Pergamon

PII: S0966-6923(97)00017-3

Journal of Transport Geography Vol. 5, No. 3, pp. 199–206, 1997

Printed in Great Britain
0966-6923/97 $17.00 + 0.00

Globalization and research issues in transportation

Donald G. Janelle

Department of Geography, University of Western Ontario, London, Ont. N6A 5C2, Canada

Michel Beuthe

Group Transport and Mobility, Facultés Universitaires Catholiques de Mons, Mons, B-7000, Belgium

This paper concentrates on the dualistic role of transportation as a pro-active agent of globalization and as a beneficiary of its development. Surprisingly, transportation is possibly the least researched element in the complex of factors that foster a changing world economy. The goal is to suggest areas that require an informed social science perspective based on research that will enhance theoretical understandings and policy formulations. Beginning with a focus on changes in the nature of demand for transportation and its supply, the discussion considers issues relating to regional inequalities in accessibility, standardization for multimodal transport, and governance of global transportation. The vulnerability of transport-dependent globalization, and the role of transportation in the dematerialization of society for sustainable development are also areas suggested for extended research. © **1997 Elsevier Science Ltd. All rights reserved**

Keywords: globalization, multimodal transport, space-adjusting technologies, transportation, Europe, North America

Perspectives on a globalized economy

In its simplest form, globalization refers to the increasing geographical scale of economic, social, and political interactions. These include international trade and related traffic of imports and exports, the expanding mobility of capital and investment transactions, and the growth of tourism, global conferences and sporting events. Other transnational exchanges that give rise to a consciousness of global involvement include mail, television programming, cinema productions, publications, organizational memberships, videoconferencing, and telecommunications and Internet connections. In essence, instantaneous global transmission of local events promotes individual and institutional consciousness of opportunities and problems that exist beyond local and regional scales (see Janelle, 1991).

Globalization is also characterized by changing patterns of institutional organization and structural shifts in the nature of the world economic order. Most conspicuous is the expanded significance of multinational corporations (MNCs), regional trade alliances among nations, and the roles of non-governmental organizations (NGOs) and the United Nations.

Global-level opportunities for the corporate sector are reinforced by trends towards privatization of former public services and deregulation of public controls over the actions of private enterprise. In combination with technological developments, these changes facilitate structural adjustments that alter fundamentally the institutional framework for the production and distribution of goods and services, change the nature of employee–employer relationships, and result in significant changes in both national and international geographical patterns of commerce and development. Collectively, globalization, deregulation, and privatization provide the basis for exploiting an international division of labor for restructuring national and global economies.

Explanations for globalization span a rich intellectual history. In general, regional development and international trade theory interpret the current restructuring as a transitional stage in a long-term process based on increasing economies of scale and scope in production and distribution. This process is seen to benefit organizational efficiency, productivity, competitiveness, and greater international wealth. However, contrary theoretical perspectives, stemming from

Marxist economics, world systems analysis, and other broad historically rooted concepts, see current economic changes leading to greater social polarization, inequitable unevenness in the distribution of wealth, and decreased standards of living for a significant proportion of the world's population. In the North, this is often equated with the transfer of capital and jobs to offshore locations, job displacement through organizational downsizing and technological substitution, and core–periphery imbalances in the distribution of national wealth. In the South, such restructuring is equated with dependency on the North, indebtedness, and social polarization. A synthesis of these views, both supportive and critical, portend an international political economy that is increasingly under the influence of global private corporate entities.

Globalization and the agents of change (MNCs, global cities/regions)

The contention that MNCs and networks of global cities are replacing nation states as the primary players in the new economy is widespread in the literature (see Wriston, 1992). The expanded role of MNCs is certainly one of the most significant factors contributing to globalization. Unlike nation states, which are fixed in space, MNCs are able to follow the markets for capital, talent, resources, favorable regulatory and taxation environments, labor, and final consumption (O'Brien, 1992). Thus, product development (e.g. the Boeing 747) may involve engineers from countries around the world. Ford's Escort (world car), assembled at a maquiladora in Mexico from parts produced in many countries, is marketed at the global level. Such global operations are enhanced by information technologies, international trade agreements, and policies of privatization and deregulation (Majone, 1990).

