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Potential Advantages and Disadvantages of Case Study as Methodological Approach in Streetscape Research

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ABSTRACT

In recent decades, streetscape research has advanced quickly in tandem with societal understanding of the impact of urban environmental quality on aesthetic satisfaction and urban dwellers' well-being. The case study method is one of the methodological approaches that has grown in popularity in streetscape research. However, no researchers have yet conducted a comprehensive investigation into the efficacy of case studies when used in streetscape research. Based on the experiences and findings of other researchers using case studies as their research design, this study explores the potential advantages and drawbacks of using case studies in streetscape research. The study uses the systematic literature review method to collect and analyze past relevant streetscape research findings to identify the potential advantages and disadvantages researchers may face when doing their streetscape research, which comprises several stages, namely case selection, development of a theoretical framework, data gathering, data analysis, discussion, and conclusion. The research findings have shown that the case study approach can result in in-depth studies by creating a well-defined research protocol that aligns with the particular environmental situation under examination. However, adopting technology in streetscape research can pose difficulties and limitations for researchers, such as the challenge of accessing advanced technology and mastering the complexity of analytical tools with intricate requirements.

Keywords: potential advantages and disadvantages, case study, methodological approach, systematic literature review, streetscape research

INTRODUCTION

The term "streetscape" describes how various exterior physical components on city streets appear and interact to create a specific identity or character (Hartanti, 2014). These tangible components include the exteriors of buildings, sidewalks, bike lanes, street furniture, lamps, signage, and plant arrangements. Several studies have expanded the notion of a streetscape to include observations of the physical state of roads, associated activities, human emotions, and a sense of community (Ye et al., 2019). The idea of a streetscape as a public area has an immediate impact on perceptual qualities in the form of emotions or sensations that manifest following the physical features of the cityscape (Edirisinghe & Hewawasam, 2020). Even as social infrastructure, a streetscape suggests a connection or bond between human perception and action (Jing, 2022).

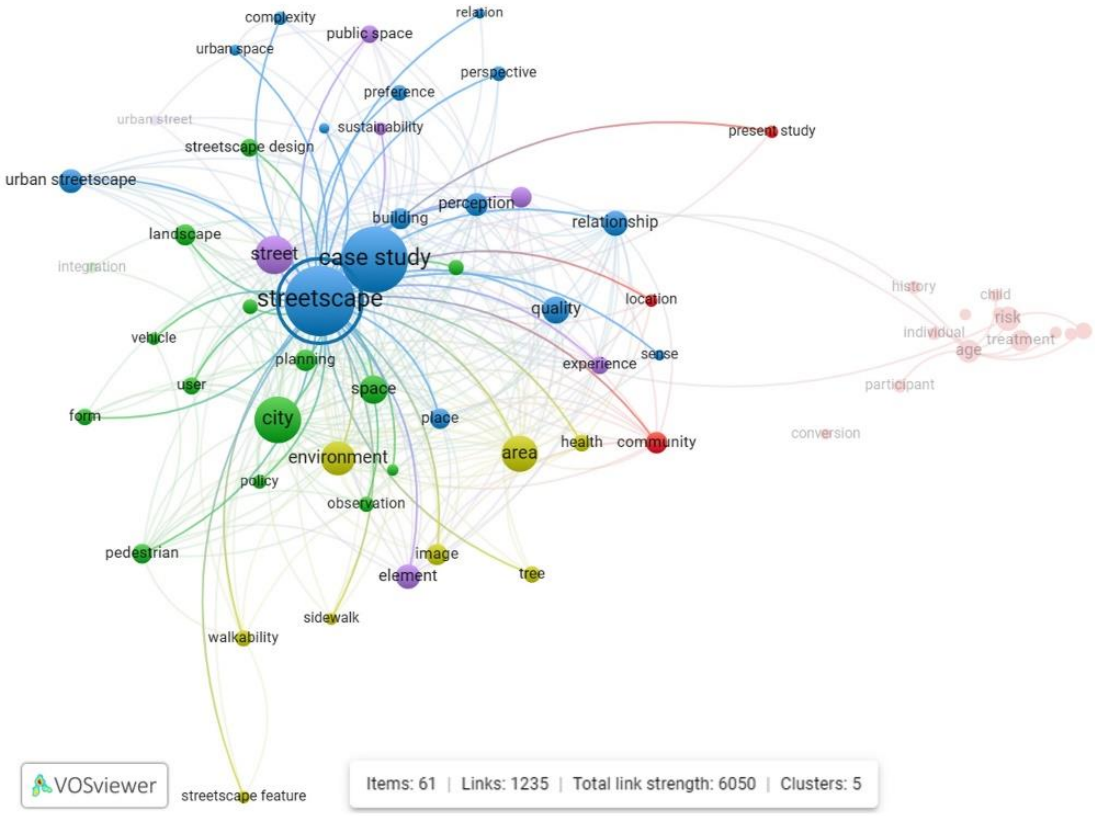
Physical factors are no longer the only indicator of the quality of a road area in a streetscape study. Users' subjective reactions or perceptual associations are equally important. As part of the study of streetscapes, it is important to collect and analyze users' perceptions and satisfaction (Surinta, 2023). These characteristics are essential when studying streetscapes since the interaction between the physical aspects and how people perceive them is the basis for comprehending and interpreting the streetscape. Most of the research conducted on public spaces (streetscapes) uses a combination of both methods to gain a deeper understanding of the relationships between design, use, and preference (Lesan & Gjerde, 2020). Researchers combined quantitative and qualitative research techniques to develop the streetscape study. While qualitative research gauges the users' subjective reactions, quantitative research objectively analyzes the streetscape's quality.

This study uses two instruments to support the process of systematic literature review, namely the scientific article search tool "Publish or Perish" and the research distribution mapping tool "VOSviewer." It started with an inventory of previous articles related to streetscape, using the "Publish or Perish" tool. The search process focused on the keyword "streetscape" and "case study" and was limited to the articles published in the last five-year period (2019–2023). The search yielded 269 relevant articles. These articles were then inputted into VOSviewer to generate the distribution map of previous research topics on streetscape based on keywords extracted from the title and abstract. The processing through VOSviewer resulted in a total of 61 items and their distribution map, as shown in Figure 1.

