smart cities

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Review

Smart City Assessment in Developing Economies: A Scoping Review

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Abstract: There are limited research articles that focus on smart city assessment (SCA) applications as it is a relatively new field of research and practice. However, numerous studies have been conducted and published to date, particularly in developing countries, with the broad objective of building theoretical frameworks that are centered on smart city assessments. This study aimed to systematically examine the available literature on SCA, particularly in the context of developing economies, and provide valuable insights for the various stakeholders involved in smart city projects. The specific objectives of the study were to synthesize the existing literature on smart city assessment in developing economies, analyze the frameworks employed for smart city assessment, and identify critical gaps in these frameworks while providing recommendations for future research. The methodology employed involved a scoping review procedure, and the data that were collected and analyzed were specific to developing economies. The findings revealed that SCA often incorporates other research methods, such as mixed and quantitative analyses, and embraces a multidisciplinary approach that encompasses various subject areas. While social science emerged as a prominent subject area, sustainability, renewable energy, and industrial development also play crucial roles in smart city assessments. This study highlighted that ISO 37122:2019 is the most widely adopted framework due to its structured methodology, ability to measure progress over time, and potential for benchmarking against other cities. However, it is important to consider that each framework has its own strengths and weaknesses, and cities may opt to utilize multiple frameworks or tailor them to their specific needs. Our paper concludes by emphasizing the significance of this research in providing comprehensive insights into smart city assessment in developing economies and the need for further studies to address the identified gaps and enhance future assessments.

Keywords: smart city; smart city readiness; smart city assessment; developing economies; PRISMA; assessment tools

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1. Introduction

A city is generally an urban area in which many people live close together; cities have their own separate governments and systems for maintaining and providing utilities and transportation. Smart cities are urban communities where information and communications technologies (ICTs) are applied to address local issues and promote social, economic, and environmental sustainability [1–4]. These cities adopt scalable solutions that take advantage

of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life [5,6]. There are a lack of global standards for smart cities as some dimensions, measures, and indicators are absent, which represent negative internal dimensions in smart communities themselves [2,7]. A smart city is defined as a designation that is given to a city that incorporates ICTs to enhance the quality and performance of urban services, such as energy, transportation, and other services, in order to reduce resource consumption, wastage, and overall costs while meeting the goals of the industries [8–10]. Recently, smart agriculture and smart health were included in the concepts of smart city technology [11–13]. Smart health systems were noticeable during the pandemic with the introduction of online consultations and modern medical technologies. Smart city technologies are also relevant in the development of city logistics for ensuring efficient levels of services in a city's intermodal logistics network system [14]. There are several references that are available in the concepts of smart city technologies [15–17]. Despite the benefits of smart cities, there are some concerns that need to be addressed. These concerns include infrastructure, security and hacking, privacy concerns, educating and engaging communities, and social inclusiveness [18]. It is possible that the tool that this study aims to examine may be relevant in addressing the main issues in smart city developments, most notably in developing economies; likewise, the tool may also be useful in ascertaining what will indeed be appropriate for urban areas or cities. This section will now further elaborate on the approach that was used in this study.

There are several stages to smart city processes, including the starting, planning, project development, assessment, and evaluation phases, as well as the communication of data and information that are related to the smart city strategy; each phase has its own unique activities that characterize and serve each phase. To further understand the concept of smart city technologies, the SCA tool may be employed in order to evaluate the performance of a given indicator in the scope of a smart city concept implementation [1,2,5,19]. Moreover, smart city tools can also be used to present city rankings, which reveals places for certain activities and in turn can be a central instrument for assessing the attractiveness of urban regions [11,20,21]. In principle, two major approaches can be distinguished for the study of SCA tools: those focused on providing an overview of the tools; and those involving more detailed analyses of the tools to better understand their thematic focus, including the typology of their indicators [1,2,5]. The assessment of the smartness of cities has received much more attention in recent years; however, very few studies have analyzed SCA tools and their strengths and weaknesses [11]. There are limited research articles that have analyzed SCAs, which is due to the fact that it is a relatively new field of research and practice [1]. SCA established itself as a new scientific field in the year 2009; however, despite the growing number of publications, the concept is far from having a clear and established definition [1]. Although numerous studies have been recently published, more particularly in developing countries and with a focus on different SCA frameworks [22], the downsides of these publications include the similarities in creating assessment frameworks and concepts.

At present, developing economies, once referred to as lesser developed economies, are characterized by a poor infrastructure, inferior growth rates, an imbalanced economy, and extremely low personal incomes. These economies lack the knowledge and assets required to shift away from an excessive reliance on production [23,24]. The goal of a smart city in developing economies would be to identify and prioritize areas where smart city initiatives could improve the city's efficiency and livability. This would include an assessment of the city's infrastructure, transportation, public safety, energy, and water systems [4,25,26]. Smart cities in developing economies are technology-based urban communities whose measures help a city improve its social, economic, and environmental conditions and provide a better life for the city's residents with their participation in the planning of city projects [27,28]. SCAs in developing economies can deliver important performance indicators in the monitoring and evaluation of multiple benefits for different actors and stakeholders, such as city authorities, investors and funding agencies, researchers, and

citizens. On the one hand, Smart City characteristics and components are classified into six major domains: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance [16]. Similarly, the proposed eight core components of a smart city assessment include: policy context, governance, management and organization, technology, people and communities, natural environment, economy, and built infrastructure [3]. The key components of smart city assessments, on the other hand, are economy, energy, finance, governance, transportation, urban planning, urban/local agriculture, and information communication technologies (ICTs) [22,29]. The applications of smart city technologies in urban and regional planning are basically aimed at improving the quality of life (QoL) of the people and preserving the environments of the communities while ensuring balanced, inclusive green growth.

Figure 1 depicts the smart city concept of ISO 37122:2019. It is a standard that was developed by the International Organization for Standardization (ISO) that provides a framework for measuring the performance of smart cities. This standard provides a set of indicators that can be used to assess the performance of a city in a range of areas, including economy, environment, mobility, governance, people, and living standards [6,19,27]. The smart economy component is intended to measure the city's economic performance, such as its gross domestic product (GDP), employment rates, and the number of businesses operating in the city. By tracking these indicators over time, cities can gain insights into their economic strengths and weaknesses and develop targeted strategies to enhance their economic development [3,27,30].

