Sustainable transportation and information technology: suggested research issues

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Information/communication technologies definitely hold potential to make more efficient use of existing and new transport facilities, but serious questions arise concerning their likely impact on environmentally sustainable futures. Validity of the substitution hypothesis, that transportation will give way to communication, is increasingly in doubt.

Information about information and communication technologies

The European Union recently issued a call for tenders for a regional telecommunications atlas to describe the state of infrastructure and service provision on a regional level. A similar effort is needed in North America to more clearly identify the relationship of such technologies to transportation and to monitor the space–time diffusion of their accessibility.

Spatial structures and telecommunication–transportation futures

The computer-based information era opens new horizons for the organization of resources and people and for rearranging geographical patterns of economic production and consumption. What are the potentials and consequences of the information-based economy to expand its spatial frontiers beyond traditional information-intensive metropolitan centers?

(1) Communication technologies, along with transport-ation, facilitate greater freedom of locational decision-making, e.g. where to live and work and where to set up production and distribution centers. How are such developments altering the limits of urban growth? Allowing for greater locational centralization of some activities and for greater spatial dispersal of others, there is considerable uncertainty as to how people and corporate agents are adjusting locational and travel behaviors. For example, if greater locational freedom enhances prospects for residental dispersal over low-density regions, how will this alter the demand for point-to-point transport and the utility of different transport modes? Will this intensify the demand for more customized trans-port routings? Will intensified information flows actually promote more and longer trip-based activi-ties and freight transfers?

(2) North America has witnessed a gradual transfer of transport accessibility advantages from the centers to the edges of cities. This needs stronger docu-mentation in regards to economic and social impli-cations. While it has been axiomatic for information-based economic decision-makers to favor central-city locations, communications–computer technologies have enabled a gradual dispersion of information-based activities to peripheral locations. There is need to assess where this is happening, what kinds of activities are relocating, how this affects firms' efficiency and effectiveness, and how this impacts on transporta-tion patterns and demands.

(3) Is the information era contributing to greater volatility in the demand for transportation? A possible research question is whether the increase in footloose global enterprise poses problems of instability in the demand for transportation at local and regional levels?

Transport informatics and sustainable environments

(1) Transport informatics and the related logistics of 'just-in-time' (JIT) practices have altered the nature of transportation on North American highways and fostered spatial reorganization of production and distribution economies. Will trends for smaller, timely consignments be furthered by implementation of more advanced information and control technologies (e.g. the intelligent vehicle highway)? Are risk assessments of societal vulnera-bility to the inevitable breakdown of such systems (labor disputes, resource shortages) required? But, more importantly, is there a need to audit the social/environmental costs associated with JIT?

(2) Could intra-mode cooperative use of Internet bulletin boards among trucking firms facilitate the use of excess freight space to improve efficiency in the trucking sector to compete with rail and air for the freight market? Would such practices have environmental benefits for sustainable transporta-tion futures?

(3) Will electronic management of transport logistics and automated pricing for use of roads and so forth foster trends to privatization of transportation in North America, alter spatial patterns of regional economic development, and influence social-group accessibility to transportation opportunities?

(4) How are new information systems and communication tools used to exploit trip-reduction programs of large employers (e.g. car sharing and van pools) and trip-coordination planning in metropolitan areas?

(5) Will the use of road information and guidance technologies (intended to enhance efficiencies and reduce congestion) actually encourage more transportation to take place?

Assessing the substitution viewpoint

Advocates of the 'substitution' view see telecommunications as good for the environment, saving time and energy, and leading to less congestion in transport. But, do such technologies encourage greater resource use and less environmentally sensitive forms of locational and activity behavior? Two of the most widely acknowledged forms of substitution are telework and teleconference.

Information technology plays a significant role in altering the traditional linkage between home and workplace. Teleworking (working from home or from decentralized work centers by means of networked telephones and computers) is frequently suggested as a means of substituting telephone computer linkages for physical transportation. However, the extent of teleworking and its impact on residential locations has been difficult to determine. Have time savings by teleworkers at the household level been used in localized activities in a more home-centered lifestyle, transferred to longer non-work trips, or allowed for dispersal of populations to amenity-rich regions? Are fuel savings in commuting offset by more travel for non-work purposes or by the need to heat and air condition homes for a longer portion of the day? Beyond transportation, issues arise regarding the changing social fabric of communities, the role of work in society, and the changing nature of the household.

The distance between the home and the workplace is one of the most sensitive social indicators of the impact of space-adjusting technologies on the conditions of employment and on the conditions of neighborhood (place). In particular, information and telecommunication technologies allow broad innovation (and increasing uncertainty) in how the workday and the workplace are structured. A simple hypothetical example helps to illustrate the potential impact of how combinations to telecommunicating and transportation inputs can alter the accessible land supply from a city (and related transport/energy requirements). The example assumes a fixed upper limit of 150 minutes per week for commuting on one-way journeys from home to workplace for a five-day period.

In this example (see *Table 1*), the impacts of small increments of speed on the accessible land supply within an average daily 30-minute threshold is evident. However, the impact of redistributing the work from the primary work site to the home (telecommuting) for only two of the five days in the workweek are even more dramatic. Without any increase in average travel speed (80 kph), the land supply within the 250-minute weekly limit expands by 180%. In light of this simple example, how relevant is it to regard telecommuting/working as a means of fighting traffic congestion?

Teleconferencing, based on ISDN (integrated digital services network), can accommodate participants in dispersed locations in major cities, institutions and industries throughout the world. Research is needed to assess the benefits and costs associated with such communications. For example, do they substitute for trips and, if so, what are the savings to the firms/individuals and to society? What is the comparative effectiveness of face-to-face, on-site communications vs teleconferencing? Does teleconferencing work best for large or small groups and for short or long distances between participants? What kinds of communication tasks is it best suited for? Can we measure the trade-offs in fuel/time savings and reduced pollution against the costs of infrastructure and communications and the effectiveness of business transactions?

Conclusion

This brief statement calls attention to a few of the specific research requirements needed to more fully comprehend the impact of space-liberating technologies on patterns of development, transportation and environmental sustainability.

Table 1 Average transportation speeds and the potential impact of telecommuting on accessible land resources from an urban center

Average travel speed (km/hr)	Average daily commuter trip time (minutes)	Potential distance from the city center (sq. km)	Land resources	Temporal cycle of work trips for one-way	Total travel time per week
60	30	30	2827	M/T/W/T/F	150
70	30	35	3848	M/T/W/T/F	150
80	30	40	5027	M/T/W/T/F	150
80	50	67	14 103	M/W/F Telecommute T//T	150