The mapping result shows that there has been a significant amount of streetscape research using case studies as their primary approach and method. It justified a strong relationship between the streetscape research and the case study approach and method, as the case study offers a flexible way to create or build a set of research methods needed by the researchers who study different aspects of the streetscape. Based on previous studies on streetscapes, this study then tries to identify and summarize the potential advantages and disadvantages of streetscape research using a case study as an approach and method. These research precedents will ultimately provide important references for future researchers on how to effectively utilize a case study approach and method in their coming research project on streetscapes. This research aims to answer two research questions related to streetscape research: First, to what extent are case studies utilized in streetscape research? Second, what are the potential advantages and disadvantages of case studies as a methodological approach in streetscape research?

Figure 1

Distribution Map of 61 Streetscape Research Articles Published in the Last Five Years



Note. VOSviewer is a software tool for constructing and visualizing citation networks of publications (bibliometric networks). From “VOSviewer version 1.6.18” by Leiden University (https://www.vosviewer.com/). Copyright 2024 by Centre for Science and Technology Studies, Leiden University, The Netherlands.

METHODOLOGY

Using the systematic literature review (SLR) method, we evaluate the strengths and weaknesses of the pertinent research studies, perform an overview, and assess their breadth of knowledge (Snyder, 2019). The systematic literature review helps us to develop a knowledge of the scope and depth of the previous research, assess relevant literature, and identify research gaps (Xiao & Waston, 2019). As recommended by Kosztyán et al. (2021), to conduct a structured literature review, the researcher has to determine the focus and scope of the evaluation, develop criteria for literature searches, analyze relevant studies, build a theoretical framework, and report the findings.

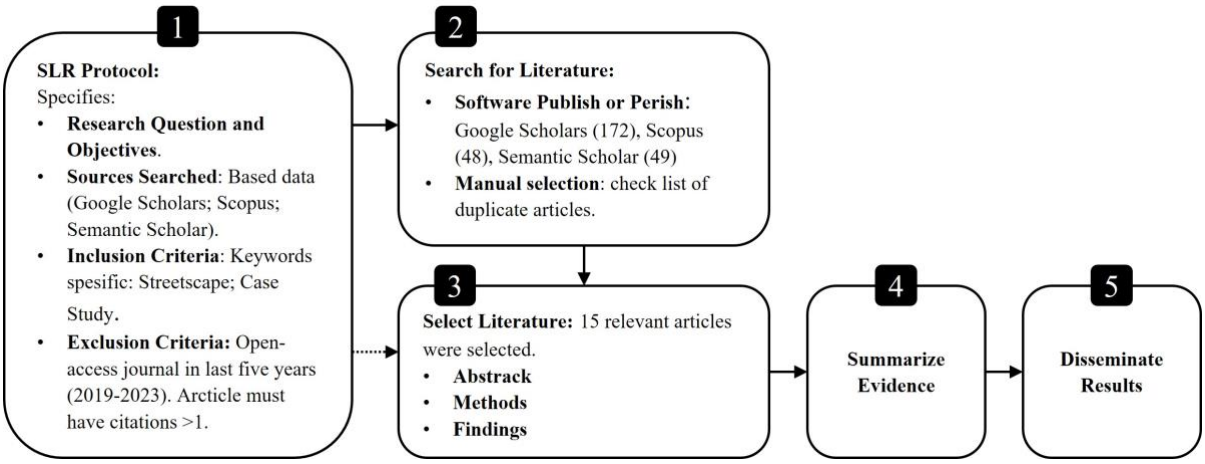
Referring to Boell and Cecez-Kecmanovic (2015); Kosztyán et al. (2021), we determined the research objectives and question and accordingly set a protocol for the systematic literature review (SLR) method, as shown in Figure 2. To ensure that we work with credible data sources, for the literature search, we relied on Google Scholar, Scopus, Semantic Scholar, and Publish or Perish, as shown in Figure 3. Our literature search covered articles published in open-access journals within the last five years (2019–2023), which focused on streetscape studies using a case study approach and method. A total of 269 articles were collected from different sources: 172 from Google Scholar, 48 from Scopus, and 49 from Semantic Scholar. To avoid any duplicate articles, we used 'Publish or Perish' for checking. Finally, 15 articles (Table 1) were selected after examining their relevance in detail. The selection process was carried out manually by briefly skimming each abstract,

method, reasons behind the method selection, and research findings. Each of these sections is described as a result and discussion chapter in this research article.

In the systematic review process, we noted how the researcher selects the case study approach and method, develops a theoretical framework, sets a procedure, and decides on techniques for gathering and analyzing research data. Lastly, we examined the research findings of the study, the potential advantages and disadvantages of the case study as an approach and method, and other relevant comments and notes.

Figure 2

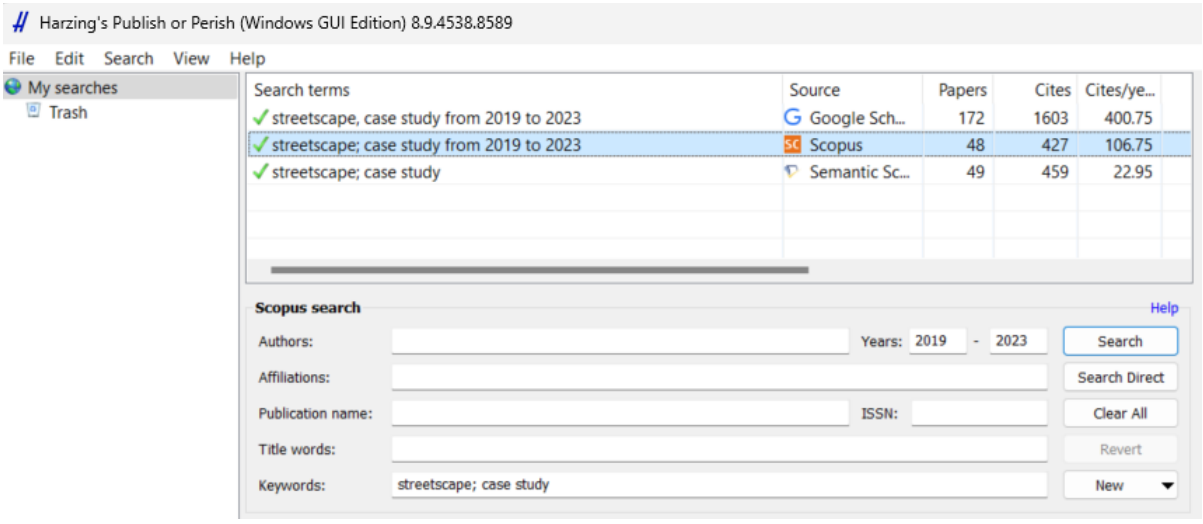
Protocol for the Systematic Literature Review (SLR) Method



Note. Adapted from “Debates And Perspectives On Being 'Systematic' In Literature Reviews In Is” by Boell, S. K., and Cecez-Kecmanovic, D., 2015, *Journal of Information Technology*, *30*(2), p.161–173 (https://doi.org/10.1057/jit.2014.26). Copyright 2015 by Association for Information Technology Trust.