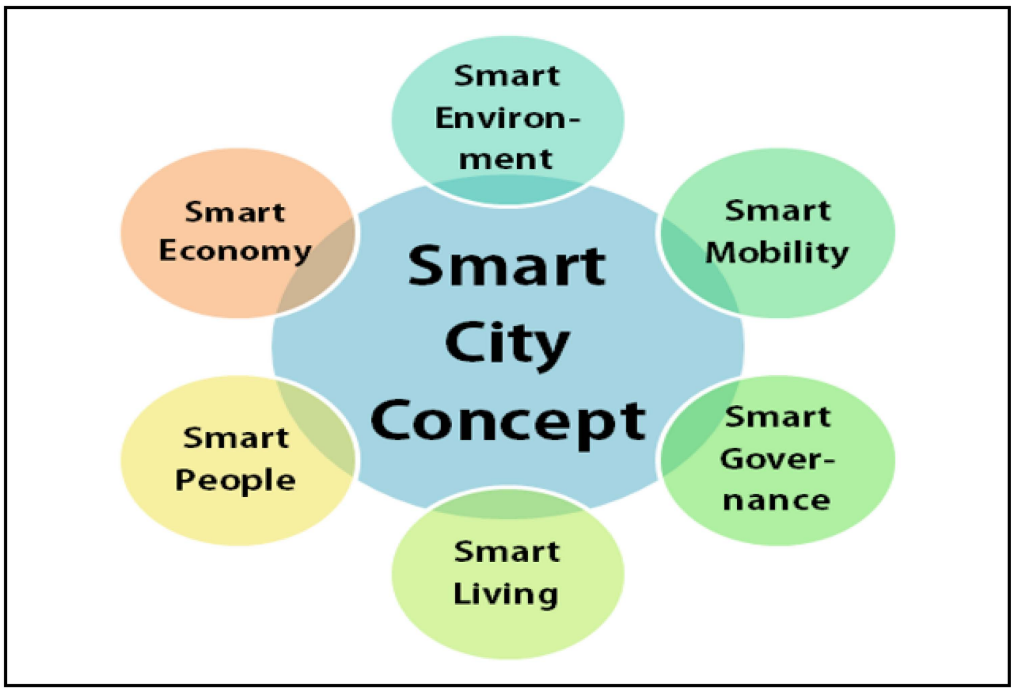

Figure 1. ISO 37122:2019 smart city concept.

The smart environment component includes indicators that are related to environmental sustainability, such as air and water quality, greenhouse gas emissions, and waste management. These indicators help cities to evaluate and identify opportunities for improving environmental sustainability [3,22,31]. The smart mobility component refers to the availability and use of public transportation, traffic congestion, and the infrastructure. These metrics are intended to provide perspective on the city's initiatives to support effective and sustainable transportation networks [32,33]. Smart governance refers to the effectiveness and efficiency of city governance. Indicators in this component include citizen participation, transparency, and the use of technology to improve governance. These indicators are designed to provide insights into the quality of governance in the city and

the extent to which it is responsive to the needs of its residents [34–37]. Additionally, the component's indicators include the prevalence of poverty, income inequality, and the availability of affordable housing. These metrics are intended to shed light on how much the city is trying to promote social inclusion and combat inequality [7,16,38,39]. Furthermore, smart living refers to the standard of living in cities. This component includes indicators for accessibility to facilities such as education, healthcare, and culture, as well as safety- and security-related factors. These metrics are intended to shed light on the general standard of living for urban residents [4,31,40]. Lastly, a smart economy is an economic system that uses technology and data to optimize the allocation of resources and improve efficiency. It involves the use of advanced technologies such as artificial intelligence, blockchains, and Internet of Things (IoT) to create new business models, improve productivity, and enhance sustainability. Dr. Mohan Munasinghe developed the concept of environmentally sustainable development (Figure 2), wherein the concept focuses on the integration of economic, social, and environmental factors in development planning and decision making. The concept further stressed that smart city technologies are found to provide the balance among these three aspects of inclusive growth, which is balanced and anchored on green development [23].

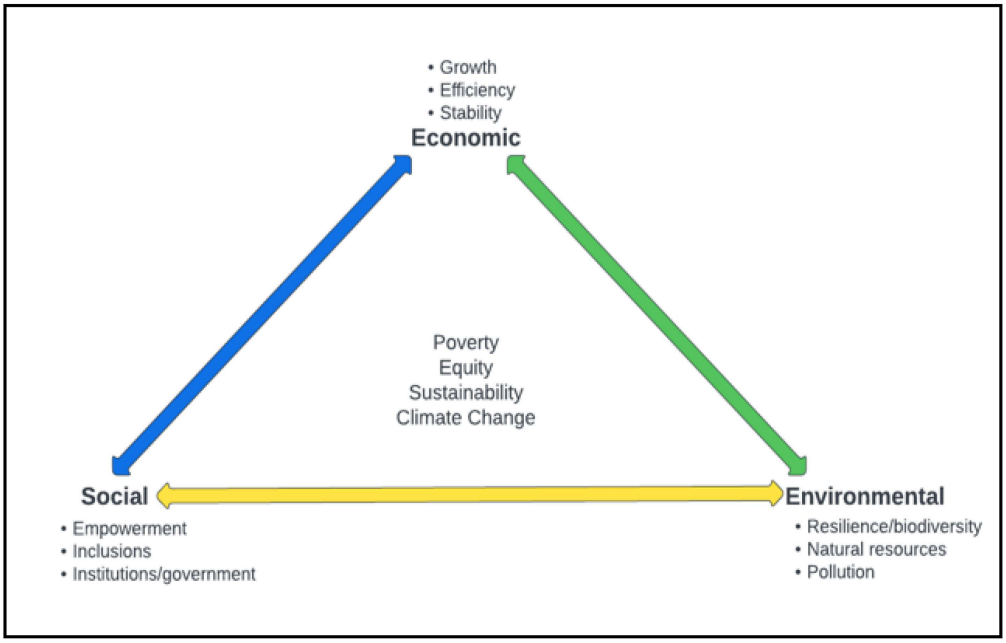

Figure 2. Dr. Mohan Munasinghe's balanced inclusive green growth.

While the smart city concept focuses on the use of technology and data to improve the quality of life for urban residents while minimizing resource consumption and environmental impact, Dr. Munasinghe's concept of environmentally sustainable development aims to ensure that development meets the needs of the present generation without compromising the ability of future generations to meet their own needs. There is a significant overlap between these two concepts, as smart cities can contribute to environmentally sustainable development by optimizing resource use and reducing emissions. For example, smart energy management systems can help to reduce energy consumption and greenhouse gas emissions, while smart transportation systems can reduce congestion and air pollution. In order to fully realize the potential of smart cities contributing to environmentally sustainable development, it is important to ensure that technology is used in a way that prioritizes environmental and social outcomes over purely economic ones. This requires a holistic approach to planning and decision making, which considers the needs and perspectives of all stakeholders, including marginalized communities and future generations.

Destination marketing organizations (DMOs) also play a crucial role in smart cities in promoting tourist destinations, shaping their image, and enhancing their competitiveness [41]. The presence of DMOs in destination management emphasizes the importance of studying their communication, promotion, marketing strategies, and future actions. The literature review on DMOs encompasses four key studies that have significantly contributed to our understanding of DMOs and their impact on tourist destinations. The study of [41] employed a bibliometric analysis to examine the impact of tourism promotion on tourist destinations. The findings revealed the effectiveness of various promotional strategies that were employed by DMOs. In another study [42], the authors investigated the role of smart tourism city governance in shaping stakeholder networks. This research explored how DMOs' strategies and actions in smart tourism cities influence the relationships among different stakeholders, and the study focused on the practical interpretation of a smart destination from the perspective of DMO managers in Spanish World Heritage Cities [43]. Their study highlighted how DMOs understand and implement smart destination concepts. Another study delved into the concept of the "Smart DMO" and its implications for the digital transformation of destination management organizations [44]. The research examined how digital technologies and strategies are integrated into DMO operations. These studies collectively contribute to our understanding of DMOs and provide valuable insights into their strategies and actions in destination management.