Ohmae (1990, 1995) contends that largely through the practices of MNCs, a borderless world economy will result in a weakening of corporate capital's allegiance to communities and nations. Teeple (1995) notes how privatization and de-regulation have already lessened the role of state enterprises, laws, standards, and regulations as forms of distributive justice. While this may be the case for some individual states, the experiences of NAFTA and the European Union point to contrary results, with the negotiated unions imposing more rigorous standards on environmental protection and on the establishment of standard technical protocols to facilitate trade. Esterbrooks (1995) sees globally networked security markets creating large reserves of stateless money and securities that make possible stateless corporations. However, against this backdrop, others (e.g. Carnoy, 1993) argue that the role of the state as host and headquarters for MNCs is still pro-active and important. Indeed, governments play a very active role in financing, marketing, and protecting their national airplane producers, and they take pro-active approaches to attracting new plants of international corporations to locate in their jurisdictions.

Spatially, it may be suggested that major global cities and a few regional economies are the big beneficiaries of global restructuring. An emerging network of global cities may foster economic linkages that are stronger among cities scattered among many countries than are linkages within the national realms of individual cities. Ohmae (1995) sees economic-based regional economies, on the scale of Silicon Valley or the Kansai region of Japan, as superseding nation states as focal points of technological innovation and economic change (similar in scope to the focus of Andersson (1993) on European regions of scientific and cultural creativity and high transportation capacity). Such regions enjoy economies of scale in research and development as well as in production. In addition, many of their resident firms foster economies of scope by spreading their costs of production, marketing, and distribution over many different items of production.

Space-adjusting technologies as agents of globalization

Surprisingly, with a few exceptions [e.g. the Capello and Gillespie (1993) and Harvey (1989) documentation of space–time compression processes], the principal conceptualizations of globalization either ignore completely any reference to transportation or make only implicit linkages. Such neglect may relate to the apparent invisibility of international transportation and communications: much of it occurring over oceans and in the air, transmitted by under water/ground cables, or by remote satellites and electromagnetic waves. Yet, some inconsistencies in discussions on the socio-economic consequences of globalization may be explained through greater understanding of transportation and related space-adjusting technologies. The transport industry is a major beneficiary of recent technological developments and a central contributor to this new economy. It acts as catalyst for reduced restrictions on international trade, promotes new technologies and markets them on a global basis, seeks both national and international policy measures to support expanded transport investments, and often discourages regulatory measures to internalize the negative social and environmental costs associated with transport practices.

Space-adjusting technologies, including energy, transportation equipment, infrastructure, and labor, function to produce accessibility. However, as Sheppard (1996) observes, they differ fundamentally from other forms of production. "They produce flows linking places, not goods in places. Their product (accessibility) is necessary to the successful realization of any economic activity...[and] must be consumed

between the production and consumption of all goods (including itself)" (Sheppard, 1996). These distinctive characteristics have been largely ignored in the literature on globalization, yet they provide foundations for economic transformations at all geographical scales of organization. Understanding the link between globalization and space-adjusting technologies should be a high priority for scientific research, development strategies, and policy analysis. Examples of related research questions include the role of international multimodal carriers, transport network restructuring among world cities, and the integration of telecommunications and transportation systems.

The role of international transport agents

Proprietary information complicates the researcher's ability to understand governance within the transport sector itself. For example, little is known of how the growth of large-scale multimodal international carriers influence transport flows within and among nations. What strategies do large liner shipping firms (e.g. Sea–Land, part of CSX, an American integrated intermodal corporation) follow in establishing scheduled routings among ports that serve transatlantic trade? The stability of such routes is an important consideration for major ports and intermodal load centers in their investment strategies (see Slack, 1995), yet frequent changes in liner routing are common. There is need for a thorough understanding of the practices and significance of international shipping conferences, airline and other strategic alliances within the transport corporate sector (Brooks *et al*, 1993; Debbage, 1994), and of other organizational changes that reflect the transport sector's own responses to economic restructuring.

