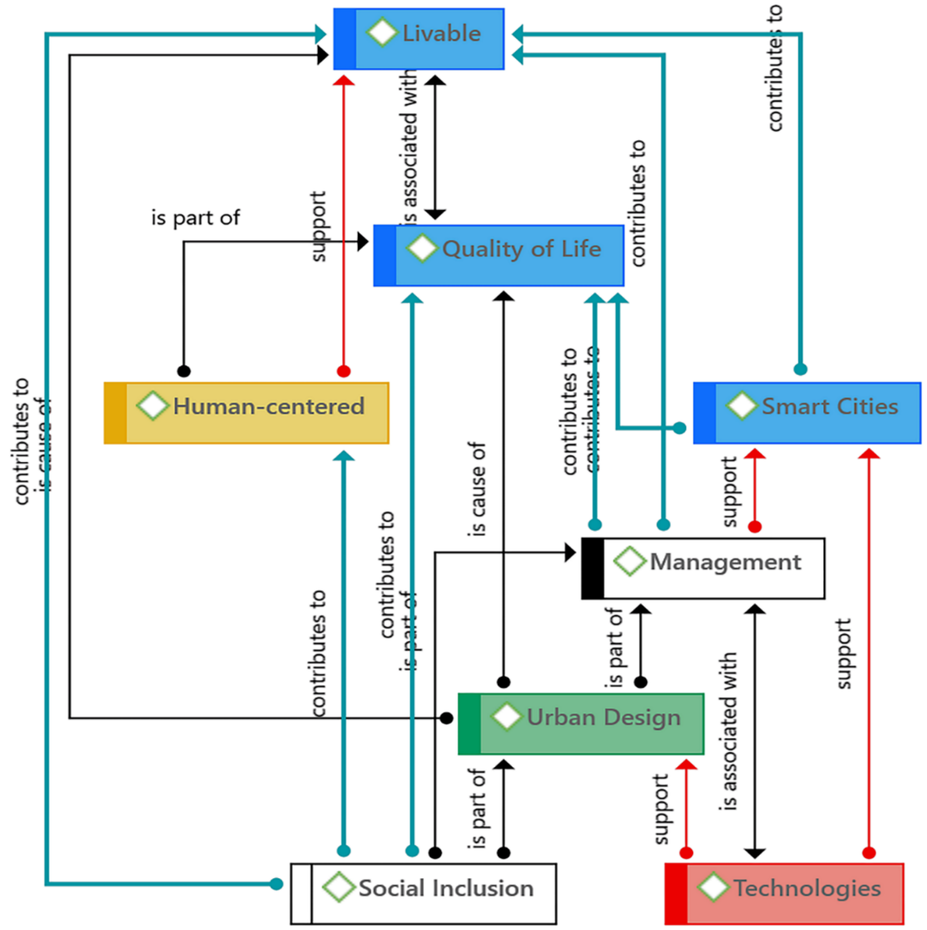

Figure. 3. Network depicting the conceptual relationships and interlinkages among the codes. Authors' elaboration through Atlas.ti.

4.3 Extensive analysis

4.3.1 Influence on the livability of a city

Regressing Livable against the five independent variables resulted in a chi-square of 113,77.848 with five degrees of freedom (df), Table 3. The calculated chi-square is significant at the 0.000 level. The pseudo-R-square is 0.689 (Cox and Snell),[5] 0.922 (Nagelkerke),[6] and 0.848 (McFadden),[7] Table 4, suggesting that the five independent variables affect a city's livability. Results show that Human-centered and Urban Design are the factors that contribute to a city's livability, as the chi-square suggests, Table 3. Social inclusion has the highest beta weight, as Table 4 exhibits, the parameter estimates for city livability, which affirms the code matrix analysis results that Table 2 exhibits.

Table 3. City's livability likelihood ratio tests. Authors' elaboration from SPSS

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	chi-square	df	Sig.
Intercept	93.473[a]	0.000		
Human-centered	1755.412	1661.938	1	0.000
Management	156.194[b]	62.721	1	0.000
Social Inclusion	96.255	2.782	1	0.095
Technologies	100.296[b]	6.823	1	0.009
Urban Design	244.160[b]	150.687	1	0.000

The chi-square statistic is the difference in -2 log-likelihoods between the final and reduced models. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

b. There may be a quasi-complete separation present in the data. The non-existence of maximum likelihood estimates, or the occurrence of infinite parameter estimates is possible.