There are many studies on SCAs, but they lack synthesis on the scope of SCA frameworks among developing economies. In addition, the lack of frameworks for the strategic planning and economic base of the city as well as some elements of environmental sustainability are still undistinguished [1,3,5]. Hence, the purpose of this study is to examine and explore the literature using various methods for assessing the progress and success of smart city initiatives in developing economies. This study aims to provide valuable insights for city administrators, smart city implementers, city planning officers, technology providers, IS researchers, and rural and urban planners on how to effectively measure and evaluate the impact of smart city projects on the livability and sustainability of urban areas. The study identifies key indicators and metrics for assessing smart city progress and success and provides recommendations for future smart city assessments. The general objective of this paper is to synthesize the scope of smart city assessment in developing economies. To expand the research, the researchers narrowed the objectives and made three specific objectives: to synthesize the literature on smart city assessment in developing economies; to synthesize the smart city assessment frameworks in developing economies; and to determine the critical gaps on smart city assessment frameworks for developing economies and provide recommendations for future studies. This study followed a scoping review procedure to evaluate the different smart city assessment frameworks in developing economies. The data that are gathered in this study only focus on the context of developing economies. The rest of the article is arranged as follows: Section 2 presents the methodology and research strategy applied in the current research. Section 3 introduces the findings of the SCA frameworks in developing economies. Section 4 discusses the gaps identified in the previous literature and future avenues.

2. Research Methodology

2.1. Literature Profiling

The scoping review of the smart cities literature involved a systematic process: identification of the research question, the development of a search strategy, the selection of relevant studies, the analysis of data for themes, and the synthesis of results. The goal was to provide an overview of the existing literature, identify research gaps, and gain a comprehensive understanding of smart cities [45]. As such, this method allows researchers to gain a broad understanding of the research landscape on a specific topic and identify areas where further research is needed. This section includes the methods used for gathering and selecting the data to achieve the goal of synthesizing the articles that were related to smart city assessments in developing economies. The researchers determined the processes used

to generate the sample size of studies, profiled the sample sizes, identified the tools used in synthesizing the sample size, and discovered the gaps found in each journal article. This study used the structured guidelines of the 2020 Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [46–48]. To collate and synthesize the studies of SCAs in developing economies, this study utilized the Google Scholar database to explore, select, and identify studies from the literature. Google Scholar was used in this study because it provides a wide range of scholarly literature, including both peer-reviewed and non-peer-reviewed sources. Additionally, its interdisciplinary coverage was deemed more suitable for capturing diverse perspectives, which is relevant to smart city initiatives in developing economies. The researchers reviewed the references of all study materials included in the current review as well as the reviews found throughout the search. The researchers also checked the identified papers that mentioned studies that were included using Google Scholar's tools. When the sample size for the studies was finalized, the researchers saved all of the collected material in a literature bank to aid with the journal assessment.

As exhibited in Table 1, there were 4 keywords used in the search string to identify relevant studies, including smart city, smart city assessment, developing economies, and assessment tools [1,2,4,5,40]. The selected articles needed to match at least one word of each keyword.

Table 1. Keywords used in the search string.

Keywords	Search Strings
Smart City [7,11,34,40]	"Smart cities" OR "smart-city" OR "smart-cities" OR "sustainable city" OR "Sustainable urban developments" OR "eco-city" OR "digital cities" OR "intelligent city" OR "livable city"
Smart City Assessment [1,4,6,34,35,49]	"Smart city assessments" OR "sustainable city assessment" OR "sustainable city assessments" OR "urban city assessment" OR "urban city assessments" OR "emerging city evaluations"
Developing Economies [19,34,40,50,51]	"Developing economy" OR "developing countries" OR "developing country" OR "developing society" OR "developing societies" OR "middle income countries" OR "emerging city" OR "emerging markets" OR "less developed countries"
Assessment Tools [1,3,4,11,34,49]	"Assessment Tool" OR "evaluation tool" OR "evaluation tools"

As depicted below in Figure 3, the key terms were searched in Google Scholar, and a total of 1,830,000 results were found in the cloud database. The results were then classified by language and year published ranging from 2012 to 2022, which produced 99,300 results. The collected studies were then narrowed down into those having at least 2 or more citations, which resulted in 20,200 articles. Other criteria in the search process included narrowing down all journal articles and empirical studies to those that had the designs

of qualitative studies, quantitative studies, and mixed method studies, which resulted in 17,480 articles. The researchers only incorporated studies with detailed information on the principles, applications, dimensions, and objectives of the smart city in the context of developing economies, including the drivers and barriers that smart cities face [34,40,50,52]. After intensive searching, the number of studies was finally reduced to 150 articles, and these articles were stored in the literature bank in Google Drive after being modified to match the desired articles' title, abstract, and keywords.

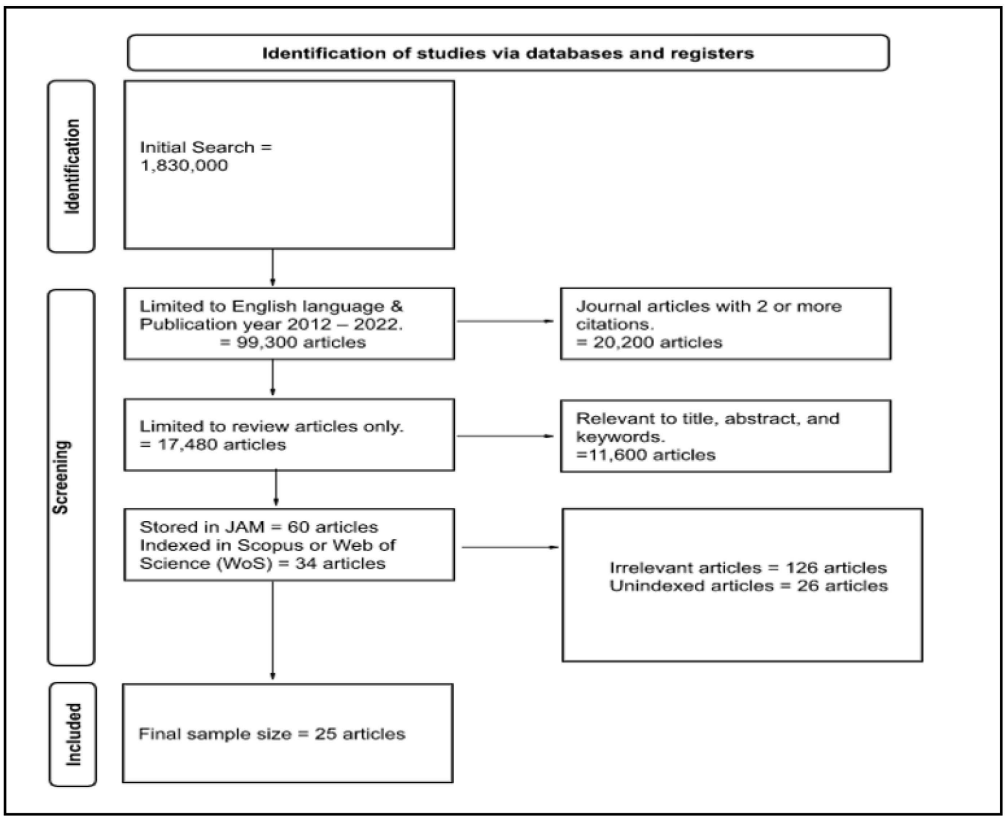

Figure 3. Data mining literature using the 2020 PRISMA flow chart.