Network restructuring among world cities

Changes in the principal players in a global economy alter the requirements for transportation and the distribution of transport resources (accessibility). One example is the trend to supplement hub-and-spoke networks (for efficient consolidation and distribution of traffic) with direct point-to-point connections, particularly among major global cities. This is evident in air passenger and in both ground- and air-freight transportation (e.g. in express delivery operations). Cities serviced by direct connections are likely to gain appreciable accessibility advantages over other places within national and international urban hierarchies. However, the scale advantages of large hubs for international marine traffic (e.g. New York–New Jersey, Rotterdam–Maas, Osaka Bay) may be less subject to such change, particularly as the increasing sizes of ships promote concentration of shipping activity in a small number of ports.

Integration of transport and communications systems

The decreasing cost to consumers for international telephone calls and for Internet service has resulted from new communication technologies, increased competition among service providers, and from growing international contacts in business and tourism (see selections in Brunn and Leinbach, 1991). Investigations into how expanded and less expensive telecommunications influence physical transport of goods, services, and people is required. For instance, the use of telecommunications strategies by cities and regions may be seen as a means for competitive global positioning to attract investment (and the ensuing transport connections). A prime example is in the development of teleports as points of access to advanced telecommunication systems linked at the global scale. Progressively, through exploitation of space-adjusting technologies, cities seek to extend their competitive presence from regional and national settings to the international domain. Yet, uneven geographical spread of communication technologies is likely to enlarge disparities in transport development and have urban and regional development implications, particularly if economic competitiveness on the international level is the commanding principle for such diffusion. To understand such processes and their consequences, it is incumbent that concepts on the co-evolution of globalization and space-adjusting technologies treat transportation and communications as a single phenomenon.

Altering the nature of transport demand

Broad generalizations about how the demand for transport responds to globalization might reasonably include:

- longer and more customized transport linkages;
- greater sensitivity to the timing of connections, arrivals, and departures;
- expanded reliance on communication and computer networks;
- speed of movements and transactions; and
- standard equipment and procedures.

These demand-sensitive logistical concerns for transportation operations are consistent with many trends in global economic restructuring, such as:

- reliance on out-sourcing;
- customized production runs;
- flexibility in resource access (regardless of distance);
- just-in-time management of production and distribution processes;
- zero inventory;
- information access and exchange;
- the need to arrange for face-to-face meetings, often on short notice; and
- opportunities for economies of scope.

To function in such an environment where production processes are often fragmented (temporally and spatially), it may be axiomatic that heterogeneity of transport and logistical options be supported by a diversity of immediate and precise information resources. A host of new technologies have allowed improved predictability and reliability in meeting transport demands: on-board computers, cellular phones, and navigation systems, and a host of hardware and software developments for electronic data interchange (EDI). The sophisticated and expensive equipment needed for keeping track of shipments and for improving service quality also promotes economies of scope for the transport sector. The same technical resources permit it to spread its costs, allowing it to serve a variety of different consumer needs and to adapt quickly to volatility in the production and marketing of goods and services. However, the appropriate interface for linking transportation and information systems will be subject to continual technological change and will constitute a need for highly adaptable approaches in transport logistics.

The extent to which transport demand responds to logistical concerns of production and distribution in a global economy warrants significant research attention. Of many possible examples, three issues are identified in the following sections: environmental implications of just-in-time production processes; the geographical dispersal of transport demand to continental interiors; and trends for direct transport linkage of producers and consumers.

