Building a New Mobility Industry Cluster in the Toronto Region

A study of trends that are transforming transportation, the resulting global demand for New Mobility, the state ofToronto's supply capacity in New Mobility, and proactive steps for the region tocapitalize on global market opportunities

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About the Authors

ICF Consulting is a global consulting firm that works on strategy and policy issues in economic development and sustainable transportation.

- In their Economic Development Practice, ICF Consulting works with regions across Canada and abroad to develop and implement long-term strategies for sustainable economic development. They recently completed Toronto Competes: An Assessment of Toronto's Global Competitiveness for the City of Toronto, and are working on economic development strategies with Ottawa, Edmonton, Calgary and other Canadian regions.

- In their Transportation Practice, ICF Consulting works with federal, provincial/state governments, municipalities, planning agencies and the private sector to develop innovative solutions addressing the environmental, economic and social challenges facing the transportation sector.

Ken Watson, Project Manager, and Jim Gollub, Senior Vice President, led ICF's research team.

Moving the Economy (MTE) is a partnership that works to speed the pace of New Mobility industry development and innovation. Working regionally, nationally and internationally, MTE undertakes projects, partnerships, research and industry marketing geared at building solutions for local application and for export. Projects include:

- Integrated Mobility Systems, a Canada-wide public-private consortium with over 20 members, focuses on smart cards as a tool to link a range of urban transport modes and urban services to provide a seamless, convenient, sustainable door-to-door trip.

- InfoMobility Network, a Canada-wide partnership geared to providing practical on-line urban transport information for users, and one-stop access to transportation information and research for transportation professionals. InfoMobility links to MTE Online, a searchable database of New Mobility case studies, and Detour Publications, an online bookstore focusing on sustainable transportation and urban ecology.

- Urban Goods Movement Initiative, including workshops, partnerships and the recent publication of Moving Goods in the New Economy – A Primer for Urban Decision Makers.

- Network of Excellence for Sustainable Transportation (NEST), supports the development of knowledge, skills and human resources in New Mobility through academic and professional development partnerships and initiatives.

Beth Jones, Manager of Research and Program Development, Janet Lo, Manager of NEST, and Sue Zielinski, Director of MTE, led MTE's contribution to this study.

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Section 1 Investing in Toronto's Prosperity

Toronto has a strong and diversified portfolio of healthy industries generating jobs, wealth and an enviable standard of living for the region's citizens.[1] Today's economic performance, however, cannot be taken for granted. Globalization and the New Economy challenge every region, including Toronto, with rapid market shifts, new foreign competition and fast changing technologies. Standing still is not an option. Sustaining and enhancing prosperity requires constant renewal of the region's competitiveness and acting strategically to position the region to capitalize on emerging market opportunities.

1.1. New Realities for Economic Success

As the New Economy has taken hold, so too have new rules for economic success. Only a decade ago, economic development was largely concerned with attracting industrial plants and corporate offices by offering a range of incentives, such as tax breaks, improved infrastructure and publicly supported skills training. However, since all regions were competing for new investment with the same incentive-based approach, the result was a zero sum game. Firms moved around seeking low costs, but net economic growth was often lacking. Furthermore, attracting cost-sensitive firms (often paying relatively low wages) contributed little to the goals of increasing per-capita incomes and standards of living.

Sustaining prosperity in today's new global economy requires recognition of four new realities for economic success:

1. **Regions Drive the World Economy**—Metropolitan regions provide the economic base for wealth generation. Advanced communications, globalized production, trade liberalization and capital mobility have dispersed economic activity. Jobs flow to the regions that can best supply the economic inputs firms need to compete in the New Economy, inputs such as skilled labour, technological innovation and access to financing.

2. **Clusters Drive Regional Economies**—A region's economic health is determined in large part by the health of its portfolio of industry clusters. Clusters are interrelated, geographically concentrated industries and their key suppliers and supporting economic foundations. Clusters reflect the export base of the economy, and may account directly for only 25 percent or less of a region's employment. However, the "multiplier" effect of the export base supports the rest of the workforce. An expanding export base (i.e. competitive clusters) brings wealth into the region, allows local-serving businesses to thrive, and raises the standard of living for the community at large.

3. **Input Advantage Powers Cluster Competitiveness**—Clusters derive their competitiveness in part from having access to strong economic inputs or foundations. In the New Economy, these foundations include accessible technology, adaptable skills, available financing, adequate infrastructure, advanced information infrastructure, a supportive business climate and the quality of life needed to attract skilled workers.