2.2. Scoping Analysis

This section outlines the scoping analysis method that was utilized to determine the tools that would allow for the understanding of SCAs in the context of developing economies. Based on the results of the tally, the researchers decided to follow the methods employed by various studies and included variables such as used methods, frameworks, and objectives [1,27,28,30,31,53–55]. The methods, frameworks, and objectives (MFOs) were used in the study in order to distinguish numerous methods, frameworks, and objectives to collect significant indicators for SCAs in developing economies [1,3,28,31,53]. Furthermore, the MFO approach clearly defines the objectives of the scoping review. The approach also ensures that all relevant aspects of the research topic are covered; the methods used to collect data, the frameworks used to analyze the data, and the objectives of the study are all defined in advance, ensuring that the research is comprehensive and covers all of the necessary aspects of the topic [56]. The MFO approach helps researchers identify relevant frameworks that can be used to organize the literature and synthesize the findings [50,56–58]. This approach ensures that the review is grounded in relevant concepts, which enhances the quality and rigor of the study. After profiling the collected samples, the researchers utilized the combination of inductive and deductive qualitative coding techniques to investigate the significant themes and variables.

As depicted in Figure 4, the MFO approach can help researchers to design, conduct, and report research in a clear, efficient, and accountable manner, while also ensuring

replicability and adaptability. The significant methods that were identified in the literature were conceptual, hierarchical, cognitive mapping, best worst method (BWM), and multi criteria decision making (MCDM) [27,31,54,59]. The framework was defined by analyzing what type of tools and conceptual models were used in the sample literature. The objectives were the goals or guides to the studies that were being thoroughly evaluated [28]. To summarize, the MFO approach helps in achieving the goal of SCA, which is to identify the key domains of smart city implementations and its indicators.

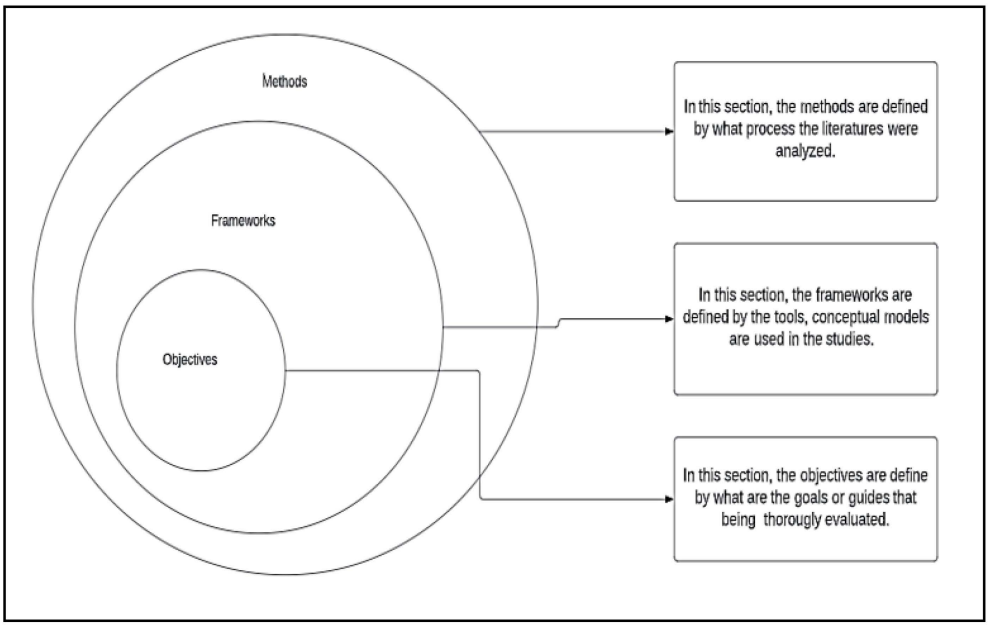

Figure 4. Methods, frameworks, and objectives model.

In this study, customizing the data extraction of SCAs proved to be challenging. To overcome this limitation, a Microsoft Excel spreadsheet was utilized instead. This approach offered the advantage of sorting and filtering studies based on various characteristics, such as study size, year of study, or type of conceptualization. This facilitated the initial analysis process. Additionally, conditional functions and pivot tables/charts were employed to gain a deeper understanding of the review's content.

2.3. Research Gap Analysis

As depicted in Figure 5, this section discusses the evaluation of the conclusions and recommendations of each of the collected 25 journal articles and conducts an inductive and deductive qualitative coding to organize these journals into themes. The initial set of codes was derived from the categorization of information. These codes consist of keywords that frequently appear in the conclusion and recommendation sections of each article. The codes were refined through a thorough re-evaluation of the articles to ensure that they accurately reflected the relevant knowledge and information about SCAs. Finally, the results of these codes help to direct this review in highlighting significant gaps in the literature that are related to SCAs; the researchers aligned the problem statement and objectives with the conclusion and recommendations of each paper. In this conducted scoping review of the SCA literature, the researchers identified several gaps after a thorough synthesis of the sample: (i) there was an insufficient number of studies in the scoping review of SCA in developing economies; (ii) most journal articles used similar frameworks; and (iii) the frameworks were complicated. These gaps will serve as a good reference for future research.

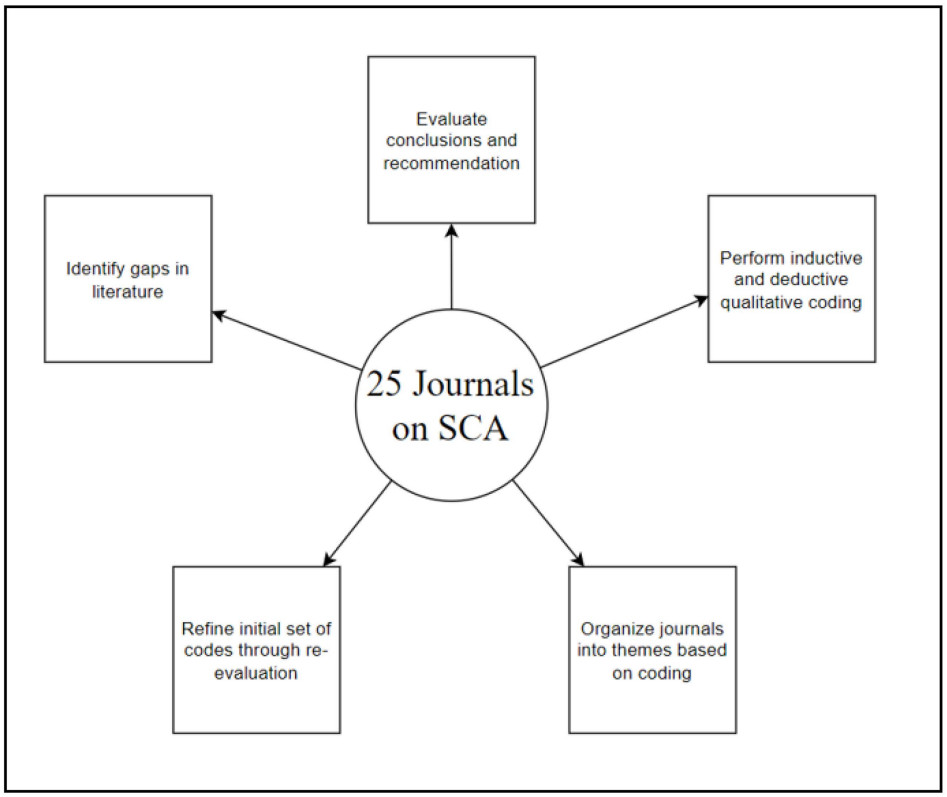

Figure 5. Research gap analysis model.

