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## SPATIAL TECHNOLOGIES, ACCESSIBILITY, AND THE SOCIAL CONSTRUCTION OF URBAN SPACE

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ABSTRACT. Accessibility is both an important concept, and a powerful indicator, in the understanding of the impact of spatial technologies, i.e. transportation, communication, and information technologies. However, virtually all existing measures of intra-metropolitan accessibility incorporate only transportation without considering other means of spatial interaction. In this paper, the author argues that by carefully examining the relationship between transportation and communication, it is possible to develop measures that represent urban spatial structure more completely. Based on studies of teleworking in the United States, the author presents an accessibility measure that takes into account both travel and telecommuting. A case study of employment accessibility in the Boston Metropolitan Area indicates that advances in spatial technologies may generate the dual effect of locational equalization and socio-spatial polarization. In the urban space that is increasingly technologically delineated and socially constructed, low-income workers will very likely find themselves in a more and more disadvantaged position. © 1998 Elsevier Science Ltd. All rights reserved

#### INTRODUCTION

The term "spatial technologies" — adopted from Couclelis (1994) — is a collective name for the transportation, communication, and information technologies that modify spatial relations. Advanced telecommunication networks and digital information systems are dramatically redefining urban space. They are challenging many basic concepts and analytical frameworks of urban geography and planning, and raising numerous fundamental questions for scholars in these fields. This paper is aimed at addressing three such questions: Are traditional measures of accessibility useful in understanding conceptually the socio-spatial impacts of advanced spatial technologies? Can we modify

<sup>&</sup>lt;sup>1</sup>It was almost four decades ago when several urban researchers, including Meier (1962) and Webber (1964), pioneered in studying the relationship between communication technologies and the spatial organization of urban activities. Many geographers and planners have since contributed to this important and dynamic area of academic research. Examples of recent influential works are those of Batty (1990), Couclelis (1996), and Mitchell (1995).

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some traditional accessibility measures to make them suitable for assessing such impacts? and How do advances in spatial technologies affect urban residents and neighborhoods with various socio-economic characteristics?

Clearly, these questions are of critical importance to urban planners, whose primary function is to facilitate economic efficiency and social equity in spatial contexts. If we construct a proper analytical framework for measuring, interpreting, and simulating complex relationships between spatial technologies, urban physical environments, and social structures, we may become capable of better planning and managing our cities.

In this paper, I shall first briefly review several existing accessibility measures which represent different views of the relationship between transportation technology and the city. I shall then discuss how we might extend some of the existing measures to include telecommunications as an important variable in the analysis of urban spatial structure. The discussion will be followed by the formulation of an employment accessibility measure which is useful for understanding the likely socio-spatial consequences of communication and information technologies. This extended measure will be applied to a comparative analysis of the urban spatial structure of the Boston Metropolitan Area under two different scenarios: (1) a negligible amount of teleworking; and (2) a substantial amount of teleworking. Finally, I will conclude the paper by drawing several implications from the research and defining some possible directions for future research.

#### TRANSPORTATION TECHNOLOGIES AND ACCESSIBILITY

Urban space is defined here as the whole set of geographical relationships among urban residents and their socio-economic activities. Accessibility is a measure of the strength and extensiveness of these geographical relationships. Despite the fact that communication and information technologies are now playing a critical role in determining the strength and extensiveness of various geographical relationships, virtually all existing accessibility measures take into account only transportation without considering other means of spatial interaction. Nonetheless, a critical review of these measures is essential, as some of them may be useful in understanding the socio-spatial implications of communication and information technologies. At the very least, it will help us build a foundation for constructing new analytical frameworks.

#### Accessibility as a Location Indicator

Many existing measures of accessibility were initially created to describe intrametropolitan location characteristics of different urban areas (zones). The demographic and social compositions of zones were not considered in the representation and interpretation. This feature is shown clearly in the basic gravity formula originally conceived by Hansen (1959):

$$A_i = \Sigma_j O_j f(C_{ij}) \tag{1}$$

 $A_i$  is accessibility for zone i,

 $O_i$  is number of relevant opportunities in zone j,

 $f(C_{ij})$  is the impedance function measuring the spatial separation between i and j, For an urban or regional system with N zones, i = 1, 2, ..., N, and j = 1, 2, ..., N.

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