Implications of just-in-time production

Just-in-time production and distribution is a hallmark characteristic of global competitiveness. Yet, very little research has explored its implications for transport network management and broad environmental concerns. International-scale analyses on variations in the level of adoption of JIT might shed light on its systematic association with issues of traffic congestion, CO_2 emissions, commercial vehicle–automobile accident rates, and so forth. Such possible negative externalities need to be weighed against the advantages of minimized transhipment costs and delays, reduced warehousing, more flexible routing, and more spatially expansive regional access than is associated with bulk inland water and rail transport.

Increasing geographical dispersal of transport demand

Growth in knowledge- and information-based sectors of the economy has outstripped growth in most other sectors in recent decades. Unlike traditional heavy industry, these rapidly expanding high-technology operations are not constrained to coastal locations. Interior locations of Europe and North America share in the benefits of these new enterprises. However, logistical questions arise in the transportation sector, which must now service more dispersed demands to accommodate the need for face-to-face communication among business negotiators and knowledge-dependent innovators.

Increasing demands for direct transport linkage

As hierarchically structured production and distribution units give way to greater independence and flexibility in locational decision making, greater demands for responsiveness of freight and passenger transportation arise. Motor freight transport has benefited from the shift to less bulk in high-tech commodity production and from trends to direct linkage between manufacturers of final products and consumers, but this poses problems of road congestion and under-utilization of existing bulk (rail and barge) systems.

Regional inequalities in the supply of transport and communication technologies

The growth ethic of maximization of wealth and consumption has been traditionally supported by the maximization of mobility. To the extent that globalization is focused on a scale of operation that depends on the highest technical order of transport and communications capabilities, there is a tendency to favor concentration rather than broad dispersal of expensive infrastructure. This is seen in the existence of transportation corridors of high density and diverse transport options (e.g. Tokyo to Osaka, Boston to Washington, London to Birmingham). At national levels, this usually results in investments in the largest cities and in those centers with direct transport and communication access to world cities and capital resources.

The Randstad region of Holland provides an example of intensive hub concentration to create a magnet for international access. Cheap gasoline, low landing fees, and direct rail access are significant attractants for transiting airplanes at Schiphol Airport, a major gateway to Europe.

High-order transport systems require considerable traffic [e.g. the *train de grande vitesse* (TGV), with a new interchange at Charles de Gaulle Airport], and their tendency to adopt hub structures may have negative effects on the density of the network in more peripheral areas. Correspondingly, banking, medical, and postal operations may centralize at hub centers, possibly contributing to additional service delays in smaller bypassed cities and regions.

If globalization favors concentration of economic power and transportation/communication resources at major hubs, there are concerns for an increasingly inequitable distribution of wealth and a greater orientation to regional specialization in trade. In such cases, the effects of global capital are experienced in

the homogenizing of local/regional economies based on an international division of labor. For many regions, these trends may promote dependence, vulnerability to exploitation and abandonment, and economic insecurity. Theoretical and practical means of countering these potential disadvantages of globalization warrant consideration. For instance, how can a globalized political economy assure sufficient diversity within and among regions for them to hold local control and security over their economic futures? What would be the appropriate regional mix and distribution of transportation/communication resources, and what would be the preferred organizational and governance frameworks needed to make this possible?

The suggestion that globalization is promoting a convergence in productivity levels, labor-cost ratios, and returns on capital within industrial countries bears investigation. However, the possibilities that distinctions by core and peripheral regions at national and global levels could reflect growing disparities or divergence also merit study.

In some cases, as Illich (1974) observes, the provision of transport supply may, itself, pose a barrier to accessibility. This is the case where an expensive high-order transport system displaces an earlier system, thereby denying transportation to those who might not qualify to use the new system.

Ironically, globalization (the quintessence of accessibility) may generate its own demand for transport by creating distance. The elongation of supply lines to support production and distribution, the movement of goods and people over longer distances, the use of smaller vehicles to assure customized and time- and space-responsive service all place a toll on energy and infrastructure requirements, and may increase the risks/costs of environmental damage. To the extent that spatial unevenness is inevitable in the supply of the more expensive high-technology transport systems, it may also be that the promotion of these developments by the agents of globalization foster supply and price barriers to access for all but the most well-placed and well-heeled. Research is needed to provide a full accounting of these possibilities.