Figure 3

Collecting and Checking for Duplicates of Literature Collected From Different Sources Using Publish or Perish.



Note. From “Publish or Perish” by Harzing.com. (https://harzing.com/resources/publish-or-perish). Copyright 2022 by Anne-Wil Harzing.

RESULTS AND DISCUSSION

The Application of the Case Study Approach in Streetscape Research

In the last five years, the application of case studies in streetscape research has provided its attachment to various settings and contexts. According to Creswell and Poth (2018), by examining topics or problems unique to a case, the case study approach seeks to acquire an in-depth understanding of that situation. Case studies use a variety of sources of information to investigate specific incidents involving people, organizations, processes, initiatives, or the environment (Yin, 2018). From the 15 selected articles, it is evident that a significant amount of research on streetscape originates from the Asian region, particularly China, Japan, and Korea. The research seems to be motivated by several phenomena, including trends in rapid urbanization and the transformation of place identity, the implications of global economic development and infrastructure, social interactions, and environmental issues in public spaces, which are unique within the Asian context.

For example, Lee and Park (2023) address the issue of the new administrative capital in the Republic of Korea, requiring urban planning and the evaluation of urban space guidelines, including street landscape design. This issue encompasses challenges in implementing design guidelines to enhance visual perception and walkability in urban streets, with Sejong City as a case study. Meanwhile, other research in China and Japan has raised various issues. For instance, urban planning in districts with high activity density in Zhengzhou, China, requires street space design that considers the functional and cultural needs to shape the city's image (Tao et al., 2022). Additionally, studies by Qiu et al., (2023); Ma et al., (2021) assess the evaluation of highway policies and urban renewal projects, including their impact on property value growth in Shenzhen and Pudong District, China. Other issues, such as the quality of life and the walking behavior of pedestrians and the elderly, examine the role of public space (streets) in supporting health and comfort of usage in Tokyo, Japan (Nagata et al., 2020). We summarize the 15 selected articles in Table 1 below.

Table 1

Chosen Case Studies in Streetscape Research in the Last Five Years (2019–2023)

Year	No.	Researcher	Case study	Study area	Methods		
					Quantitative	Qualitative	Mixed
2023	1	Lee & Park, 2023	Improved streetscape visual quality and walkability	Sejong City, Republic of Korea	√		
	2	Qiu et al. 2023	The relationship between streetscape perceptions and property values	Shanghai, China			√
	3	Wang et al. 2023	Effects of streetscape characteristics on perceived safety and aesthetic appreciation of pedestrians	Zhongshan Street, China	√		
	4	Surinta, 2022	Measuring Streetscape Qualities in a Car-dependent City.	Three Historical Streets in Bangkok			√

Table 1 (Continued)

Year	No.	Researcher	Case study	Study area	Methods		
					Quantitative	Qualitative	Mixed
2022	5	Xu et al., 2022	The relationship between street-view perception and the sale of property	Shanghai, China			√
	6	Tao et al., 2022	Effect of activity density on streetscape perceptions	Zhengzhou, China			√
	7	Jing, 2022	The role of streetscapes as social infrastructure	Hornsbergs Strand, Stockholm		√	
2021	8	Ma et al., 2021	Human perceptions of streetscapes to better inform urban renewal	Shenzhen, China			√
	9	Qiu et al., 2021	Subjective perception of the streetscape as an urban design strategy	Pudong District, Shanghai			√
2020	10	Edirisinghe & Hewawasam, 2020	Streetscape enclosures' visual relationship to pedestrian movement	Colombo Municipal Council, Sri Lanka			√
	11	Nagata et al., 2020	The relation of streetscape walkability to walking comfort	Bunkyo Ward, Tokyo	√		
	12	Lesan & Gjerde, 2020	Streetscape preferences in a multicultural setting	New Zealand cities			√
2019	13	Ye et al., 2019	Streetscape visual quality	Shanghai, China	√		
	14	Capitanio, 2019	The role of an attractive streetscape in walkability and convenience	Kunitachi, Tokyo	√		
	15	Tang & Long, 2019	Streetscape visual quality	Hutong, Beijing	√		

Note. This table shows case studies of streetscape research in the last five years *(*2019–2023*).*

Studying a streetscape entails carefully examining the street, which has distinct physical features and perceptual reactions. Depending on the study environment, the outcomes of streetscape research with case studies may offer particular or all-inclusive conclusions. For instance, Capitanio (2019) streetscape research examined walkability scenarios based on walking behavior in Kunitachi, Tokyo. This research thoroughly analyzes how appealing streetscapes impact people's walking behavior, even on the longest paths. This discovery concurrently contradicts the generalization made by earlier studies, according to which the most convenient route determines how comfortable walking is.

An additional illustration is the study of Xu et al. (2022), which looked at the issue of streetscape quality in Shanghai, China. They compared objective and subjective evaluations and demonstrated the different outcomes from objective and subjective measurements. As an

illustration, while the objective measure displays a low score, the subjective one shows a high green (greenness) quality score. The participant's varied backgrounds affected how they provided subjective reactions, and this could lead to different outcomes when applied to other study areas.

Some examples mentioned above demonstrate how case studies in streetscape research aim to produce inclusive conclusions (interpretation of cases from the studied region) by researching cases carefully and avoiding the goal of generalizing cases. Another crucial point is that these studies extend our understanding of the cases we investigated rather than reporting or demonstrating their success or failure.

Overview of Case Study Design in Streetscape Research

This article reviews the case study design in streetscape studies based on the case study research design proposed by Yin (2018). It seeks uniformity in implementing case studies and helps determine each research stage's potential advantages and disadvantages. According to Yin, choosing a case is the first step in case study design, during which the researchers must specify their concerns. A theoretical framework will come next, followed by the construction of theories pertinent to the research case. The researcher then chooses the proper techniques and protocols for gathering and analyzing field data and concludes by describing and assessing the research case or subject. Figure 4 shows the flow of the case study research design.

Selecting a Case

The first step a researcher must take is choosing a case, which is a difficult stage. The researcher must be able to connect the subject to prior research or must innovate in a distinct and operationally defined way. Cases can be chosen for a case study by directly observing phenomena in the field, following the evolution of phenomena from prior studies, and emphasizing the research object to critique or further understand the case, or by developing specific methods or protocols based on the research case.