3. Results and Discussion

3.1. Literature Profiling Results

This scoping review aimed to explore the current state of research on SCAs in developing economies. Specifically, the researchers analyzed the results and will discuss the implications of existing studies on the feasibility and effectiveness of smart city assessments. By providing a comprehensive overview of the current field of research, this review will contribute to the growing body of knowledge on smart cities and inform future research and policy decisions in developing economies.

In the publication trend exhibited in Figure 6 spanning up to the current year, the earliest identified research article about SCAs in developing economies was published in 2015. According to the final sample size of papers, the greatest number of published articles about SCA was in the year 2019, which featured six journal articles; this was followed by the year 2018, which featured five journal articles. This shows that the study of SCAs in developing economies has been steadily growing over the past 10 years. This may be because smart cities are becoming more popular as a result of technological improvements, which has sparked researchers' interests about the advantages, opportunities, and challenges of smart cities.

The geographical distribution of the 25 journal articles was thoroughly evaluated, as depicted in Figure 7. The study's findings reveal that out of the 25 sample sizes, India had the most investigative articles, comprising 5 out of 25 This indicates that most of the smart city assessments in developing countries have been based in India. The second highest investigated countries were Malaysia and Africa, both of which had three articles. They were followed by Romania and Turkey, both of which had two articles; Indonesia, Vietnam, Thailand, Nepal, Mexico, Iraq, Israel, China, Brazil, and Georgia had one featured article, respectively. The various research designs are depicted in Figure 8, including qualitative, quantitative, mixed method designs. The collected sample literature in the review consisted of 18 qualitative studies, 5 mixed method studies, and 2 quantitative studies.

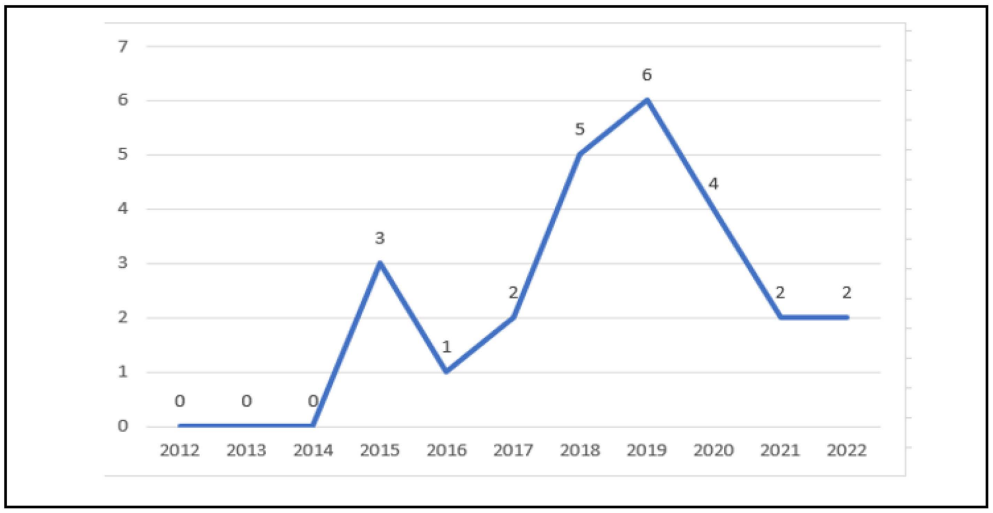

Figure 6. Published years of the qualifying articles.

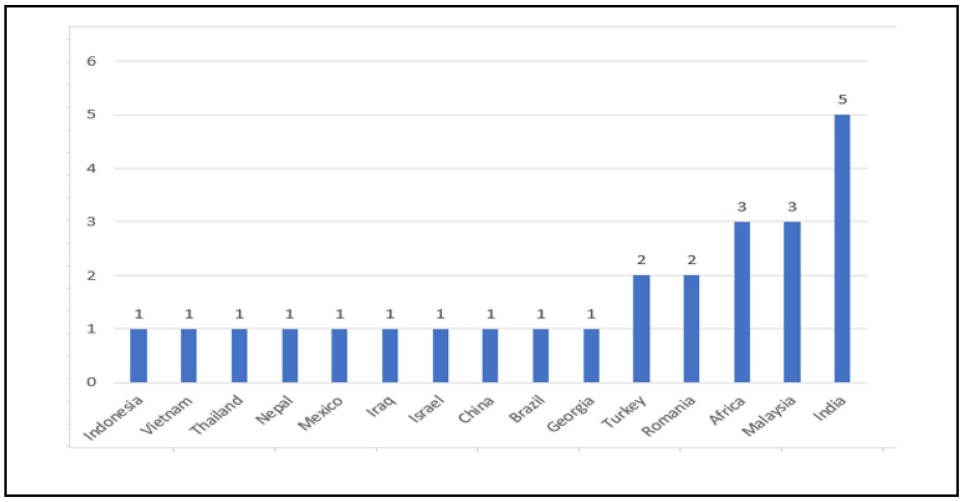

Figure 7. Geographical distribution of articles on developing economies.

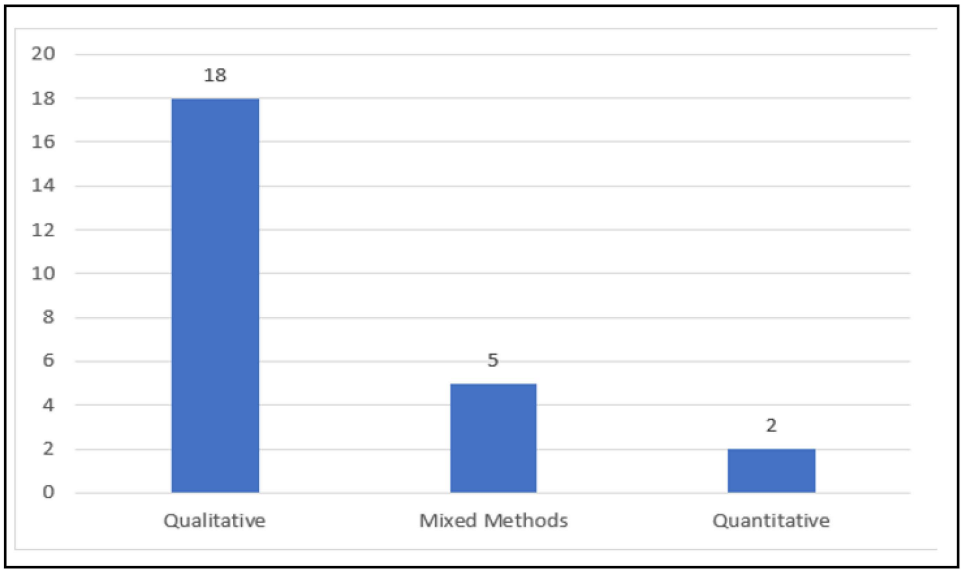

Figure 8. Research methods of the sample studies.