Multimodal transport and global standards

The increasing transport distances that accompany economic globalization often require use of complex chains of modes and means of transportation. The loading, unloading, transhipping, and setting up of cargoes are expensive and time-consuming operations, particularly if they depend on transport systems that were not designed for multimodal operations. Concerns for compatibility of equipment and logistical practices, for efficiency, security and safety, underlie the encouragement and adoption of international standards for transportation. The internationalization of transportation beyond previous levels lends significance to logistical requirements for intermodality of passenger and freight movement.

Beyond concerns for efficiency, there is evidence in both Europe and North America that the increasing transfer of freight and passenger traffic from rail to road is pressing the capacity limits of road networks beyond acceptable levels of congestion and exacerbating levels of pollution. As a partial solution, European authorities are promoting substitution of rail and short sea-transport for some long-distance road transport. However, success of this option requires the presence of a competitive and efficient organization of multimodal transport systems, with specific corridors, high-capacity interface terminals, and interoperability of networks by 'integrators' of transportation services.

A high degree of coordination/standardization in transport system design (e.g. container sizes, technical standards for firms to enter transport markets, and documentation for crossing national boundaries) and management would benefit from expanded research to model the impact of diverse options, for monitoring their effects on dynamic and complex transport systems, and for designing efficient networks.

The European Union offers an exceptional review of the difficulties in achieving broad international standards for resolving transportation problems. The situation for inland waterways transportation is instructive. While the Rhine River is open to competition, waterway traffic among the Netherlands, Belgium, and France is strictly regulated by the state or by collusive agreements among concerned parties. Rules regarding the fixing of prices, allotment of cargoes through a queuing process, and the forbidding of traffic on Sundays were intended to protect small boat owners, but they lessen the competitiveness of inland waterways and hinder logistic set-ups of combined multimodal transportation.

Difficulties in setting standards also arise in the operations of European railways. Until recently they were all organized as state monopolies, and management was mainly technical and political, with scant administrative accounting. Each railway focused on its domestic network and held exclusive responsibility for all international traffic on its territory. Wagons of commodities and passengers were transferred at boundaries from the authority of one railway to another, with appropriate documentation, but no follow-up by the railway of origin. Revenues from international traffic were shared according to the number of kilometers traversed in each country, regardless of the real costs incurred; and, as state monopolies, decisions regarding cooperation among railways (e.g. wagon sizes, clearances, rail gauges, electrical and mechanical controls, power supply, and documentation requirements) were often influenced by issues of international politics between states.

In the interest of competition and efficiency, since 1993 the European Union has required that separate

accounting be made on the management of network infrastructure, and of freight and passenger transport. It forbids state subsidies to national railways except for infrastructure and public service obligations in passenger transportation. Moreover, it grants rights of access to all national rail networks for railway corporations established in the Community. Despite some restrictions, these decisions impose entirely new rules of competition for railway transportation. However, it will take time to translate them into new institutions and into a real competitive system. While there is a strong incentive for railways to maintain friendly cooperation at the international level, economic opportunities could encourage more aggressive attitudes and ventures, particularly by the larger railways. In that respect, the way in which the right of access will be guaranteed and organized will play an important role.

Broader international issues arise with regard to Europe's solution to problems concerning standardized rail clearances and container sizes. Some countries have severe clearance problems for large containers, and for 'caisses mobiles' and trailers. Solutions involving special wagons, higher clearances, and new terminals with heavy equipment are very costly. The clearance issue is closely linked to the choice of multimodal transport techniques for long-distance transport and determines whether complete vehicles, trailers only, or containers can be carried on wagons. While large-volume container operations might be shared by several operators and different transport modes, this would pose organization problems in the European context.