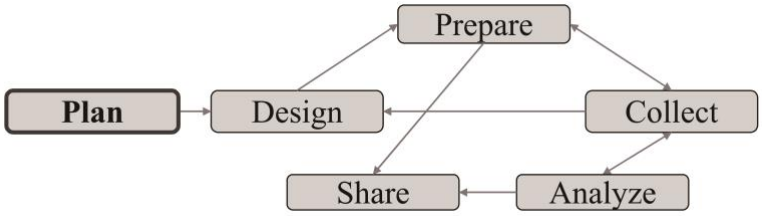
The findings of a survey of earlier streetscape studies reveal the selection criteria. For instance, Tao et al. (2022) chose situations relating to the density of people's activity and their impression of streetscapes in their study "Measuring the Correlation between Human Activity Density and Streetscape Perceptions: An Analysis Based on Baidu Street View Images in Zhengzhou, China." Tao made his decision based on the observation that people have established a connection between the two as active elements in the space of the way. Numerous earlier investigations have also supported this argument. Because of this, the study chooses cases that concentrate on how people perceive streetscapes in densely populated metropolitan locations and investigates how this perception relates to the level of activity that people engage in there.

Another example is the study by Nagata et al. (2020), which used Google Street View pictures for semantic segmentation to examine an objective assessment of streetscape walkability related to leisurely walking. This study suggests a fresh approach or practical tutorial for quantitative streetscape research. The researchers argue that the level of a friendly cityscape, which promotes walking activities as assessed quantitatively, is still insufficient, so this study suggests an automated model (semantic segmentation) to quantify the level of walkability in a streetscape more precisely. This study demonstrates that one can concentrate on creating research models that support beneficial research activities while choosing streetscape research scenarios.

Based on the illustrations mentioned above, researchers must exercise caution when selecting the cases that will be the subject of their study. Researchers have difficulties and barriers due to this situation, particularly inexperienced ones. A lack of sensitivity in observing events or insufficient knowledge of phenomena can be among these barriers. If the problem is valid, researchers can investigate it by looking at the study area to build cases and create specialized research protocols. We illustrate the flow of choosing a case in streetscape research by applying a case study approach, as shown in Figure 5.

Figure 4

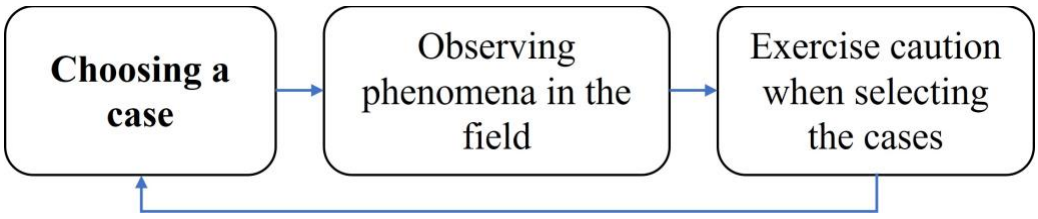
The Flow of the Case Study Research Design



Note. From *Case Study Research and Applications: Design and* Methods (p. 31), by Yin, R.K., 2018, SAGE Publications, Inc. Copyright 2018 by SAGE Publications, Inc.

Figure 5

The Flow of Choosing a Case in Streetscape Research by Applying a Case Study Approach



Building a theoretical framework

Building a theoretical research framework allows case study researchers to compare their findings to earlier studies. This framework was developed by building and assessing ideas pertinent to research cases rather than as a collection of theories or literary works. Even though case study research is inclusive, a theoretical framework is still necessary to serve as a roadmap and aid researchers in understanding the subject matter—not to test the theory in the study area.

Researchers establish a theoretical framework to map knowledge and demonstrate how the streetscape case under study develops. They always tie the questions or goals of the research to constructed hypotheses. For instance, Edirisinghe and Hewawasam (2020) study, "An Investigation of the Relationship of Streetscape Visual Enclosure and the Pedestrian Movement in Selected Case Studies in Colombo," seeks to identify the specific elements of the streetscape in Colombo, Sri Lanka, that influence pedestrian behavior and a feeling of enclosure. The notion of walkability, the physical architecture of the streetscape, and individual responses to walkability are some of the keywords that the theoretical framework gathers from the study questions.

"Measuring the Visual Quality of Street Space and its Temporal Variation: Methodology and its Application in the Hutong Area of Beijing" is the title of another Tang and Long (2019) study that seeks to achieve just that. Tang and Long created a theoretical framework for the aesthetic value of streetscapes. He sketched out the essential techniques for assessing the visual quality of streetscapes in the research area in recent years. In a study, "Current Design Guidelines' Streetscape Improvement for Visual Perception and Walkability: A Case Study of Sejong City, Republic of Korea," published in Lee and Park (2023), the authors conducted a thorough review of prior research on related streetscape features, including walkability, which is closely associated with various facets of visual appeal. They also looked at city streetscape design regulations to get a comprehensive

image. Like Tang and Long (2019); Lee and Park (2023) gathered a variety of theories from pertinent articles to ensure the objectivity and efficiency of their selection of study indicators.

Developing a theoretical framework for streetscape research is essential since it aids with topic selection through methodical literature or theory searches. In other words, the theoretical framework should be relevant to the study's questions. In addition to helping researchers see patterns and trends in their research topics, theoretical frameworks can help researchers create their knowledge frameworks. However, challenges include time and energy consumption intensity, including the effort needed to gather tens to hundreds of research papers and the energy required to review and pick a few research articles. Moreover, not all study findings and policy documents are openly accessible as data sources. We illustrate the flow of building a theoretical framework in streetscape research by applying a case study approach, as shown in Figure 6.

Collecting the data

The researcher must devise a plan for gathering the necessary data after selecting cases and creating a theoretical framework. The plan takes the shape of a thorough data collection procedure. Data-gathering techniques in streetscape studies often involve field observations, measurements, documentation, questionnaires, and interviews. Each approach can be chosen based on the requirements and data collection methods, such as field documentation when the researcher requires information about events in the research area.

Before collecting data, researchers determine the boundaries or scope of the research area, such as the location of street segments, the observation points, and the delineation. There are several ways to determine the boundaries of the research area carried out by previous researchers. As by Qiu et al. (2021); Tao et al. (2022); Nagata et al. (2020), which determines the number and distribution of sample points on the streetscape. They made these points to simplify collecting street-view photos. Researchers can also determine the length of street segments and the distribution of streetscape features. The length of a street segment depends on identifying the character and type of street, which is closely related to road users' spatial and sequential experience. Meanwhile, the observation area for streetscape research can cover all streets in a district or only certain streets in an area considered representative of the study case. These aspects are critical in determining the case study's scope and developing research protocol data collection parameters.