Table 4. Parameter estimates of a city's livability. Authors' elaboration from SPSS

Livable	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	-22.433	0.617	1,320.15	1	0.000			
Human-centered	6.363	0.347	336.894	1	0.000	579.871	293.937	1143.951
Management	4.067	0.579	49.38٠	1	0.000	58.39	18.779	181.552
Social Inclusion	13.344	0.000	0.00٠	1	0.000	623747.56	623747.56	623747.56
Technologies	0.717	0.26٠	7.63٠	1	0.006	2.048	1.232	3.407
Urban Design	1.588	0.137	134.775	1	٠,٠٠٠	4.892	3.742	6.396

a. The reference category is: Yes.
b. Setting this parameter to zero is due to its redundancy.

4.3.2 Impact on the resident's quality of life

Regression of the city's quality of life against the five independent variables yielded a chi-square value of 12,226.610 with five degrees of freedom, statistically significant at the 0.000 level,Table 5. The pseudo-R-square values are 0.715 (Cox and Snell), 0.957 (Nagelkerke), and 0.957 (McFadden), showing that the five independent variables impact the quality of life in a city. Table 6 displays the model fit criteria showing the parameter estimates for the city's quality of life, where social inclusion has the highest beta weight, consistent with the results that Table 2 depicts.

4.3.3 Contribution to the smartness of a city

At the 0.000 level, regression of the smartness of a city against the five independent variables produced a chi-square value of 10,220.326 with five degrees of freedom, Table 7. The pseudo-R-square values are 0.650 (Cox and Snell), 0.879 (Nagelkerke), and 0.780 (McFadden), Table 8. These statistics show that the five independent variables impact a city's smartness.

Table 5. City's quality of life likelihood ratio tests. Authors' elaboration from SPSS

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	chi-square	df	Sig.
Intercept	44.171[a]	0.000	0	.
Human-centered	196.784[b]	152.613	1	0.000
Management	1101.093[b]	1056.922	1	0.000
Social Inclusion	469.719	425.548	1	0.000
Technologies	74.171[b]	30.000	1	0.000
Urban Design	68.213[b]	24.042	1	0.000

The chi-square statistic is the difference in -2 log-likelihoods between the final and reduced models. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.
b. There may be a quasi-complete separation present in the data. The non-existence of maximum likelihood estimates or the occurrence of infinite parameter estimates is possible.

Table 6. Parameter estimates of a city's quality of Life. Authors' elaboration from SPSS

Quality of Life	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	-25.239	٠.233	11707.093	1	٠.000			
Human-centered	4.395	٠.509	74.557	1	٠.000	81.027	29.881	219.717
Management	5.699	٠.268	451.893	1	٠.000	298.667	176.594	505.125
Social Inclusion	20.884	٠.000	.	1	.	1173922٣27.12٠	1173922327.12٠	1173922327.12
Technologies	1.124	٠.208	29.293	1	٠.000	3.078	2.049	4.625
Urban Design	-2.183	٠.511	18.253	1	٠.000	.113	٠.041	٠.307

a. The reference category is: Yes.
b. Setting this parameter to zero is because of its redundancy.

Table 7. City's smartness likelihood ratio tests. Authors' elaboration from SPSS

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	chi-square	df	Sig.
Intercept	256.274[a]	٠.000	0	.
Human-centered	710.441[b]	454.167	1	٠.000
Management	313.910	57.636	1	٠.000
Social Inclusion	344.062[b]	87.788	1	٠.000
Technologies	499.333[b]	243.059	1	٠.000
Urban Design	2010.387	1754.112	1	٠.000

The chi-square statistic is the difference in -2 log-likelihoods between the final and reduced models. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.
b. There may be a quasi-complete separation present in the data. The non-existence of maximum likelihood estimates or the occurrence of infinite parameter estimates is possible.

Table 8 displays the model fit criteria and the parameter estimates for the city's smartness, where management has the highest beta weight.
Social inclusion has an inverse relationship with city smartness, suggesting that the smartness of a city is in the interest of businesses.

These results are consistent with the code matrix analysis presented in Table 2. These statistics show that the five independent variables impact a city's smartness. Our results are in line with contemporary literature. Successful social innovation depends on social participation. A community needs to be livable.

Social innovations are brand-new social behaviors that seek to address social needs more effectively than the current approaches, such as working conditions, education, community improvement, or health.These concepts aim to develop and strengthen civil society [35].

Human-centered planning is key to a vibrant public space [36], [37]. Results show the importance of citizen participation and social inclusion, where public places are essential to city dwellers' well-being [38].