Transportation of containers rather than vehicles or trailers simplifies the clearance problem. However, the size of the containers is subject to controversy at the international level. The United States favors larger containers. Yet, currently, the sizes of most maritime containers are not compatible with the standard pallets used in Europe. The International Standardization Organization (ISO) proposed larger sizes to solve both problems, but European maritime and inland waterway operators objected that the new containers would not fit in their boats; railways had the same objection, aggravated further by clearance problems; terminal operators feared the need to replace equipment; and, finally, most European countries will not accept large containers on their road systems for reasons of clearance and security. In contrast, American and Canadian operators seek economies of scale and ease of handling, particularly for the intermodal land-bridge traffic between Europe and Asia, and for servicing their large inland distribution centers.

Despite the difficulty of designating standard container sizes, such discussions reveal important aspects of the transportation chain for long distance and transcontinental freight movement. The debate provides an opportunity to rationalize linkages and to coordinate investment choices. Research could help find compromise solutions. Objectives could include preserving the integrity and use of existing infrastructure. Or, new standards could be designed and phased-in to facilitate intermodal operations and technologies for automating the handling of pallets within an integrated transportation chain from input feeding to output forwarding, to distribution centers and retailers.

Significantly, the construct of 'global' (e.g. global climate change) is a strong rationale for international standards, but it can also be an inhibitor of acceptance of universal standards. For instance, industries may argue that they should not bear the costs of lowering emissions since competitors in countries that do not comply with the standards would gain market advantages. Even within trade alliances such as the European Union and NAFTA, national differences in the social security costs imposed on corporations and in fiscal policies for pricing transport fuels make it difficult to introduce some reforms, like taxes on trucking and diesel fuel to reflect external costs. Drawing on evaluations of policy experiments by different countries to integrate the cost of such externalities, it may be possible for researchers to identify policy approaches that offer promise of broader compliance.

Governance of transport

The homogenization of international standards for transportation poses issues regarding the control of transport systems. On the one hand, standards may facilitate exchange, but the risk of discouraging innovation is a prospect often associated with locked-in standards. Related to any notion of global standards is the question of who governs the transport sector. This issue is complicated by an inherent feature in the complex of space-adjusting technologies. As Sheppard (1996) observes "they challenge the coherence of places, perhaps most significantly the capacity of any political authority to control its territorial borders. [Yet,] they involve an extensive history of accepted state regulation, because of the extensive fixed capital infrastructure that most transportation and communications systems require (from nineteenth century railroads to twenty-first century satellite deployment), and because of the public-goods characteristic of their product (accessibility)."

Against the backdrop of technologies and organizational forms that increasingly diminish the fixity of borders and the ability of authorities to screen information and resource flows, and against political pressures for open markets, it is a significant challenge to design and implement appropriate regulatory regimes to protect environments and to promote equity across regions and transport sectors. For example, is it possible to have a regulatory regime to monitor and control the licensing of ships, trucks and other conveyances, subsidies to transport providers, pricing, rebates

and other practices that mitigate against the down-side effects of competition and that recognize critical public requirements?

The extent to which the growth of global financial markets and multinational corporations reduce the sovereignty of states over transport regulation warrants critical review. Do existing and developing regional alliances among countries offer opportunities for achieving legal and institutional frameworks for creating cohesive networks that are sufficiently coordinated across international boundaries and robust enough to handle integrated global and regional transport requirements? These are priorities of the European Commission, which envisions freight and passenger network improvements as central to economic and political cohesion, furthering the development of less advanced regional economies by using the leverage of substantial infrastructure investments to fight unemployment. Shifts in responsibility for standards and taxation from national to international levels are one prospect, and may emerge as a reality in Europe.

