# Assessment of Current Trends and Gaps in Infrastructure Justice Research

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## BACKGROUND

Injustices have historically been embedded within the foundations that support various systems and practices in the United States.[3,4] For example, structural racism, defined here as the conditions (e.g., laws and official policies) that result in unfair treatment due to race, plays a role in how critical infrastructure systems are planned and operated.[5,6] One of the most prominent examples of structural racism's impact on infrastructure can be examined by exploring how the construction of the interstate highway system placed specific boundaries around and within predominately Black communities, causing displacement and further segregation.[7] Decades after the highway's implementation, ramifications are still experienced across the country (e.g., increased air pollution in neighborhoods surrounding highways).[8] Similar examples of structural racism and its continuous impacts on Black, Indigenous, and other people of color (BIPOC) communities are found in other infrastructure systems such as water, wastewater, and energy.[9–11]

Several emerging areas of study and associated policies have been developed in the engineering realm to remedy the faults of structural racism in the built environment. One of the more prominent areas that emphasize infrastructure is environmental justice, which refers to the fair treatment of individuals regardless of their identifiers (e.g., race, national origin, income) concerning enforcing and developing environmental policies and regulations. The term intertwines environmentalism and social justice by investigating hazardous waste, resource extraction, and other harmful land use practices in BIPOC communities.[12] Studies examining environmental injustice have spurred the creation of various policies and regulatory bodies, including the National Environmental Justice Advisory Council and the White House Environmental Justice Advisory Council.[13] In summary, environmental justice broadly focuses on the environmental ramifications of injustice associated with critical infrastructure systems (e.g., air pollution, groundwater contamination, occupational health), mainly from the perspectives of water, food, transportation, energy, and chemical sectors.[14,15] While this vital work is necessary to remedy injustice, this focus is not comprehensive of other injustices involving critical infrastructure (e.g., unequal infrastructure access and service quality and performance.) Examining these different areas would be vital in engineering equity in infrastructure development and supporting justice in populations' well-being beyond environmental and population health.

## RESEARCH QUESTION

In this proposed project, we will conduct a systematic literature review to explore current trends in the existing engineering knowledge of infrastructure justice. In this work, we use the United States Cybersecurity and Infrastructure Agency's definition of infrastructure as one of the 16 manufactured systems that sustain critical services (e.g., piped drinking water access and transportation).[1,2] By examining infrastructure and social justice-related literature, we aim to discover gaps within the body of knowledge to promote future research avenues.

## RESEARCH APPROACH

We will focus on scholarly literature to conduct this systematic review of the body of knowledge involving infrastructure justice. As this work aims to explore the current trends in engineering research related to infrastructure justice, we will conduct our search using two databases: Web of Science and Engineering Village. These databases were chosen given their breadth of engineering and technical information spanning a variety of journals.[16–18]

This systematic review will be completed following the PRISMA framework.[19] We will first use a combination of the following keywords: "infrastructure" and either "equity," "justice," and "injustice." These keywords would distinguish the articles that capture the contemporary language in current justice literature. We will then use a combination of the following keywords that reference some of the social identifiers that injustices have historically been linked with: "infrastructure" and either "race" or "racism," "gender," "socioeconomic" or "labor," and "disability."[20] These additional keywords would reflect the literature that may similarly tie to injustices without using contemporary language. We will use Boolean operators to identify focused searches in the titles and abstracts of the resulting scholarly articles. To narrow the scope of the search results, our analysis will focus on academic literature from peer-reviewed journals published from 2000 and after to capture the current trends in engineering research examining justice and infrastructure. Although using the selected keywords and our methods may not entirely encompass all literature related to infrastructure justice, we believe this work still provides a critical first look into the status of current infrastructure literature.

### Data Analysis

The scholarly articles that result from the search will be analyzed in the NVivo qualitative coding software. The articles will be categorized initially with deductive methods before inductively developing subcategories for infrastructure type (i.e., the 16 critical infrastructure sectors) and research method (i.e., qualitative, quantitative, mixed-methods analyses.) We will do initial categorizations of what type of social identifier or injustice is being explored (e.g., race-focused injustice, gender-focused injustice). Lastly, we will use an inductive approach to code to identify what aspect of infrastructure is being investigated (e.g., planning and management).[21,22]

## KEY FINDINGS

After applying the search constraints and removing duplicates between the two databases, we anticipate over 100 articles that involve some element of infrastructure justice. Additionally, we expect most of the literature to center on the historical impacts of structural racism on the transportation and water and wastewater systems sector. We predict there will be considerable gaps within the literature for other infrastructure sectors that can be supplemented by research focused on planning and management and operations and maintenance of infrastructure technical systems.

## IMPLICATIONS

Following the signing of the Bipartisan Infrastructure Bill (BIL) in 2021, policymakers have targeted several critical infrastructure sectors for additional support and funding.[23] Given the BIL's emphasis on equity, this heightened focus provides a novel opportunity for researchers to contribute to infrastructure justice literature as a means to support policy. By systematically reviewing the current body of knowledge, we can identify the current trends in infrastructure justice literature from an engineering perspective. Furthermore, this research can pinpoint additional infrastructure sectors or aspects of critical infrastructure systems that could benefit from emphasized support of equitable infrastructure development.

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