Table 8. Parameter estimates of a city's smartness. Authors' elaboration from SPSS

Smart Cities	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	-21.356	٠.368	3376.560	1	٠.000			
Human-centered	3.371	٠.240	197.231	1	٠.000	29.120	18.191	46.617
Management	17.135	٠.000	.	1	.	27640498.726	27640498.726	27640498.726
Social Inclusion	-3.075	٠.332	85.793	1	٠.000	.046	٠.024	٠.089
Technologies	4.025	٠.292	190.012	1	٠.000	55.971	31.581	99.198
Urban Design	4.466	٠.178	628.175	1	٠.000	87.031	61.375	123.412

a. The reference category is: Yes.
b. Setting this parameter to zero is due to its redundancy.

5 Discussion

The challenge of building an ordinary city is to make one exceptional, calm and restful, smart and orderly, artistic and cultivated, or livable [39]. Our results suggest that a city's livability depends on human-centered planning and social inclusion. Social inclusion is key to the resident's quality of life [20], [21], and the relationship between social inclusion and the smartness of a city is inversely correlated.

Urban planners face two challenges in a capitalist society: (a) property contradiction and (b) capitalist-democracy contradiction. The first is the tensions between the market value of an urban property, which developers and landlords appreciate, and use value, which society realizes[40]. The second contradiction is the markets' need for freedom and liberty to enable the processes of capital formation and movement of labor. Despite this, many free-market advocates argue for the importance of a government [41], [42] installed through a democratic process to manage natural and human resources by regulating space [43]. The western-democracy contradiction stems from the need for a government to control society and socialize space by handling externalities[8]and providing public goods[9][40].

In addition to these contradictions that the capitalist system imposes on planners, to engage in comprehensive planning, planners must thoroughly comprehend the overarching objectives of the communities they serve. In their true essence, comprehensive goals often possess a level of generality that hinders the ability to evaluate specific options. As a result, it proves challenging to generate political engagement among these individuals, and politicians exhibit a limited willingness to align their decision-making processes with overarching and far-reaching objectives, instead favoring lower-level choices. The delineation between planning and other specialized fields will gradually lose clarity [44]. "Comprehensiveness in city planning refers primarily to an awareness that the city is a system of interrelated social and economic variables extending over space" [45, p. 196]. In response to Altshuler, Friedmann [45] proposed a dichotomy of introducing a conceptual division between land use planners and urban designers, who are tasked with the physical planning aspects of capital improvement projects and establishing suitable design criteria to regulate the visual appearance of the city, and land use planners, who are responsible for implementing the city's land use plan in collaboration with other planning offices. The latter group specifically focuses on zoning and subdivision control.

Our findings build on the legacy of Jacobs (1961), Altshuler (1965), Friedmann (1965), Lefebvre (1996), Whyte [46], Gehl [47], and Harvey (2008) on the importance of human scale, human-centered planning and social inclusion. They are also in line with the arguments for smart cities and the contribution of technologies in planning and managing the city, as Yigitcanlar & Velibeyoglu [48], Steenbruggen, Tranos and Nijkamp [16], Kourtit et al. [49], Bibri and Krogstie [7], [50], [51], Pozdniakova [8], Fiorentino & Bartolucci [14] and Chen [52] Zabihi et al. [12].

Livable, sustainable cities require planning that prioritizes human needs and fosters social inclusivity. A livable city is smart, but a smart city is not necessarily livable. Technologies that qualify a city as smart apply in physical infrastructures, such as transportation, water and wastewater management, solid waste management, and disaster risk reduction via early warning networks.

The paper's results supported the significance of human-centered planning and social inclusion in enhancing a city's livability. Social inclusion was found to have a crucial role in enhancing residents' quality of life. Interestingly, the relationship between social inclusion and the smartness of a city was inversely correlated, suggesting that smart cities might prioritize the interests of businesses over social inclusion. The authors call on scholars and practitioners to enable, engage and empower citizens, systematically evaluate and analyze their experiences, and document and disseminate their findings and best practices.

Human-centered planning and social inclusion are possible through engaging, enabling, and empowering the public in decision-making and plan implementation might expand to making technology more widely available, inexpensive, and user-friendly, especially for those who have historically been left out or marginalized due, in part, to the digital divide, thus bridging the gap between the two schools of thought. One of the possible avenues is supporting social entrepreneurship and grassroots innovation that use technology to tackle regional issues like governance, environment, health, and education. To ensure that technology is developed and applied in a participative, inclusive, and moral manner, fostering a culture of collaboration and co-creation among various stakeholders, including governments, corporations, civil society, academics, and users, is important.