Table 2 shows the journal publications of the collected sample literature. After an intensive investigation, the results show that *Cities* had the greatest number of studies. This was followed by the *Journal of Cleaner Production*, *Sustainable Cities and Societies*, *Energies*, and *Technological Forecasting and Social Change*, each of which featured three journals. The results show that *Urban and Research Practice*; *IEEE Transactions on Engineering Management; IOP Conference Series: Materials Science and Engineering*; *Jurnal Teknologi*; *Journal of Urban Design*; *City, Culture and Society*; *Energy Research & Social Science*; *Land Use Policy*; and *Environmental Impact Assessment Review* had the least number of journals identified, with each only featuring one journal study.

Table 2. Journal publications of the collected sample journals.

Journal Publications	Number of Studies
Cities	4
Journal of Cleaner Production	3
Sustainable Cities and Societies	3
Energies	3
Technological Forecasting and Social Change	3
Smart Cities	2
Sustainability	2
International Journal of Information Management	2
Journal of Urban Technology	2
Urban Research and Practice	1
IEEE Transaction on Engineering Management	1
IOP Conference Series: Materials Science and Engineering	1
Jurnal Teknologi	1
Journal of Urban Design	1
City, Culture and Society	1
Energy Research & Social Science	1
Land Use Policy	1
Environmental Impact Assessment Review	1

As shown in the figure presented below (Figure 9), the collected sample journal articles have been profiled according to their journal publication using SCImago Journal Rank. It is a metric of scholarly journals' standing that considers both the frequency of citations that a journal article receives and the standing of the journals that the articles came from. This tool has been utilized in order to understand the subject areas and categories that were covered by the different journals that have been gathered from the sample literature. The subject area of social sciences has the greatest number of journal articles; There were 11 journals in which the focuses were the categories of geography, planning and development, transportation, urban studies, development, and sociology and political sciences. This was followed by the engineering and energy fields, which both had 10 journals. In the field of business, management, and accounting, there were nine journals, indicating a moderate level of research activity in this area. Environmental science had eight journals, followed by computer science with four journals, and agricultural and biological science had one journal.

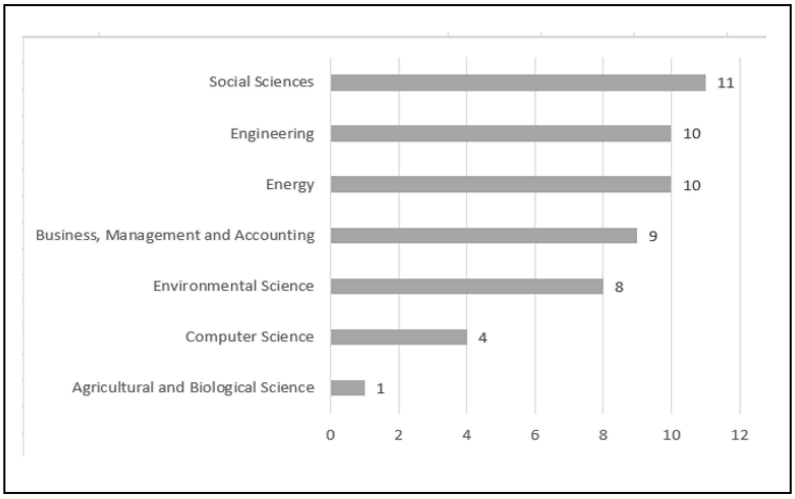

Figure 9. Subject areas of the collected sample journals.

By using SCImago, the researchers conducted a thorough assessment of the categories within the different subject areas referred to in Figure 9. To achieve this goal, a comprehensive analysis of 25 journals from a variety of disciplines was carried out. From the categories provided in Figure 10, the most common areas of focus in smart city journals from the collected sample size were sustainability and the environment and renewable energy. These categories had the highest number of journals, having 10 journals, respectively. The category of geography, planning and development also had a significant presence with seven journals, followed by urban studies with six journals. The categories of management, monitoring, policy, and law and energy engineering and power technology had the same results, with both of them having five journals each. Information systems, computer science applications, environmental sciences (miscellaneous), electrical and electronic engineering, industrial and manufacturing engineering, tourism leisure and hospitality management, and strategy management had the same results of four journals each, respectively. Information systems and management, sociology and political science, and development had three journals. Transportation and civil and structural engineering had the same results of two journals each. The following had one journal each: forestry, nature and landscape conservation, fuel technology, management of technology and innovation, business and international management, and management information systems.

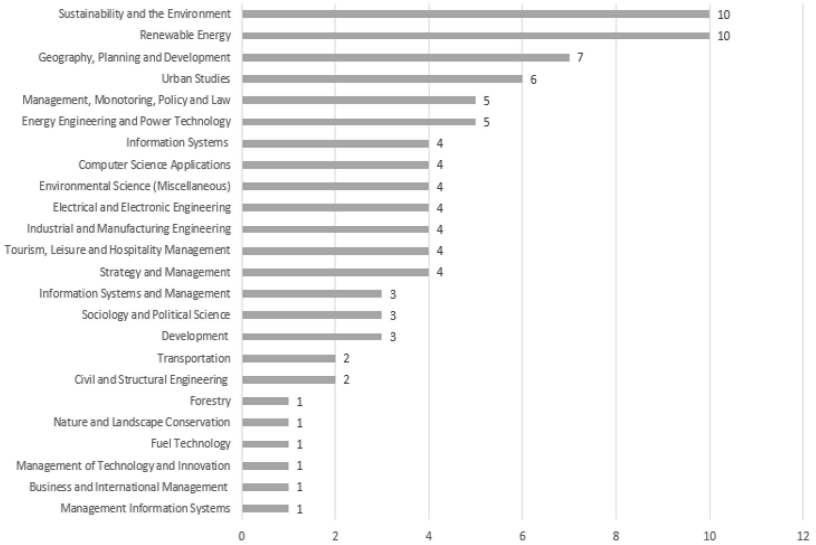

Figure 10. Categories in the collected journals.

3.2. Scoping Analysis Result

3.2.1. Objectives of Smart City Assessment

As depicted in Table 3, the results showed that the highest number of journals identified in the collected sample size were both "Industrial Development" and "Enable IoT in Cities" with eight journals each. This was followed by "Develop Sustainable Living", which had five journals. "Energy Research" and "Political Engagement" had two journals each. SCAs are evaluation tools that measure the progress and effectiveness of a city's efforts towards becoming a smart city. The overall objectives of these assessments are to provide cities with a comprehensive understanding of their progress towards becoming a smart city and to identify areas for improvement. The objectives of these assessments, based on the results, can be broadly categorized into five main categories: "Industrial Development", "Enable IoT in Cities", "Develop Sustainable Living", "Energy Research", and "Political Engagement".

Table 3. Journal publications of the collected sample journals.

Objectives	No. of Journals
Industrial Development	8 [1,11–13,34,35,56,57]
Enable IoT in Cities	8 [4,17,19,39,50,55,58,59]
Develop Sustainable Living	5 [20,21,30,34,60]
Energy Research	2 [23,40]
Political Engagement	2 [58,61]

3.2.2. Methodologies of Smart City Assessment

As shown in Table 4, there were nine journals that were identified as having conceptual models [15,22,24,31,33,36,56,61,62]. Conceptual modeling refers to the process of creating abstract representations of complex concepts, processes, or systems in order to better understand and analyze them; it involves the use of theoretical frameworks, diagrams, and mathematical or logical constructs to clarify the relationships between concepts, identify key components and variables, and create a comprehensive and integrated understanding of the system under study.