4. **Working Collaboratively Creates Competitive Advantage**—Economic foundations are not provided solely by the private sector. In each case, governments and public institutions play key roles in developing the foundations that support competitive clusters. Successful cluster development strategies bring together representatives of exporting businesses, their suppliers, public institutions providing economic foundations, and government, with the shared goal of enhancing the region's economic foundations and keeping them responsive to the changing market requirements of industry clusters.

The bottom line is that regions must be sensitive to emerging market opportunities, understand their region's capacity to capitalize on these opportunities, and work collaboratively to build competitive clusters. Toronto recognizes these new realities and features them prominently in the City of Toronto's Economic Development Strategy.[2] Indeed, "Building Competitive Export Clusters" is one of eight strategic directions guiding the City's economic development efforts.

1.2. New Mobility—An Opportunity for Cluster Development

This report is about how "New Mobility" could be developed as a competitive export cluster in the Toronto region. This significant economic opportunity is arising as a result of three key trends that point to a global transformation in urban transportation.

1. **Transportation Demand is Growing Beyond the Capacity of Current Systems**—Current urban transportation trends are now widely recognized to be unsustainable. Growing populations, demographic shifts and rising disposable incomes are increasing demand for mobility, while the resulting traffic congestion and smog threaten to choke many of the world's large cities. Meeting the economic, environmental and social challenges facing transportation systems around the world will require new approaches to mobility that can reduce congestion, smog and greenhouse gas emissions, while meeting these increased mobility demands and supporting economic competitiveness at the same time.

2. **New Systems and Technologies are Being Applied to Transportation**—Global positioning systems, supply chain management, wireless access, real-time information systems and a wide range of other systems and technologies are improving the efficiency of freight movement and allowing logistics providers to serve their clients better. Passenger transportation is also evolving with the application of innovative systems and technologies, such as real-time traveller

information, electronic fare payment, wireless navigation technologies and transit priority signalling.

3. **Business is Shifting to a Service Orientation**—Across diverse industries, the move toward a service orientation is changing the way businesses provide value to their customers. For example, the photocopying industry shifted from selling equipment to providing copying service through leases and service contracts. In the realm of transportation, some car companies have started to position themselves as providers of mobility, rather than simply vehicle manufacturers. As Bill Ford, chair of the Ford Motor Company recently stated: "The day will come when the whole notion of car ownership is antiquated. If you live in a city, you don't need to own a car."

The convergence of these trends is leading to **New Mobility**, the next generation of urban transportation systems, services and products. New Mobility innovations span the spectrum of transportation, from **moving people**, to **moving goods**, to **moving less**, where unnecessary travel or shipping is reduced. New Mobility applications are generally integrated, smart, clean, service-oriented and user-focused. Some examples include:

- **Smart Card and Wireless Applications** that link a range of transportation modes with other urban services to enhance the urban door-to-door trip.

- **Mobility Service Packages** that bundle urban and interurban transport including car sharing, regional trains, local transit, and shared bicycles.

- **Integrated Urban Goods Networks** that link logistics and freight campus solutions with intermodal options, local production and distribution, human powered cargo, and marine modes, all enhanced by Intelligent Transportation technologies.

- **Real-Time Interactive Traveller Information** that provides urban journey planning and fare payment for local and tourist markets through the internet, wireless devices, on-street kiosks, electronic signage and more.

- **Land Use and Real Estate Development** that integrates telework and teleshop infrastructure with car rental, transit and bike amenities, supported by financing incentives such as location efficient mortgages, and set within a context of smart land use and zoning practices.

New Mobility innovations like these applied locally can offer opportunities to reduce congestion, increase transportation choices and create more liveable communities. By integrating modes and expanding access, New Mobility can create a transportation system that allows us to get more from limited resources available.

Taken together, the examples listed above make it clear that New Mobility brings together services and technologies across diverse sectors. A sample of businesses and employment areas related to New Mobility are listed in the table that follows.

Businesses and Employment Areas Related to New Mobility

Telecommunications & Wireless Technologies
- Wireless/radio positioning technologies, tracking systems and navigation systems
- Wireless internet applications for ticketing and access to route/schedule information
- Wired office, retail and residential facilities
- Equipment and services for videoconferencing, telework, teleshopping, distance medicine, distance learning, etc.

