

An Introduction to Applications of Access

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From its source Latin *accedere*, the assimilated form of *ad* and *cedere*, access means “to approach.” It conveys the “habit or power of getting into the presence of someone or something.” The contemporary meaning differs, but has not strayed too far from the origin. Access means freedom, possession rights, and other means of benefiting from resources. It offers neither what people *will* do, nor what people *want to* do, rather what people *could* do. Transport access is a product of mobility and place and immediately relates to the transport network and the relative location of human activities and housing. However, there is still confusion among engineers and planners in differentiating access from mobility. Mobility indicates one’s ability to move easily. It encompasses both speed and travel time by defining how far one can travel in a given time. Access, however, is concerned with the opportunities that can be reached in a given time.

The notion of access as a central force in transport and urban development goes back at least a century. One of the early thinkers of access was Richard M. Hurd, the President of the Lawyers Mortgage Company. In 1903, in his book, *Principles of City Land Values*, Hurd sought to determine land values and development to assess loan worthiness, with “access” as the core concept.¹ He employed access to predict which patterns of transport infrastructure and land use would most improve urban development. Two decades later, Robert M. Haig further expanded this notion and argued that access has the potential to provide a scientific basis for urban planning and zoning.² In the mid-20th century, the focus from merely describing the notion of access

¹ (Hurd 1903).

² (Haig 1926, Levine 2020).

shifted to defining its mathematical form. One of the first studies in this regard was done by Stewart, who suggested mathematical metrics for evaluating access and reflected on its potential in land use development and planning.³ Later, Hansen defined access as “the potential of opportunities for interactions” and presented an access measure to predict growth in metropolitan areas.⁴ Contemporary access measures and applications mostly resonate with Hansen’s work. But it was not until the late 20th century that the concept of access blossomed and attained a more mature definition. Scholars and planners gradually began to discern that access can go beyond theoretical research and be used normatively in planning practice.

³ (Stewart 1948).

⁴ (Hansen 1959).

Wachs and Kumagai expanded the concept of access and introduced it as a social indicator and an element of life quality for policy and planning.⁵ During the 1990s, research in transport and land use continued to explore the possibility of employing access in practice.⁶ But the notion was not as widely adopted in practice as academics hoped. Yet, repeated conceptual and theoretical modifications gradually formed the modern definition of access and its broad application in urban planning. Advances of technology (e.g., Geographic Information Systems (GIS) and specialized spatial analysis software) in the 2000s gave rise to a plethora of possibilities for measuring access. This threw a flood of light onto this concept and led to renewed interest in scientific and practical advances for implementing access analysis.

⁵ (Wachs and Kumagai 1973).

⁶ (Levinson 1998).

Soon failures of the mobility-oriented infrastructure paradigm in providing solutions for the traffic congestion it purported to address, alongside its contribution to the climate change crisis, caused frustration and eventually led to the revival of applications of access in urban planning and development.⁷ Technology advances have enabled researchers to generate access measures at a high spatial and temporal quality, yet, the practical implementation of access is moving at a planner’s pace. Even adoption of simple access measures, such as cumulative opportunities, remains frustratingly slow.⁸ We propose that a comprehensive understanding of the broad applications of access could inspire researchers and practitioners to consider implementing this concept in practice more often.

⁷ (Handy 2020).

⁸ (El-Geneidy and Levinson 2021).

Through the past decades, access has been defined as the ease of reaching valued opportunities, including both life’s necessities like workplaces and food stores, and its amenities, like parks and

restaurants, and its measurement and application lead to mobility and land-use changes in urban planning.⁹

⁹ (Levine 2020).

Opportunities accumulated

In 1959, Walter Hansen borrowed the concept of opportunity for interaction to describe access to opportunities and defined “accessibility” as “the potential of opportunities for interaction.” (Hansen 1959) What has come to be known as the Hansen equation (Equation 1) has been used to measure access to different opportunities including employment, schools, groceries, hospitals, libraries, and parks.

$$A_i = \sum_j O_j f(C_{ij}) \quad (1)$$

Where:

A_i : access from location i .

O_j : number of opportunities available at location j .

C_{ij} : cost of travel from i to j .

$f(C_{ij})$: impedance function.

Cumulative opportunities measures count the number of opportunities within a *travelshed*. A travelshed is equivalent to the area enclosed by an *isochrone*, and refers to an area whose boundary is a given travel time from the origin. Opportunities that can be reached within the travelshed t are weighted with a value of one, and those that cannot be reached are weighted with a value of zero as in Equation 2.

$$f(C_{ij}) = \begin{cases} 1 & \text{if } C_{ij} \leq t \\ 0 & \text{if } C_{ij} > t \end{cases} \quad (2)$$

This definition introduces access as both a transport performance measure and an index for planning and development. However, this view of access is merely the tip of the iceberg when it comes to studying its applications in transport and urban planning. In the research literature, the application of access has been associated with active travel¹⁰, public transit system effectiveness¹¹, land use policy¹², urban planning and development¹³, equity and social justice¹⁴, and the built environment.¹⁵

¹⁰ (Ermagun et al. 2023).

¹¹ (Ermagun and Levinson 2015, Palmateer et al. 2016a;b).

¹² (Janatabadi and Ermagun 2023).

¹³ (Janatabadi et al. 2023, Maharjan et al. 2023; 2022).

¹⁴ (Borowski et al. 2018, Ermagun et al. 2023, Ermagun and Tilahun 2020).

¹⁵ (Ermagun 2021).

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