Table 4. Journal publications of the collected sample journals.

Methods Used	No. of Journals
Conceptual Modeling	9 [15,22,24,31,33,36,56,61,62]
Cognitive Mapping	7 [16,25,54,63–66]
Hierarchical method	4 [7,27,37,67]
Best Worst Method	3 [31,40,68]
MCDM	2 [28,35]

In this study, there were seven journals that were identified as using cognitive mapping methods [16,25,54,63–66]. Cognitive mapping is a process of creating visual representations of an individual's mental models and mental processes. This method allows for the visualization and examination of an individual's perceptions, beliefs, and understanding of a particular phenomenon, problem, or system. Cognitive mapping typically involves the use of diagrams, flowcharts, or other graphical tools to represent the relationships between different elements of a mental model. The purpose of cognitive mapping is to gain insight into the way people think, process information, and make decisions, as well as to identify areas of confusion, knowledge gaps, or misconceptions.

In this study, there were four journals that employed hierarchical methods [7,27,37,67]. A hierarchical method is a technique used to organize and structure data, information, or

systems into a hierarchical structure, wherein the elements are organized based on their relative importance or level of abstraction. In a hierarchical system, each element is a parent or child of another element, which creates a tree-like structure. This method is used in various fields, including computer science, data organization, and decision making, among others. Three BWM journals were also identified in the study [31,40,68]. BWM is a research technique used to elicit preferences or trade-offs between a set of options or alternatives; it involves presenting participants with a set of items or attributes and asking them to select the best and worst options from the set. This method can be used to measure relative importance or rank/order a set of options, and it has been widely used in various fields, including psychology, marketing, and public policy. Also present in the study were two MCDM methods that were identified in the literature [28,69]. MCDM is a mathematical approach that is used to make complex decisions. It is a process that helps to identify and analyze the most important factors that influence a particular decision and to rank them in order of importance. MCDM is a useful tool for decision making because it provides a systematic approach for analyzing and ranking alternatives.

3.2.3. Frameworks of Smart City Assessment

The purpose of using frameworks in SCAs is to provide a structured and systematic approach for evaluating the progress and effectiveness of smart city initiatives. Frameworks provide a common set of guidelines, best practices, and metrics for assessing the impact of smart city projects on key indicators such as economic growth, environmental sustainability, and social well-being [28,33,60]. As shown in Table 5, after an intensive investigation from the sample size of 25 journal articles, it was found out that the greatest number of frameworks used in the articles was "IoT-Enabled Smart City Framework", which registered eight counts. The second highest number of frameworks identified in the literature collected was the "Smart Cities Index-India" framework with four journal articles, followed by the "Smart Cities Ranking of European Medium-sized Cities" and "Community KPIs for the IoT and Smart Cities" frameworks with three articles each. The "Cities in Motion Index" framework had two journal articles that were identified. Both the "China Smart City Performance" framework and the "Smart City Governments" framework had one journal identified, respectively.

Table 5. Frameworks identified in the MFO model.

Frameworks Used	No. of Journals
ISO 37122:2019	6 [1,5,6,19,24,63]
IoT-Enabled Smart City Frameworks	5 [34,59,60,62,63]
Smart Cities Index-India	4 [27,31,35,57]
Smart Cities Ranking of European Medium-sized Cities	3 [26,56,62]
Community KPIs for the IoT and Smart Cities	3 [37,70,71]
Cities in Motion Index	2 [30,72]
China Smart City Performance	1 [67]
Smart City Governments	1 [36]

3.3. Research Gap Analysis Results

This section discusses the common conclusions in the sampled literature. As shown in Table 6, the results indicate that the proposed conceptual models/frameworks were essential in developing SCAs to understand and evaluate the level of smartness of the cities in developing economies [1,13,20,22,27,32,58,66]. Moreover, it is important that assessment practices are integrated into official urban planning and management mechanisms and strategies to ensure that urban development is sustainable, equitable, and responsive to the needs of the community and environment [1,28,31,62,65]. Furthermore, stakeholder

engagement is a critical aspect of SCAs. By engaging with residents, local businesses, government agencies, and technology providers, city officials can gain valuable insights into the needs and priorities of the community, build support for smart city initiatives, and gather feedback on the effectiveness of these projects.

Table 6. Common conclusions identified.

Common Conclusions	Number of Journals
Proposed conceptual models/frameworks	8 [1,13,20,22,27,32,58,66]
Assessment practices are not yet integrated into official urban planning and management mechanisms and strategies	5 [1,28,31,62,65]
Performance rankings	5 [49,52,72–74]
Assess the performance of smart cities	4 [17,23,57,75]
Engagement with stakeholders	3 [35,76,77]

Table 6 shows the common conclusions that were identified by the researchers. The results show that "Proposed conceptual models/frameworks" have the highest number of conclusions identified in the collected sample size, which was featured in eight journal articles. This was followed by "Assessment practices are not yet integrated into official urban planning and management mechanisms and strategies" and "Performance rankings", which were identified by five journal articles each. Four journals identified the need to assess the performance of smart cities in developing economies. "Engagement with stakeholders" had the least common conclusions identified, only featuring three journal articles. The common conclusions identified in the smart city assessments in developing economies highlight the need for a comprehensive approach to assessing the performance of smart cities. This includes the development of conceptual models and frameworks, the integration of assessment practices into official urban planning and management mechanisms and strategies, the use of performance rankings, the assessment of smart city performance, and engagement with stakeholders.

Over the past few years, there has been a considerable increase in the number of SCA tools that have been developed for assessing the performance of smart city projects and initiatives. Despite the widespread interest in this field, there are significant assessment gaps in smart cities, most of which are in developing economies.

Table 7 shows the common limitations that were identified by the researchers. In this conducted scoping review of the SCA literature, the researchers identified several gaps after a thorough synthesis of the sample:

(i) There was an insufficient number of studies in the scoping review of smart city assessments in developing economies. SCA established itself as a new scientific field in the year 2009; however, despite the growing number of publications, the concept is far from having a clear and established definition [1,18,19]. After an intensive digestion of the 150 journal articles collected, the researchers concluded that there were limited number of studies in SCA in developing economies in the context of scoping reviews. Most of the literature reviews that have been tackled are only structured, systematic, and critical reviews.

(ii) Most journal articles used similar frameworks. Literature reviews on SCAs have shown that there were similar frameworks being used across various studies. These frameworks aim to evaluate the progress and effectiveness of a city's implementation of smart technology [1,17,28,37,52,69].

(iii) Complicated frameworks. Due to the lack of standardization in the assessment frameworks of SCAs, the other studies tended to develop complicated frameworks. However, the increased complexity of these frameworks can present a challenge for city administrators, smart city implementers, city planning officers, technology providers, IS researchers, and rural and urban planners. It can be difficult to under-

stand and effectively utilize these frameworks, leading to confusion and inefficiency in the evaluation process [22,25,27,31,78].

Table 7. Common limitations of research.