The previous sub-chapter discussed how using case studies in streetscape research could give researchers great flexibility when creating or developing research protocols tailored to the study area's circumstances. In recent studies by Edirisinghe and Hewawasam (2020); Qiu et al. (2021); Ye et al. (2019); Ma et al. (2021); Xu et al. (2022); Tao et al. (2022); Lee and Park (2023); Qiu et al., (2023), the method of gathering data on street views using digital imaging first surfaced. To collect field data efficiently and successfully, the researchers use developments in digital imaging technology, such as Google Street-View Image (GSVI) or Baidu Street-View Image (BSVI) (Figure 7).

Figure 6

The Flow of Building a Theoretical Framework in Streetscape Research by Applying a Case Study Approach

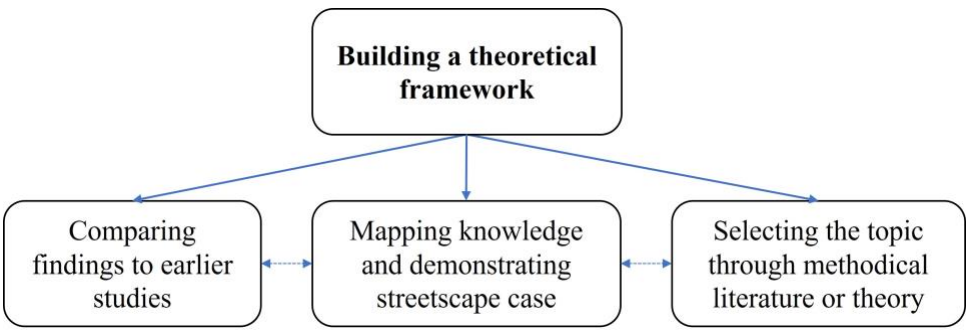


Figure 7

The Data Collection Technique for Street Views Using Baidu Street-View Image (BSVI)

(a) 300 SVI sample points (b) A sample SVI (c) Camera settings

Note. (a) 300 SVI sample points; (b) a sample SVI; (c) camera settings. From "*Subjective or objective measures of street environment, which are more effective in explaining housing prices?*", by Qiu, W., et al, 2021, *Journal of Geo-Information, 221*, 104358 (https://doi.org/10.1016/j.landurbplan.2022.104358). Copyright 2022 by Elsevier B.V.

This approach is increasingly popular for gathering data on road space views since it simplifies field data collection for academics rather than direct documentation. The primary advantages of GSVI images are their low cost, simplicity of usage, and time savings (Rzotkiewicza et al., 2018). Researchers can consider this method in a sizable study area covering a region or city. For instance, Tao's study gathered 21,054 pictures of streetscapes in China's 7,511 km2 Zhengzhou region. Another example is the research by Xu, which used digital Baidu Street View photos to collect 25,276 street space images over a 6,340 km2 area in Shanghai, China. This digital survey technique is also quite successful when surveying roads with heavy traffic. To get multiple pictures of street views, researchers no longer need to manually document in the middle of the road (street centerline observation).

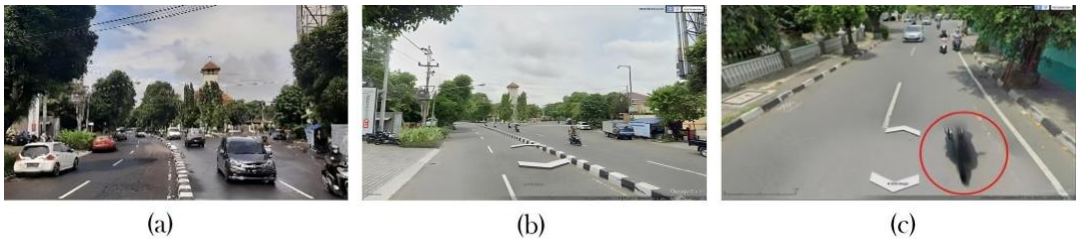
GSVI or BSVI were the methods employed in the research to obtain street view data. However, there are still some challenges when using the GSVI or BSV photos as data for qualitative or quantitative analysis due to flaws or disparities in the images. Google Street View is frequently used by urban space scholars, according to Biljecki and Ito (2021). However, GSVI is not the only data source used; researchers can combine other techniques to acquire more information.

GSVI has the following flaws: First, because it is not in the high viewpoint of the human eye, the resulting image does not precisely represent the human seeing angle (higher). Second, the stretched appearance of the GSVI/BSVI picture deviates from the actual visual and spatial situations. This situation calls into question Li and Ratti's (2019) claim that GSVI can faithfully represent streetscapes as they seem to individuals. The ultimate issue is the poor quality of the GSVI images, where many details are fuzzy or obscure (Figure 8). According to Li et al. (2020), this strategy purposely omits direct observation, which could impair the precision of perceptual judgment. As a result, field data verification by researchers is still necessary. Wang et al. (2023) suggest that measuring the effects of streetscape characteristics should be conducted on-site to measure traffic throughout the day.

Interviews and survey questions are two other methods of gathering data. These methods investigate how well-designed the cityscape is in drivers' eyes. Several streetscape studies have utilized online surveys to collect and examine opinions about the subjective quality of the streetscape (Figure 9). Harvey and Aultman-Hall (2016) claim that information technology, including online surveys, pictures of street scenes, and social media, may aid in gathering samples of the spatial satisfaction of road areas. The street space assessments of respondents were collected using an online survey approach by Talen et al. (2022); Xu et al. (2022); Loodin and Thufvesson (2022), who displayed various images (photos) of road space for respondents to evaluate. This method aids in visualizing the questionnaire questions, enabling responders to assess the streetscape quality quickly and adequately (Figure 9). Researchers can more easily integrate data by combining places on the digital roadmap with even the photographs included in the questionnaire.