E-business & New Media
- Web portals for traveller information, trip planning and online reservations/ticketing
- E-learning software & program delivery
- Digital media marketing for mobility services
- Interactive wayfinding and mapping
- Visualization for Smart Growth simulations
- E-business applications to goods distribution

Information Technology
- Electronic payment –smart cards, wireless, etc
- End user equipment –readers, writers
- Interactive kiosks
- Hand held ticketing and navigation devices
- Backend software for transactions, booking, scheduling, interactive journey planning, etc.
- System integrators for turn-key applications

Tourism and Retail
- Retail applications and loyalty programs on transportation smart cards
- Teleshopping and home delivery
- Web mapping, traveller information and wayfinding
- Urban green tourism and ecotourism services and promotion
- Local supply chains and urban agriculture

Transportation Operations and Services
- Carsharing, ridesharing, station cars, car rentals and taxis
- Inter-city rail and urban transit/paratransit
- Bicycle rentals and related equipment
- Ferries
- Transportation management associations
- Professional services for planning, implementation, and system integration
- Marketing for mobility services
- Fleet management
- Outdoor and in-vehicle advertising
- Human factors design for service and technology interfaces

Goods Movement & Supply Chain Management
- Goods movement and logistics services (rail, truck, marine, air, human power, etc)
- IT applications for space and route optimization
- Fuel efficiency and advanced vehicles
- Reverse logistics including reduced packaging
- Real time congestion information for carriers
- Systems to streamline intermodal connections
- Electronic information processing at border crossings and inspection stations
- Local production and distribution
- Freight campuses

Intelligent Transportation Systems
- Real-time traveller information
- Traffic management systems
- Electronic payment/access for tolls, parking, etc.
- Commercial vehicle regulatory systems
- Fleet management systems
- In-vehicle information and navigation
- Advanced vehicle control and safety

Real Estate Construction, Planning, & Operations
- Smart buildings and live-work developments
- Mobility service packaging in residential buildings
- Delivery coordination for tenanted buildings
- Mixed-use, infilling, and nodal development
- Commercial location brokerage services
- Planning and professional services for intensification, urban centre renewal, transit-oriented development, smart growth, etc.

Geomatics
- Global positioning systems and remote sensing
- Spatial or geographic information systems, and mapping

Financial Services, Banking and Investment
- Electronic payment systems
- Public-private partnerships
- Project financing and venture capital

Transportation – Equipment
- Advanced materials and fuels for vehicles
- Vehicle and fleet conversions
- In-vehicle information and tracking systems
- Vehicle design/manufacturing (rail, bus, bicycle, auto, truck, air, marine) for goods and people
- Urban transport ticketing and tolling equipment

1.3. Capitalizing on the Opportunity—Building a Cluster in the Toronto Region

Consistent with the theme of "Building Competitive Export Clusters" in Toronto's economic development strategy, Moving the Economy's strategic goal is to support the establishment of the Toronto region as a hub of employment, innovation and skills in the emerging New Mobility industry. As a sector development agency, since 1997 Moving the Economy has been undertaking projects, partnerships, and research that support the articulation and development of the New Mobility industry.[3] A diverse network of industry, public, labour, academic and community players has grown around these activities.

In September 2001, ICF Consulting was engaged to work with Moving the Economy to explore cluster development in New Mobility. The collaborative research that resulted addressed four main areas of inquiry: the trends that are transforming transportation, the resulting global demand for New Mobility, the state of the Toronto region's current supply capacity, and collaborative actions to strengthen regional businesses' ability to compete successfully in the emerging global markets. Each area of inquiry forms a section of this study (see box, next page.)

A range of sources informed the results:

- Interviews and discussions with representatives of many Toronto-region businesses and institutions active in the emerging market for New Mobility;
- A global reference group with representation from EcoPlan, Paris; the European Conference of Ministers of Transport, the International Council for Local Environmental Initiatives; the Organization for Economic Cooperation and Development, the United Nations, and the World Business Council for Sustainable Development;
- A review of current literature; and
- Moving the Economy's research, activities and partnerships since 1997.

The resulting research and analysis point to three key conclusions:

- New Mobility presents a major economic opportunity for export-oriented businesses, job growth and wealth creation;
- The Toronto region has important strengths that could be harnessed as building blocks for a New Mobility industry; and
- Proactive steps will be needed to build on these strengths and encourage the growth of a New Mobility industry cluster that can contribute to Toronto's on-going prosperity.

This study summarizes the research results and recommends an action plan to help catalyze a New Mobility cluster in the Toronto region.