Common Limitations	Journal ID
Similar frameworks	10 [12,20,21,37,40,49–51,74,79]
Lack of standardization	8 [1,18,19,24,31,68,72,80]
Limited studies in scoping reviews	4 [6,33,38,81]
Limited sample size	3 [23,57,69]

By synthesizing the findings from existing studies, the authors were able to identify common recommendations. These common themes serve as a guide for future research as depicted in Figure 11, providing a direction and starting point for further investigation. The researchers highlighted the common recommendations that were based on the literature reviews collected. These recommendations include future studies on SCAs in developing economies, especially in the field of scoping reviews, developing a standardization of smart city frameworks, and proposing new frameworks. The researchers also highlighted the importance of measurable and data-driven recommendations in order to make sure that the newly developed frameworks are easy to evaluate and the data are accurate. Smart cities have been widely recognized as a promising solution for addressing the challenges of urbanization in developed economies [1,31,34,82]. Applications of smart city technologies, notably in urban and regional planning, including transport, have indeed shown the vast possibilities of the technologies in ensuring balanced and inclusive green growth. The same is also true for improving the levels of services of urban intermodal logistics network systems.

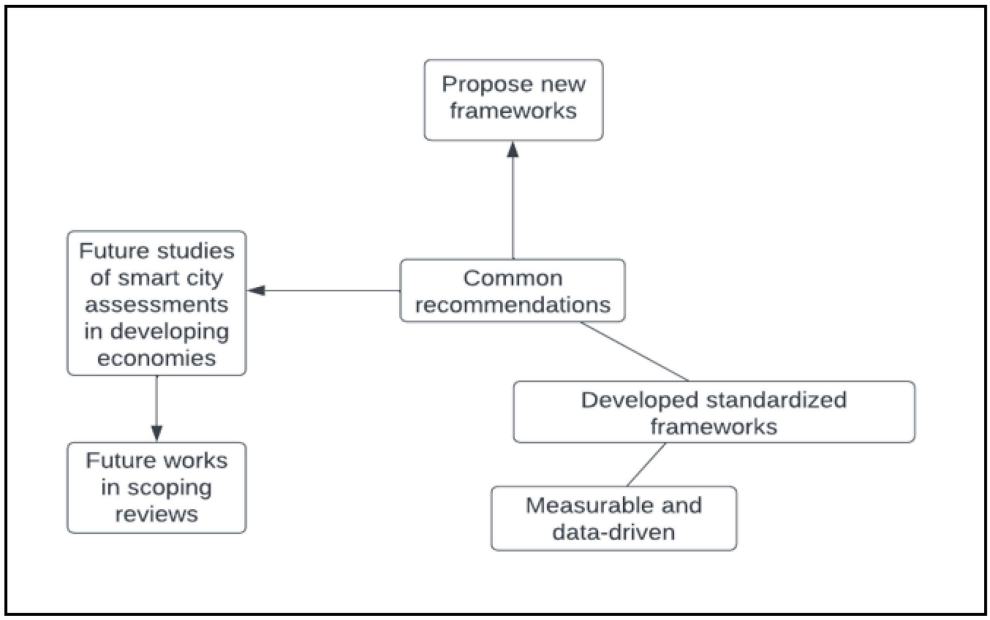

Figure 11. Common recommendations.

4. Conclusions and Recommendations

The findings highlight the significance of social sciences as a vital component and the most common subject area within the 25 journal articles examined. However, it is important to recognize that social sciences is just one facet of the intricate and multifaceted field of smart city assessment (SCA). The assessment categories of sustainability, environment, and renewable energy are also crucial in SCAs as they contribute to creating livable, pros-

perous, and resilient communities. Industrial development is identified as an important objective in SCA, and it supports sustainable economic growth and improves residents' quality of life. Conceptual modeling emerges as the predominant method in SCA, although other methodologies presented in the study offer valuable means of assessing smart city initiatives. The widely adopted ISO 37122:2019 framework is favored for its structured methodology, longitudinal measurement capabilities, and benchmarking opportunities. Regarding research design, qualitative research is frequently employed in SCAs, allowing for the capture of stakeholders' perspectives and experiences. However, its limitations, such as potential biases and difficulties in generalizing the findings, necessitate the combination of qualitative, mixed, and quantitative methods for a comprehensive understanding. SCAs typically encompass a multidisciplinary approach and various subject areas. While alternative frameworks exist, the popularity and adoption of ISO 37122:2019 suggest its current prominence, although cities may opt to use multiple frameworks or tailor them to their specific requirements.

Based on the findings of this scoping review, it is recommended that future research in this field should focus on developing frameworks and methodologies for assessing the feasibility and sustainability of smart city initiatives in developing economies. Additionally, more emphasis should be placed on identifying and addressing the specific challenges and opportunities that arise in different developing country contexts, as has been mentioned elsewhere in this paper. As this year progresses, the dimensions and indicators of smart cities are possible to rise or recompose. The advancement of smart technology, innovation, and initiative in many operational aspects of cities, which has been carried out by many multidisciplinary experts, has significantly contributed to present and future smart city development. Measuring the success of a smart city or the level of smartness based on its dimensions and indicators will be inconvenient, as every city has unique characteristics, development, and challenges. For instance, cities with transportation issues, whether they be complex traffic regulation, congestion, parking spaces, or public transportation, will benefit from the smart transportation/mobility dimension of the smart city. However, for some cities that are dealing with catastrophic issues, there is a chance that some novel and innovative disaster management initiatives will emerge. However, for some cities that are dealing with catastrophic issues, there is an opportunity to develop smart disaster management in the future. Similarly, the Sustainable Development Goals have increased from 3 pillars to 17 goals. The level of sustainability in every city is not identified by its ability to achieve all 17 goals; rather, it is measured by the capacity to prioritize some goals regarding the characteristics of regional challenges and community needs. The ability to prioritize dimensions and indicators based on the characteristics of the region or city and on the characteristics of people's needs is required to develop a sustainable smart city. This is particularly relevant in cities that are situated in developing economies, which have limited investment for smart city development, and research needs to determine the scale of priorities. Even though the development of smart cities has increased the effectiveness and efficiency of many operational aspects of cities, it requires a large upfront investment, especially at the initial stage. Therefore, planning involving community participatory and multidisciplinary experts is urgently essential to be able to determine the priority based on the visions of cities, character uniqueness, and needs of people. Moreover, the success of a smart city development should be measured by the planning process, risk mitigation, and impact of development. We hope that cities in developing economies will not simply serve as consumers of the technology that is needed to develop smart cities that can effectively protect real-time data and information. A potential research avenue in the future could be to examine the benefits and impacts of smart city development projects in various cities worldwide in order to conduct research on the assessment of dimensions and indicators of a smart city. A scoping review of the literature on smart city assessments in developing economies has revealed several challenges and opportunities for the successful implementation of smart city initiatives in these contexts. A total of 25 journal articles were analyzed to provide insights about smart city assessments in

developing economies. Additionally, to enhance the robustness of future studies, it is recommended to employ a systematic review methodology, such as a PRISMA scoping review, to ensure the transparency and consistency of the review process. Furthermore, it is crucial to conduct a comprehensive and thorough literature search, one that includes both primary and secondary sources, to capture the most relevant and up-to-date studies. Overall, this scoping review of smart city assessment aims to provide relevant insights for governments, institutions, and researchers of developing economies as a proper starting point for contextual and localized sustainable smart city initiatives.

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