Figure 8

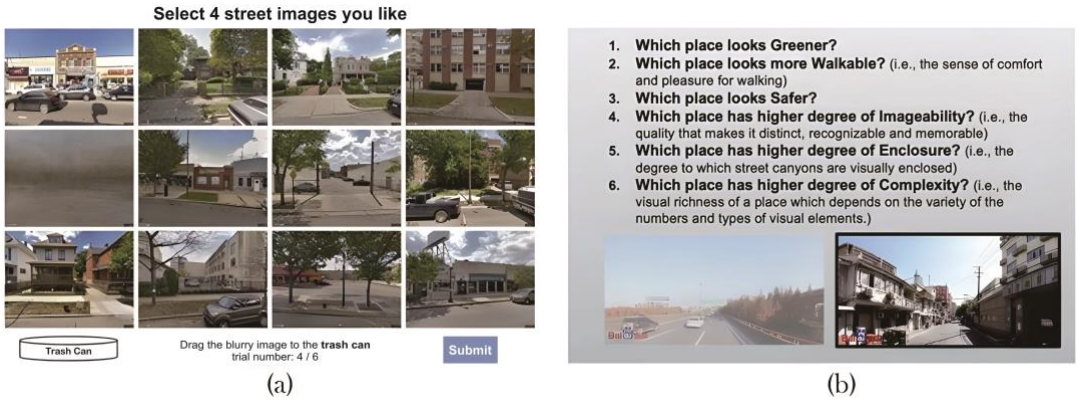
Examples of Flaws in GSV Images



Note. (a) existing photo; (b) GSVI distortion; (c) obfuscated object. From “Google Street View Images” by *Google Earth*, 2023. Copyright 2023 by Google Earth, Data SRTM/NASA, DigitalGlobe.

Figure 9

Online Questionnaire on Streetscape Research

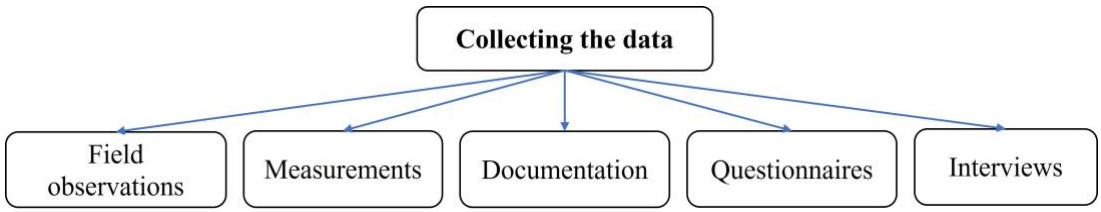


(a) (b)

Note. (a) the survey questions given to participants using the MTurk survey. From “Street design preference: an on-line survey” by Talen et al., 2022, *Journal of Urban Design*, *28*(1), p.1–24 (https://doi.org/10.1080/13574809.2022.2066512). Copyright 2022 by Informa UK Limited, Taylor & Francis Group. (b) an online survey platform to collect subjective streetscape perception. From “Associations between Street-View Perceptions and Housing Prices: Subjective vs. Objective Measures Using Computer Vision and Machine Learning Techniques” by Xu et al., 2022, *Remote Sensing, 14*(4), p.891 (https://doi.org/10.3390/rs14040891) Copyright 2022 by MDPI, Basel, Switzerland.

Figure 10

The Flow of Collecting the Data in Streetscape Research by Applying a Case Study Approach



For now, streetscape data collection techniques continue to provide researchers with opportunities to create more representative methodologies and equipment. Due to this issue, future streetscape studies could benefit from various approaches and procedures for gathering street view data. We illustrate the flow of collecting the data in streetscape research by applying a case study approach, as shown in Figure 10.

Analyzing the Case

Examining research cases entails exploring all the material gathered to establish the case's integrity. Creswell and Poth (2018) contend that the researcher must analyze all data, including the particulars of each case. In-depth comprehension of the issue is the goal of this idea. Different data analysis techniques, such as quantitative, qualitative, or mixed data analysis, have been utilized in previous streetscape studies.

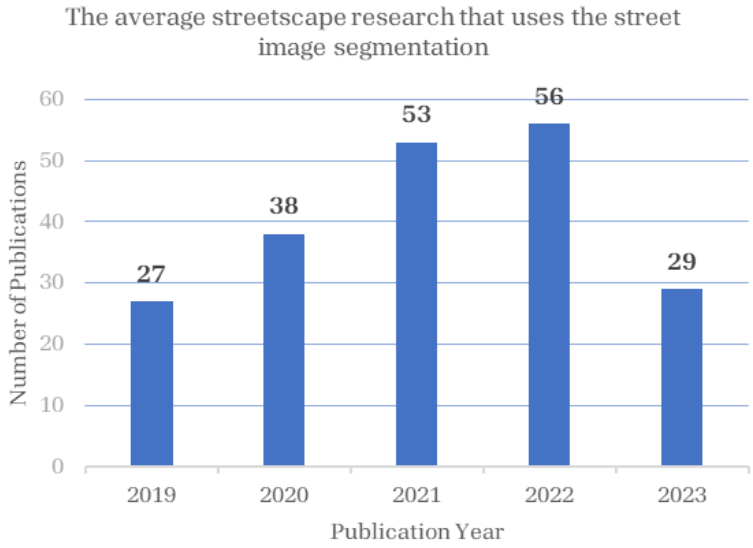
The emergence of quantitative data analysis techniques has shown their applicability to analysis software in streetscape studies. In the last five years, semantic segmentation has dominated the quantitative research of streetscapes. Based on the number of articles that employed this approach to study streetscapes, we located 27 articles in 2019, 38 in 2020, 53 in 2021, 56 in 2022, and 29 in 2023 (Figure 11).

For the first time in the field of health sciences, the researcher employs the semantic segmentation technique to identify and interpret the characteristics of cancer using patient image extraction. In the streetscape analysis stage, semantic segmentation entails sequestering the streetscape elements from the picture data or photographs of the street environment. These elements include moving objects, plants, structures, sidewalks, street furniture, roadways, sky views, and walkways.

Through this method, researchers can obtain precise statistical results relating to the prevalence of streetscape objects (features) that influence streetscape quality (Sehar & Naseem, 2022). According to Li et al. (2020), in their study "Semantic Segmentation of Urban Street Scene: Based on Convolutional Neural Networks," technology advancements (artificial intelligence) have made it possible to analyze data by anticipating the features of urban street items (components) (Figure 12). The shortcomings of earlier quantitative analysis techniques, such as the use of GIS, which has issues measuring road micro-data, are supplemented by this technique (Harvey & Aultman-Hall, 2016). The difficulty of interpreting the data from the presented findings is a challenge to the semantic segmentation analysis approach. Therefore, researchers must conduct it carefully. However, this method provides accuracy in the data outputs (Qiu et al., 2021).