Key Areas of Inquiry and Study Structure

Section 2 New Mobility: Overview and Industry Trends

- What will the future of mobility look like?
- What key factors have affected, and will affect, the New Mobility industry, globally and locally, including:
  - Market context (congestion, smog, demographics, etc.),
  - Service/product context (availability of new systems and technologies), and
  - Business context (e.g. New Economy, service orientation, customization)?
- What new businesses and services will emerge and grow?
- What job areas and skill sets will be needed for New Mobility?

Section 3 Emerging Global Markets for New Mobility

- What are the economic opportunities in New Mobility, now and in the foreseeable future?
- How significant are the opportunities (market size)?
- What services and products will be in demand?
- Geographically, where will this demand be located?
- Who will be buying?

Section 4 Foundations of a New Mobility Cluster in Toronto

- Does Toronto have the building blocks needed for a New Mobility industry that can compete in the emerging global markets?
- What are the region's relative strengths and weaknesses?
- Does the region have the R&D capacity to generate and commercialize technological and service innovations in transportation?
- Is the region's business climate conducive to the formation and competitiveness of New Mobility providers and suppliers?
- Does the region have the venture capital and financing capacity to support new businesses, R&D and export?
- What education, training and retraining programs and human resource policies exist that can meet evolving employment needs, and what will be required to support skills development and training?
- Does the region offer the quality of life needed to attract the workers that a New Mobility industry will require?

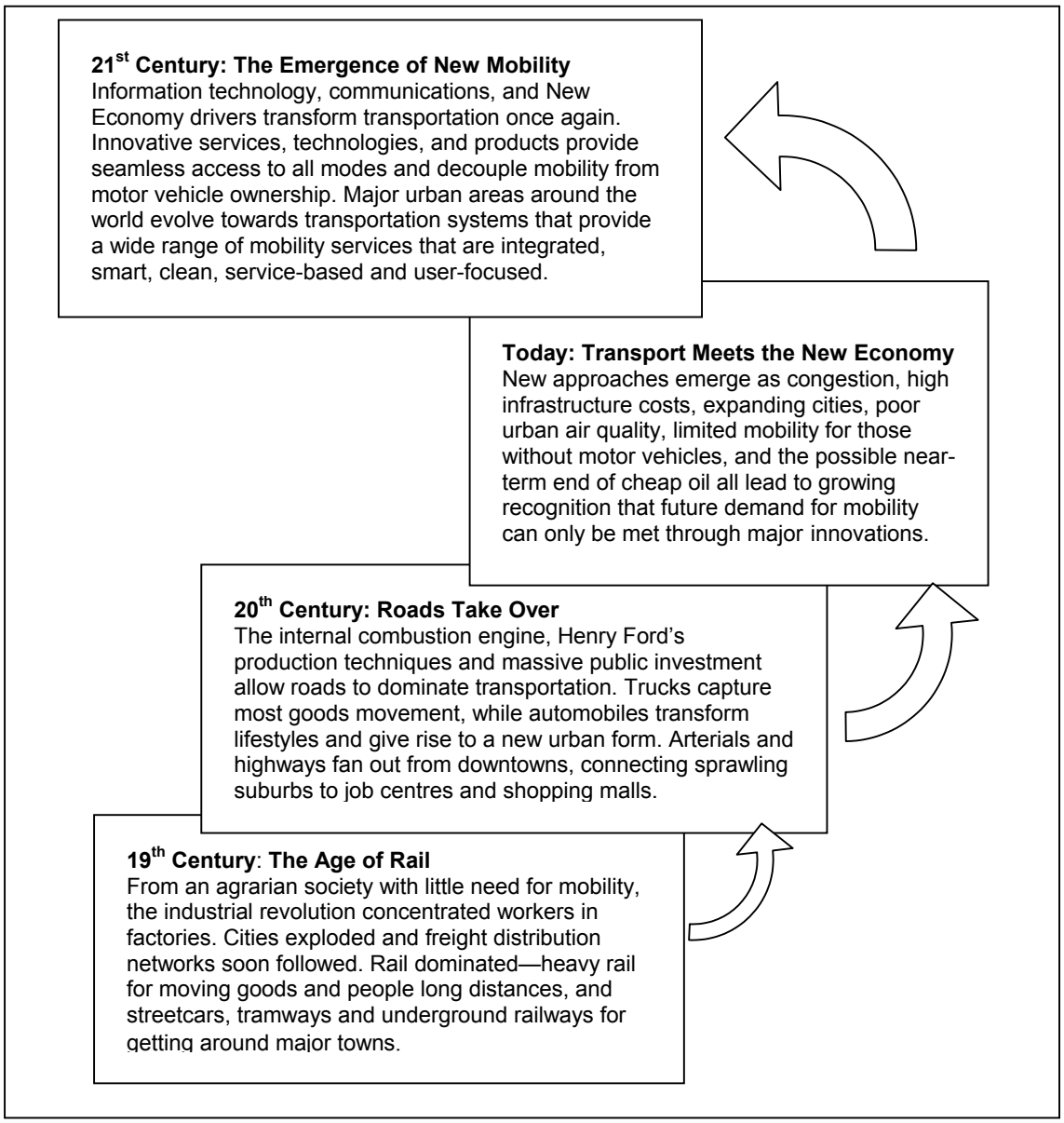
Section 5 A New Mobility Seed Cluster Strategy for Toronto