The findings align with contemporary literature on the importance of social innovation and citizen participation in sustainable urban development. Moreover, the study revealed technology's potential challenges, including the digital divide, privacy concerns, and moral dilemmas.

5.1 Recommended actions

Based on the findings of the inquiry, the authors recommend that governments, Non-Government Organizations, research institutions, and private-sector companies, within their Corporate Social Responsibility, ensure equitable access to technology involves promoting the general availability of technological resources, including the Internet and digital devices, with a particular focus on marginalized communities. Efforts should prioritize closing the digital gap by offering training programs and inexpensive technology access.

Urban planning agencies, local governments, and municipal authorities ought to incorporate technology into the planning process, specifically emphasizing inclusivity. Involving local communities in the planning process reveals their needs and includes various viewpoints. Utilize technology to design environments catering to diverse demographics and a wide range of skills.

Community-centric innovation is a must. It is possible when authorities engage locals in designing and implementing technological solutions. Enabling local communities to recognize and collaboratively develop enduring technological solutions that cater to their distinct requirements.

An institutional transformation for a smart and sustainable city requires formulating and revising rules and regulations to align with the rapid progress of technology. The newly developed institutional framework has to be robust, guaranteeing the responsible and ethical use of technology, specifically addressing privacy, security, and environmental concerns.

Education and skill development are central to and a requirement for the newly devised institutional framework. Educational initiatives must provide people with the necessary competencies to effectively interact with and derive advantages from technology. Accordingly, educational programs encompass digital literacy and training initiatives for emerging technologies, enabling inhabitants to engage actively in the digital transformation of their cities.

The newly developed institutional framework has to foster open data projects to bolster openness and ensure accountability. Facilitating public access to pertinent data promotes cooperative problem-solving and enables citizens to engage in decision-making procedures actively.

Financing the transformation to an institutional framework that closes the gap between technology and social inclusion for a smart and sustainable city is possible. One possible funding mechanism is Public-Private Partnerships to capitalize on their respective advantages. Partnerships can stimulate creativity, optimize the allocation of resources, and guarantee that technology advancements align with wider social sustainability objectives.

Adopting smart governance strategies that utilize technology to enhance the efficiency and responsiveness of local administration is a sine qua non for a smart and sustainable city. The system encompasses digital platforms that facilitate citizen interaction, data-driven decision-making, and real-time monitoring of urban services.

The suggested institutional framework must incorporate technology in a manner that gives precedence to environmental sustainability. Smart solutions should strive to decrease resource usage, limit pollution, and enhance communities' overall ability to withstand climate change's impacts.

Lastly, the founded institutional framework must promote cooperation among technologists, urban planners, social scientists, and other pertinent fields. An interdisciplinary approach guarantees that technical solutions consider urban surroundings' many social, cultural, and economic aspects.

By adopting these approaches, metropolitan areas can initiate the process of connecting technology with social sustainability, cultivating an all-encompassing and adaptable urban environment that utilizes the advantages of technical advancements for the welfare of all inhabitants.

5.2 Limitations

Although this paper offers insightful information on factors affecting urban sustainability, it is important to recognize several limitations. The authors used only the ScienceDirect database to obtain data, which may have introduced bias. Alternative databases, Web of Science, can produce different results, necessitating additional research and validation. Because this paper's results emerged from a particular collection of ScienceDirect articles, they might not accurately reflect the complete body of research. Consequently, care should be taken when extrapolating the findings to specific metropolitan settings or areas.

The analysis concentrated on works published between 2016 to December 2022, which might not have considered the most current developments or adjustments to urban development tactics. Future studies must consider adding more recent data to represent the changing context of sustainable urban development.

The quasi-complete separation in the data may make it difficult to estimate some parameters precisely and impact how the results are interpreted. While examining the data, researchers must be mindful of this potential limitation.

The cross-sectional form of the inquiry prevents the identification of direct causal links between the independent factors and urban outcomes. Stronger proof of causation may come through longitudinal research or experimental procedures.

The quality of the titles, abstracts, and keywords in the chosen publications determines the correctness and dependability of the data. Inaccurate or lacking data in the database could have affected the results.

Although the paper highlighted important elements, such as human-centered planning, social inclusion, urban design, and technology, additional pertinent variables, such as infrastructures and social services, were overlooked in the analysis. Future studies may examine additional elements to provide a more thorough picture of urban sustainability.