Figure 11

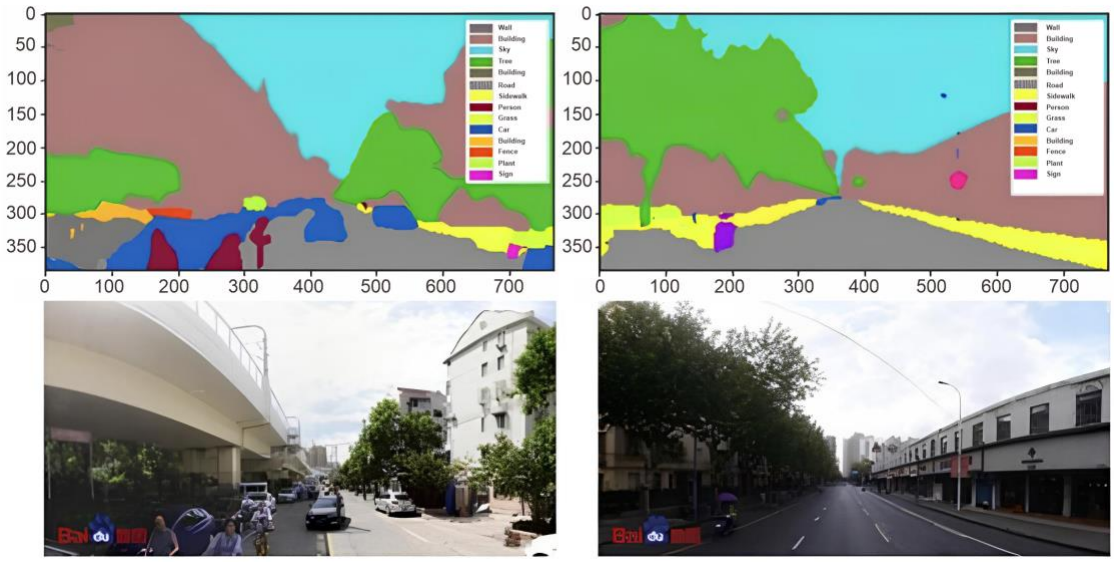
The Average Streetscape Research That Uses Street Image Segmentation



Note. The researcher did the literature search in June 2023. It generated 203 results using the keywords *streetscape research* and *picture segmentation techniques* based on *Publish or Perish* data sources and the categorization of studies published on Google Scholar and Scopus.

Figure 12

Process of Extracting Streetscape Features via Semantic Segmentation



Note. Physical streetscape feature classification. From “Subjective or objective measures of street environment, which are more effective in explaining housing prices?”, by Qiu, W., et al, 2021, *Journal of Geo-Information*, *221*, 104358 (https://doi.org/10.1016/j.landurbplan.2022.104358). Copyright 2022 by Elsevier B.V.

In contrast, the researcher used qualitative analytic techniques such as questionnaires and interviews to evaluate respondents' perceptual evaluation of the quality of the street area. The judgment of the visual quality of the road space can range significantly across different groups of respondents, which presents a hurdle during the qualitative analysis stage. The researchers try to resolve this issue by comparing groups (Tang & Long, 2019). For instance, Talen et al. (2022) compared how professionals (urban designers and architects) and non-experts (from the community) perceived the quality of the streetscape. Each respondent's various backgrounds and understandings can also offer an extra appraisal. However, these findings can help designers determine what to consider when creating new street space designs.

In the mixed methods technique, the researcher compares or organizes the data (quantitative-qualitative). In a comparative analysis, the researcher analyzes both quantitative and qualitative findings. Consecutively, the researcher examines the data one by one. Performing the quantitative and qualitative steps before or after one another is possible. For instance, Qiu et al. (2021); Xu et al. (2022); Qiu et al. (2023) conducted research using a mixed comparative analysis approach to compare quantitative and qualitative data findings to determine the degree of convergence and divergence of each data set. This approach gives researchers a thorough understanding of examining and interpreting the results of streetscape case studies. To ensure that the data gathered is reliable and stable, the researcher should carefully analyze the design of mixed-model research methodologies (Xu et al., 2022).

According to data analysis techniques used in streetscape research, researchers must select an appropriate analysis strategy to prevent skewed research outcomes. Additionally, researchers can perform rigorous analysis and interpretation of mixed, qualitative, and quantitative results. Data analysis techniques that are constantly changing, like computational analysis techniques (computer learning), present a significant challenge for streetscape researchers. These techniques call for researchers to be tech-savvy and collaborate across disciplines, like computer scientists, to apply different perspectives from various fields. We illustrate the flow of case analysis in streetscape research by applying a case study approach, as shown in Figure 13.

To sum up, the 15 selected articles have sufficiently demonstrated the upshots of using the case study method approach in streetscape research. The impact extends to the entire research process, including selecting study cases, developing theoretical frameworks, and collecting and analyzing data. Each of these processes presents potential advantages and disadvantages that streetscape researchers must consider. This evidence is valuable for expanding the perspective of streetscape research in the future. A summary of potential advantages and disadvantages according to each researcher is shown in Table 2.

Figure 13

Flow of Case Analysis in Streetscape Research by Applying a Case Study Approach

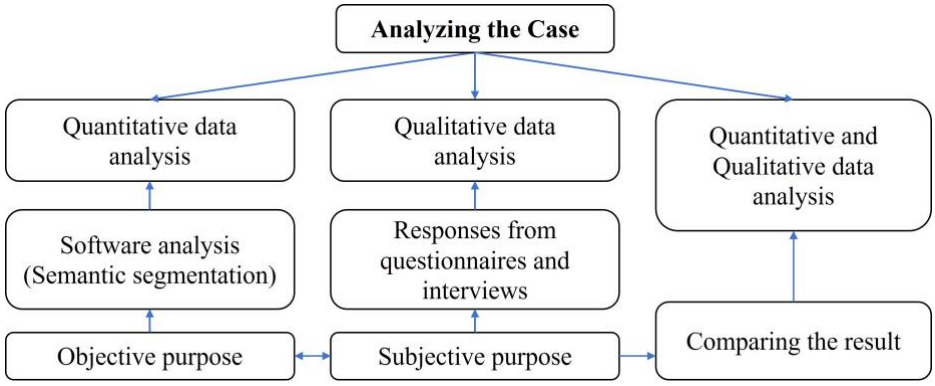


Table 2

Potential Advantages and Disadvantages of Implementing the Case Study Approach in Streetscape Research

Research Design Flow	Potential Advantages	Disadvantages
Selecting a case	• Provide flexibility for researchers to explore cases. (Capitanio, 2019; Edirisinghe & Hewawasam, 2020; Jing, 2022; Qiu et al., 2021). • Develop knowledge of cases or develop research methods or protocols (Nagata et al., 2020; Xu et al., 2022).	• Lack of sensitivity in seeing phenomena, especially for novice researchers. • Complete knowledge of case phenomena and developments is a requisite.
Building a Theoretical Framework	• Support researchers in seeing maps and trends in research topics (Nagata et al., 2020; Xu et al., 2022). • Help researchers dialogue about several theories that support research questions (Lee & Park, 2023).	• It takes time and energy for researchers to conduct searches on previous studies. • Access to research results and data sources is limited.