- Based on all of the above, how can industry growth be spurred in the Toronto region to best capitalize on global market opportunities?
- What challenges will have to be overcome?
- What proactive steps will be needed from business, government and the region's various institutions and organizations?

Section 2 New Mobility: Overview and Trends

People of the last century witnessed a radical change in transportation. Less than 100 years ago, rail, marine, horse and walking served the vast majority of mobility needs. Then, driven by technological advances in engines, vehicle production processes and road construction, coupled with massive investments in public infrastructure, road transportation exploded. Cities and lifestyles were reshaped, trade patterns were redrawn, and feeding the energy requirements of the system became a top priority on the government agenda.

The Evolution of Transportation



Today, evidence points to another major shift in transportation systems. Transportation's evolution mirrors the ways in which the New Economy is rapidly transforming other sectors, where new systems and technologies are enhancing traditional services, products and manufacturing processes. This innovation is key to creating greater employment opportunities and higher standards of living.

Transportation's evolution mirrors the emergence of new systems and technologies in other sectors. Just as businesses moved from the typewriter into the networked and multifaceted computer age without completely rejecting the typewriter, and just as we moved to road-based transportation without completely eliminating rail and marine, transportation systems are evolving beyond a motor vehicle focus without rejecting motor vehicles.

This section characterizes this evolution in transportation, and the trends that are creating economic opportunities in the emerging New Mobility industry.

2.1. Transportation is Evolving

Changes are occurring across the spectrum of transportation, from moving people, to moving goods, to moving less, or reducing the need for unnecessary travel and shipping.

Moving People—New approaches to moving people include integrated mobility service packages, advanced transit approaches, trip information and mobility centres, sophisticated car-sharing schemes, innovations in bicycle infrastructure and provision, advanced electrified urban rail networks, and more. A number of these innovations are being explored in the Toronto region, including Auto Share's successful car sharing business, and Moving the Economy's Integrated Mobility Systems, an electronic pass which will link a whole range of transportation and other service options.

Moving Goods—New approaches to moving goods address the entire mobility chain through city logistics, joint distribution centres, bundling of freight transport, cleaner freight vehicles, fuels and green fleets, new approaches to air and marine freight, local production and distribution, and human powered goods movement. Goods movement is becoming a key urban issue as cities grow. A number of goods-related innovations are being explored or applied in Toronto, such as Exel's Toronto Regional Campus that consolidates manufacturers with similar distribution channels and centralizes freight management, and the City of Toronto's Green Fleets initiative that optimizes routes and introduces cleaner vehicles.

Moving Less—New approaches to providing more efficient access (moving less) include advances in telework and teleconferencing, New Media applications like teleshopping, telebanking, distance learning and distance medicine, as well as progressive zoning and growth management policies, mixed use community centres and development around transit stations, car-free housing options, and more. Here in the Toronto region, innovative zoning approaches such as the Kings and the Waterfront aim to revitalize

downtown industrial and potential live-work areas; and the Government of Ontario's Smart Growth Initiative has also identified the need to address and link decisions on issues such as transportation, infrastructure, land use, housing and public investment.

2.2. Adding Value to Traditional Transportation

Within each of these areas (moving people, moving goods and moving less), New Mobility innovations bring added value to traditional transportation systems in ways that are:

- Integrated
- Smart
- Clean
- Service-Oriented
- User-Focused

Integrated—New Mobility integrates transportation modes, services and planning. For example, New Mobility reduces dependency on one mode and provides seamless, convenient access to whatever combination of modes can best serve the particular transportation need. It integrates transportation services with other lifestyle services to create user-focused service packages. It also integrates planning and governance across a wide spectrum of transportation, land use, economic and urban development issues.