NAFTA's political objectives are more circumscribed than those of the European Union, but experiences within an emerging Single European Market may offer research opportunities to better understand processes for implementing change in North America. For example, NAFTA's efforts to reduce cabotage restrictions on transport operations among Canada, Mexico and United States might benefit from an analysis of changes occurring in Europe, where quotas on international cabotage will be eliminated completely in July 1998.

While environmental and equity consequences of transport developments pressure governments towards greater regulation of transportation, interest in efficiency and international trade favors less state intervention. Studies regarding this tension and the governance of transportation under the influence of the European Union and the North American Free Trade Agreement would assist understanding of the broader globalization process and its relationship to governance of transportation. For example, systematic studies might explore where, how, and to what effect transportation has undergone administrative devolution or concentration. Comparative analysis is needed to assess the impact of different governance systems on the externalities associated with transportation systems.

Globalization and the vulnerability of transport systems

Globalization exposes transportation to severe vulnerability, often at short notice. For example, high levels of automobile and petroleum dependence, which are undergoing world-wide diffusion, place transportation at risk from political/economic boycotts and embargoes. The immunization of transportation from such debilitating dependence is not likely, but research into the politics of such actions is needed to suggest ways of mitigating impacts when they do occur. Similar arguments are possible regarding the security of passengers, freight, and transport infrastructure; since transportation is a frequent target of terrorist threats, its use and design must be cognizant of the broader international political environment.

Even the sensible realization that global environmental problems (such as air pollution and global warming, and marine discharge of waste) warrant global solutions exposes current transportation systems and their dependent economies to serious problems. For example, implementation of global standards on fossil fuel use will impact on the price of petroleum, with potentially significant ripple-effects on land use, transportation behavior, and resource substitution. Modelling such processes at different spatial scales is an important challenge for researchers that will yield critical information for decision makers. In addition, preemptive strategies to restrict land use patterns to offset fossil fuel dependence or to encourage greater efficiency in fuel use warrant continued research and policy consideration.

Internationalization in the trade and transport of toxic/hazardous products and waste is an issue that touches on inequalities in North–South relationships and in core–periphery relationships within countries. The nature of this problem and the comparative ability of states to respond cooperatively on an international basis are areas of growing concern. For transportation, it entails the process whereby such trade develops and the related problems of finding disposal sites and appropriate routings that minimize the vulnerability of population and property.

Transportation and the dematerialization of the economy

Transportation has served as the vehicle for intensifying mass consumption of resources and goods beyond subsistence levels for many centuries. Globalization of commodity and resource trade reinforces this role. To this extent, since transportation and consumerism are products of mutual causation, transportation must figure prominently in the changing attitudes and practices regarding consumerism.

To the extent that future economies might be based on a higher ratio of information-based goods and services to material resources (dematerialization of the economy), the relative extent of transportation input to final production might be reduced. Also at issue is the possibility for advanced design technologies to reduce the reliance on material resources, thus lessening transportation requirements in keeping with principles of environmental sustainability. Related issues of waste recycling and requirements to manage the production cycle through the complete range from production to

the final treatment of discards and waste have important implications for transportation and warrant consideration in any comprehensive research agenda.

Conclusion

This statement illustrates how global mobility is part of a larger debate. While mobility is a central requirement for large regional and global economies, there is the risk that its resource demands and pollution consequences will contribute to the environmental unsustainability of global industrialism. One of the main issues regarding globalization is its repose on relatively cheap transportation. Taking into account the externality costs of environmental and social consequences, and the limited availability of energy resources, is transportation too cheap? How would a 'global optimization' that accounted for full costing of all externalities alter current geographical patterns of economic activity? These questions significantly broaden the concerns for global economic restructuring (and transportation) beyond issues of technological and organizational response for efficiency and competitiveness. There is a need to treat both social and ecological forces as parts of any model for a sustainable transport system in the global political economy.