Table 2 (Continued)

Research Design Flow	Potential Advantages	Disadvantages
Collecting the data	• Utilization of technology can provide convenience and effectiveness in field data collection (Qiu et al., 2021; Tao et al., 2022; Wang et al., 2023). • Open the opportunities for streetscape researchers to develop more representative data collection techniques and tools (Loodin & Thufvesson, 2022; Talen et al., 2022; Tang & Long, 2019).	• Deficiencies in data collection methods using digital images (e.g., GSVI/BSVI) can bias the results of qualitative or quantitative analysis. • Researchers are still required to confirm the field, requiring additional efforts.
Analyzing the case	• The divergence of quantitative and qualitative results can enrich the evaluation of streetscape quality (Lesan & Gjerde, 2020, p. 2020; Qiu et al., 2023; Surinta, 2023; Xu et al., 2022). • Develop analytical skills by leveraging technological resources (Ye et al., 2019). • Collaboration across disciplines.	• Requires the ability to analyze and interpret data accurately and carefully. • It is challenging to perform a quantitative analysis of results using the semantic segmentation analysis method. • Requires researchers to know the development of data analysis methods.

Note. This table demonstrates the potential advantages and disadvantages of implementing the case study approach in streetscape research.

DISCUSSION

Discussion Potential Advantages and Disadvantages of Implementing Case Study Approach in Streetscape Research

This article has demonstrated that the application of a case study approach in streetscape research over the last five years (2019–2023) has shown a significant increase. The selection of a case study is justified due to its high flexibility, allowing researchers to comprehensively understand the scope of the study, contextualize research instruments, and ensure research quality. Additionally, this article maps out potential advantages and disadvantages that may arise during the streetscape research process using a case study approach. It aims to enable researchers to develop strategies and anticipate necessary considerations during their research.

The results of systematic literature reviews (SLR) on previous studies have revealed the potential advantages and disadvantages of employing case studies in streetscape research. Some of these likely benefits aid researchers in creating comprehensive case study research designs that align with contextual and research needs. A profound understanding of case study phenomena in streetscape research requires intensive direct field observations, as advocated by Tao et al. (2022). This phase offers opportunities for researchers to propose and formulate new instrument models that align with

research needs. Additionally, streetscape research using the case study approach allows researchers to study phenomena through various data sources, such as literature, field observations, and policy documents (Lee & Park, 2023), urban renewal documented data (He et al., 2023), including evaluations of street spatial planning projects (Ma et al., 2021). These diverse data sources contribute to a comprehensive understanding of streetscape phenomena.

However, to maintain research quality, limitations must be identified and mitigated by researchers. For example, using technology in streetscape research, such as Google Street View Imagery (GSVI), has offered practicality in quickly digitally collecting street scene data. Nevertheless, some researchers suggest the need for on-site confirmation to avoid data biases such as distortions and image quality weaknesses introduced by GSVI. Another discussion involves the high time consumption when manually collecting data, such as collecting tens of thousands of street scene image samples by Qiu et al. (2021); Xu et al. (2022); He et al. (2023), across districts in China. They justify the use of GSVI and BSVI, arguing that these images closely resemble pedestrians' perceptions, making them suitable for measuring streetscape quality objectively and subjectively. This offer ultimately requires the researcher's decision to choose and limit the extent to which the technology is used in their research in order to maintain the quality of the research.

Another challenge is the use of technology as a tool for data processing and data analysis, such as popular image segmentation models in the last five years. The full integration of technology in the streetscape image data processing with segmentation models has sparked debates. Li et al. (2023) mentions that researchers using image segmentation models need to compare each data with different computational models because machine learning operates predictively and can yield different results with different coding mechanisms. Other researchers, such as Xu, (2019); Liu (2023), also mention that the possibility of interpretation errors in machine learning results can decrease accuracy in data interpretation, necessitating a much more complex computer analysis framework. However, data processing with image segmentation models remains a quantitative analysis method used to date. Therefore, our research suggests that streetscape researchers should possess strong computational abilities for data analysis or collaborate across disciplines, such as in the IT field, to support the data processing and analysis process for greater accuracy.

CONCLUSION

The exposition of the previous research results on streetscape in this article has revealed that the success of applying the case study approach in streetscape research depends on at least three aspects: first, the suitability of the case study as a research approach for addressing the specific contextual issues at hand; second, the researcher's ability to develop research designs and protocols and utilize cutting-edge technology as research instruments; third, the researcher's ability to maintain the validity of each stage of the research process to prevent bias or errors in the final research outcomes. This article provides insights and ideas to researchers intending to employ the case study approach to optimize potential advantages and mitigate potential disadvantages at each research stage.

Previous research methods on streetscape reported in this article have also shown how technology developments have substantially impacted the sophistication and accuracy of research methodologies and the scholarly rigor and propriety of research findings. On the one hand, this phenomenon is incredibly encouraging. On the other hand, concerns arise about the potential for creating a substantial social divide among researchers, as only those with strong academic credentials and ample money will have access to pricey technological developments.

Despite the successful description of the potential advantages and disadvantages of implementing a case study approach in streetscape research, there are some limitations to this study. The literature collection process using tools like 'publish or perish' has shown a dependency on the available literature, potentially limiting the comprehensiveness of literature diversity. In this context, the research articles successfully gathered are also limited to

open-access sources, leading to the exclusion of inaccessible articles and restricting the diversity of literature sources in this study. Furthermore, we propose that future research investigates the potential advantages and disadvantages of applying the case study approach in streetscape research in more detail, particularly regarding the implications of each potential aspect on research outcomes.

For future studies, it is recommended that the benefits and drawbacks of the case study approach in streetscape research be explored more thoroughly. Additionally, researchers could compare their findings with the application of other research approaches besides case studies, providing a broader understanding of various approaches in streetscape research.

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