Smart—New Mobility incorporates a range of information and communication technologies into transportation services, infrastructure and modes. It applies technologies such as wireless communication, smart cards, the internet, and global positioning systems to create Intelligent Transportation Systems (ITS) to reduce, replace, or make more efficient physical travel, and to provide better traveller information. It also includes knowledge-based applications such as human factors design and decision support systems (DSS) for land-use and transportation planning.

Clean—New Mobility contributes to achieving an environmentally sustainable transportation system. Depending on the specific application, New Mobility may address air pollution, fuel consumption and greenhouse gas emissions, land use, noise pollution, resource conservation, and other environmental impacts of traditional transportation.

Service-Oriented—Changes in transportation reflect an economy-wide shift in business orientation towards service intensification. New Mobility involves a distinct shift from merely providing vehicles and infrastructure to offering door-to-door mobility services that allow people and businesses to more conveniently and effectively meet their diverse and dynamic transportation needs.

User-Focused—By providing integrated, smart, clean, service-oriented transportation services, New Mobility offers a greater capacity to create and market customized, user-focused products and services. It enables a shift away from the one-size-fits-all approach

of today's transportation system to attend much more closely to the individual needs and preferences of the customer.

The following table outlines some examples of New Mobility which embody these five areas of added value. The remainder of this section draws on many of these examples as it explores each area of added value in greater detail.

New Mobility in Action: Selected Examples

	Moving People	Moving Goods	Moving Less
Integrated	Multi-Application Smart Cards: - Izmir, Turkey - Hong Kong - IMS, Canada Mobility Packaged in Housing: - Stadthaus Schlump	Modal Integration - CN RoadRailer - CP Expressway	Mixed-Use Developments - Villa Italia Smart Growth Planning - Portland, Oregon - Ontario Smart Growth
Smart	Real Time Tracking: - Helsinki bus notification - NextBus, San Francisco Traveller Information kiosks, electronic signage, wireless Congestion Management Transit Priority Signalling	Fleet Management Systems -unit tracking -positioning and data exchange Commercial Vehicle Regulatory Systems	Teleconferencing Telecommuting Telemedicine Distance Learning E-commerce
Clean	Increasing modal share: - GO Boulder - Rovaniemi, Finland Advanced Fuels, Vehicles Ecotourism & Transport - Soft Mobility, Europe - Green Tourism, Toronto	Route Optimization: -Toronto Green Fleets Fuel-efficient & alternative fuel vehicle purchasing policies Improved maintenance & reduced idling practices	Telework - British Telecom
Service-Oriented	Vehicle Sharing - Toyota's Crayon - Toronto's AutoShare - Shared Bikes Trip Coordination & Information - TMAs - Wuppertal's Mobicenter - Montreal's Tous Azimuts - InfoMobility Network - Walking School Bus	Goods movement services and coordination: - Third-Party Logistics Providers	Distance Medicine Distance Psychiatry Distance Learning
User-Focused	Mobility Packages: - Swiss Mobility Transit and Vehicles for Special Needs - SaFIRES, Virginia - Taxitub, France - Electric station cars	Home Delivery: - Grocery Gateway	Enhanced Teleconferencing (Telepresence): - Toronto-based Telbotics

2.3. The Trend to Integrated Transportation

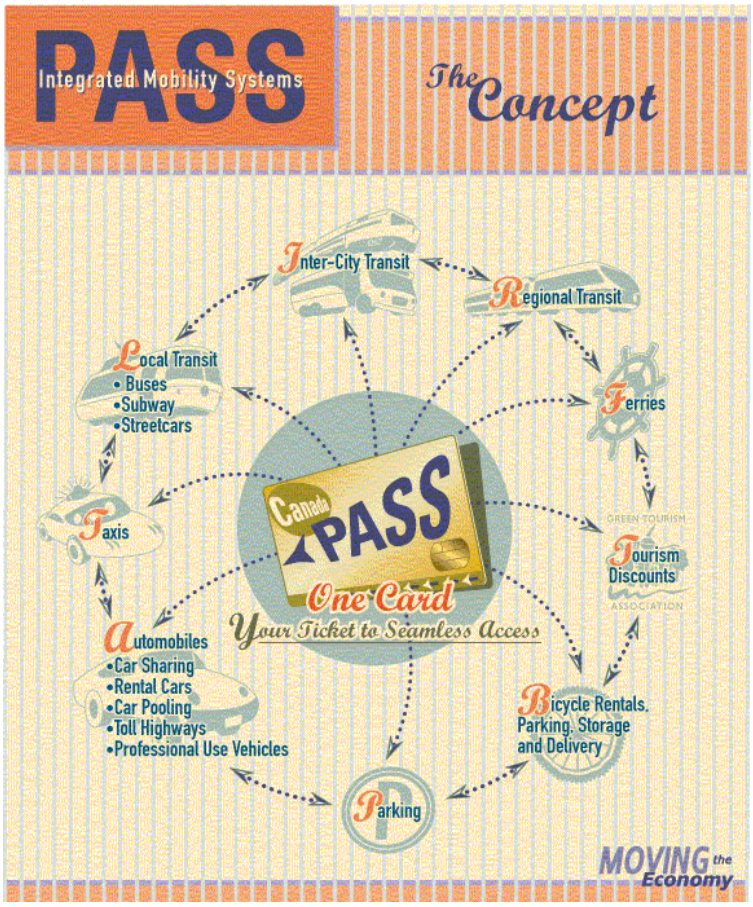
A key element of New Mobility is better integration across systems and modes, both for passenger transportation and for goods movement. **Modal integration** has been a prominent issue for freight for many years, in an effort to create better door-to-door customer service using the most competitive combination of truck, rail, air and marine. More recently, practical breakthroughs are being made to integrate modes for moving people. Examples of modal integration include:

- **Izmir, Turkey's Smart Card**—This smart card payment system integrates commuter train, transit and ferry services into a one-payment network and provides travellers with complete intermodal service. As an extra incentive to use these modes and help contain the growth of the personal vehicle population, the Smart Cards allow travellers one hour between modes to run errands before reboarding on the same fare.

- **Canadian National Railway's RoadRailer and Canadian Pacific Railway's Expressway**—Canada's two major railways are implementing new intermodal technology to further integrate truck trailers and rail cars. The systems eliminate the need for cranes and other infrastructure to load trailers onto traditional rail cars, and reduce time spent at transfer facilities. The systems make rail more attractive to shippers by adding the flexibility of trucking's door-to-door capacity.

The trend towards integration is not limited to transport modes. **Multi-application service integration** is also expanding rapidly and adding value for users by integrating services and retail with transportation. Examples include:

- **Canada's Integrated Mobility Systems Consortium**—Led by Moving the Economy, this Consortium is a Canada-wide initiative of over 20 members exploring smart card electronic fare payment to link multiple applications and modes. The consortium membership includes representation from parking authorities, toll roads, carsharing, transit, commuter rail, and urban green tourism. A demonstration has already linked payment for GO Transit, Burlington Transit, and Burlington Swimming Pools all on one smart card so transit riders can get a free swim after ten transit rides.



- **Hong Kong's Octopus System**—Currently the world's largest multi-application service integration project in the transportation sector is Hong Kong's Octopus System. Over 7.5 million smart cards are in circulation offering seamless access to the region's major transportation providers. The Octopus card covers 30 mobility service operators (ferry, bus, light rail, heavy rail and the underground), plus parking, telephones, retail and vending, and building access control.[4] New applications are being added. Non-transport applications have already captured 2 percent of 7 million daily transactions from limited rollouts and trial applications. [5]