This statement has not addressed the data requirements of exploring fully the varied relationships between globalization and transportation. Documentation and timely researcher-accessible databases are needed. For example, information on commodity flows must be tied to specific cities and urban regions (in addition to national levels of aggregation) and be available in time-series form to capture the processes and patterns of linkage between places of production and consumption. Absence of such disaggregated data masks important intraregional variations in the accessibility impacts of transportation. Similarly, information on the organizational and operational practices of transport agents must be more widely available in order to explore fully opportunities for logistical improvements, governance possibilities, and options for socially and environmentally conscious solutions to transportation issues.

Acknowledgements

An earlier draft of this paper was prepared for the National Science Foundation, European Science Foundation Workshop on Transportation Research, in Strasbourg, France, on 7th October 1996. This revision has benefited from the constructive critique of participants, particularly the designated discussants, Jan S. Kowalski of the Institute for Economic Policy Research at the University of Karlsruhe, and Eric Sheppard of the Department of Geography at the University of Minnesota.

References

Andersson, Å. E. (1993) Infrastructure and the transformation to the C-society. In *The Future of Transportation and Communication: Visions and Perspectives from Europe, Japan, and the U.S.A.*, ed. R. Thord, pp. 11–26. Springer–Verlag, Berlin.

Brooks, M., Blunden, R. G. and Bidgood, C. I. (1993) Strategic alliances in the global container transport industry. In *Multinational Strategic Alliances*, ed. R. Refick, pp. 221–250. International Business Press, New York.

Brunn, S. D. and Leinbach, T. R. (eds.) (1991) *Collapsing Space and Time: Geographical Aspects of Communication and Information*. Harper Collins Academic, London.

Capello, R. and Gillespie, A. (1993) Transport, communications and spatial organization: future trends and conceptual frameworks. In *Transport and Communications Innovations in Europe*, eds. G. Giannopoulos and A. Gillespie, pp. 24–56. Belhaven Press, London.

Carnoy, M. (1993) Multinationals in a changing world economy: whither the nation state?. In *The New Global Economy in the Information Age: Reflections on our Changing World*, eds. M. Carnoy, M. Castells, S. S. Cohen and F. H. Cardoso, pp. 45–96. The Pennsylvania State University Press, University Park, PA.

Debbage, K. G. (1994) The international airline industry: globalization, regulation and strategic alliances. *Journal of Transport Geography* **2**(3), 190–203.

Esterbrooks, M. (1995) *Electronic Technology, Corporate Strategy and World Transformation*. Qurom Books, Westport, CT.

Harvey, D. (1989) *The Condition of Postmodernity: An Inquiry into the Origins of Cultural Change*. Blackwell, Oxford.

Illich, I. D. (1974) *Energy and Equity*. Calder & Boyars, London.

Janelle, D. G. (1991) Global interdependence and its consequences. In *Collapsing Space and Time: Geographical Aspects of Communication and Information*, eds. S. Brunn and T. R. Leinbach, pp. 49–81. Harper Collins Academic, London.

Majone, G. (ed.) (1990) *Deregulation or Re-regulation: Regulatory Reform in the United States and Europe*. St. Martin's Press, New York.

O'Brien, R. (1992) *Global financial integration: the end of geography*? Council on Foreign Relations Press, New York.

Ohmae, K. (1990) *The Borderless World*. Harper Business, New York.

Ohmae, K. (1995) *The End of the Nation State: The Rise of Regional Economies*. The Free Press, New York.

Sheppard, E. (1996) National Science Foundation—European Science Foundation Workshop on Transportation Research, Strasbourg, France, 7th October 1996.

Slack, B. (1995) Container shipping networks and trade patterns in North American ports. In *Transport Planning and Policy Issues: Geographical Perspectives*, ed. J. Andrey, pp. 1–23. Department of Geography, University of Waterloo, Waterloo, Ont.

Teeple, G. (1995) *Globalization and the Decline of Social Reform*. Garamond Press, Toronto.

Wriston, W. (1992) *The Twilight of Sovereignty: How the Information Revolution is Transforming our World*. Charles Scribner's Sons, New York.