Urban sustainability integrates various academic disciplines, including urban design, engineering, sociology, and economics. It may be necessary to conduct additional interdisciplinary research because this paper may not adequately reflect the intricate interplay of influences from several fields.

Despite these drawbacks, the paper lays the framework for further research and offers insightful advice for urban planners and policymakers in building more livable and sustainable cities. To evaluate and build upon the findings, researchers should be cautious when interpreting the findings and consider performing larger and more varied investigations.

6 Conclusion and further research

Achieving urban sustainability, which requires balancing the environmental, social, and economic components of urban development, is one of the key issues of the twenty-first century. Social inclusion, or the degree to which all members of society may participate and profit from the opportunities and resources the city provides, is a crucial component of urban sustainability. However, various forms of inequality, discrimination, and marginalization can obstruct social inclusion by building hurdles to basic services, education, health care, employment, and civic engagement.

6.1 Recapitulation of findings

The authors have explored the intricate relationship between human-centered planning, social inclusion, and technology-driven solutions in the context of sustainable urban development. The findings underscore the significance of both approaches, but they also highlight the need for an inclusive and comprehensive strategy to bridge the gap between these two perspectives.

Technology may play a critical role in bridging the gap between social inclusion and urban sustainability by providing innovative solutions that fulfill the needs and ambitions of various urban populations, strengthen their capacities, and enable them to contribute to the common good. Technology can, however, also provide risks and difficulties for social inclusion, including the digital divide, privacy concerns, moral conundrums, and unforeseen effects. As a result, it is crucial to take a comprehensive and inclusive approach to technology development and implementation that considers the social, cultural, and ethical components of urban sustainability and includes all pertinent stakeholders.

There are two main schools of thinking in today's literature on sustainable urban development: those who support the human-centered planning of a metropolis and those who think technology alone can solve urban problems. Arguments that the development of information and communication technologies can only maintain a metropolis have been hotly contested by many academics. In addition to the cost of these technologies, concerns exist about the utility, safety, usability, and effectiveness of smart city services.

6.2 The way forward

Making technology more accessible, affordable, and user-friendly could be an extension of involving, enabling, and empowering the public in decision-making and plan implementation, which would help close the gap between the two schools of thought. Supporting grassroots innovation and social entrepreneurship that employ technology to address local problems with government, the environment, health, and education is one of the viable directions. Fostering a culture of collaboration and co-creation among diverse stakeholders, including governments, companies, civil society, academia, and users, is crucial if technology is to be developed and implemented in a participatory, inclusive, and moral manner.

Planning educators and practitioners need to pay attention to their products, i.e., their graduates and plans; the process of educating a planner or producing a plan, besides the adopted paradigm in education and practice to democratize technology use, thus paving the way to the livable city.

Acknowledgment

We wish to express our gratitude to the reviewers and the editor for valuable recommendations and feedback during the review process, which greatly enhanced the quality and strength of this work. All inaccuracies remain our responsibility.

Endnotes

1. also known as Statistical Package for Social Sciences.
2. The website provides access to a sizable bibliographic library of scientific, arts, humanities and medical articles from the Dutch publisher Elsevier.
3. 2016 is the default year for the database.
4. Also known as independent variables.
5. The Cox and Snell R2 is R2C&S= 1 – (L0/LM)2/n, where n is the number of observations. The rationale for this formula is that it is an identity for normal-theory linear regression (Source: Cox, D. R., and Snell, E. J. 1989. The analysis of binary data, 2nd ed. London: Chapman and Hall).
6. R squared of Nagelkerke represents the explanatory power of the model (Source: Nagelkerke, N. J. D. 1991. A note on a general definition of the coefficient of determination. Biometrika, 78: 691-692).
7. McFadden's R2 is defined as 1-LLmod/LL0, where LLmod is the log likelihood value for the fitted model and LL0 is the log likelihood for the null model containing only an intercept as a predictor so that everyone is predicted to have the same probability of 'success.
8. Externalities are defined as the economic costs or benefits that are incurred by individuals who did not intentionally choose to engage in a transaction with a particular entity, such as a company or an individual. Third-party involvement in an exchange can result in significant impact without direct compensation from the parties engaged in the initial arrangement. Environmental pollution resulting from activities such as waste disposal and hazardous material handling can give rise to negative externalities. Conversely, positive externalities may manifest when businesses offer employment opportunities that benefit not only their employees but also the communities in which they operate.
9. It refers to a shared resource that provides benefits to all members of the community, regardless of whether they contributed directly to its creation. Many believe public goods are essential for achieving positive outcomes as it can drive social and economic progress when utilized correctly.

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