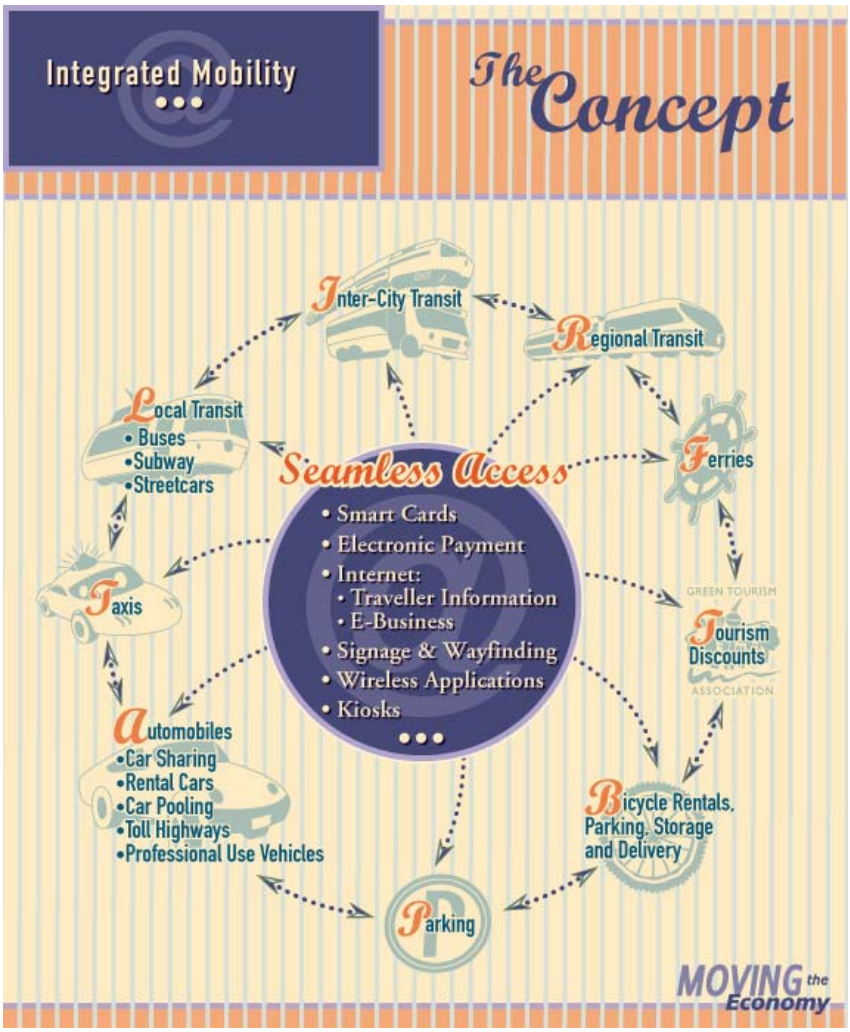
At the level of infrastructure and development, there is also a shift to **integrated planning**. Smart Growth planning concepts are gaining in popularity across North America and elsewhere, where integrative thinking brings people and their needs closer through mixed-use (jobs-housing balance) and higher density (more compact) developments linked by transit and other sustainable transportation systems. Such strategies can yield economic benefits for regional economies by lowering infrastructure costs, and by freeing up land that would be used for transportation and allowing it to be used for higher value activities.

Some leading edge developers (residential, institutional, commercial and industrial) are incorporating on-site mobility services such as car sharing, car rentals, carpooling and transit connections, technologies such as video-conferencing and high-speed internet access for telecommuters, as well as design and location choices that fit developments into more compact, mixed-use environments. For example:

- **Villa Italia**—This 35-year old suburban mall in Lakewood, Colorado is being redeveloped into a downtown-style development by Continuum Partners. The new complex will take the old mall's huge parking lots and covered shopping spaces and transform them into 19 blocks of mixed-use retail, residential and office space. [6]

- **Stadthaus Schlump**—Developers Gessner and Raap built this 44-unit housing development in Hamburg, Germany. Rental apartments offer a "mobility package" consisting of a public transit travelcard and access to a pool of 4 shared cars, as well as communal bikes for rent. Fifteen further parking spaces are available for the residents and on-street parking is permitted. Schools, shops, services and workplaces are all easily accessible. [7]

2.4. Getting Smart



On its own, integration is not new. What has changed is that the capacity for integration is expanding exponentially as smarter technologies are developed and applied. Intelligent Transportation Systems (ITS) now include advanced traffic management systems, electronic payment and access systems, commercial vehicle regulatory systems, fleet management systems, in-vehicle information systems for navigation, security and traveller information, advanced vehicle control and safety, and internet, wireless, smart cards and various e-commerce applications.

These technologies are doing more than just enabling integration; they are also adding value as they transform transportation into a more knowledge-based industry. For example, travellers get added value as real-time information and tracking provide them with better information, through services such as:

- **Helsinki's Bus Tracking and Notification System**—In Helsinki, Finland, workers can receive an automated call at the end of each day telling them that their bus will be arriving at their usual stop in a specified amount of time. [8]

- **NextBus Information Systems**—This San Francisco company has implemented bus-tracking systems in San Francisco, Boston, Oklahoma City, and two Northern Virginia suburbs of the District of Columbia. GPS/wireless transceivers send bus positions to a central information centre where the distances between the bus and all of the stops along its route are calculated. Estimated arrival times for each stop are sent over the internet where they are accessible by travellers carrying a personal digital assistant or cell phone.[9]

Such information technologies have already transformed the business of shipping goods into the knowledge-based industry that is now called logistics. Modern logistics—the process of handling the storage and flow of materials and related information along the supply chain from the point of origin to the point of consumption—depends heavily on

sophisticated tracking and information management technologies, many of them pioneered by the large courier companies. Specialized software, global positioning systems (GPS), geographic information systems (GIS), wireless communication and numerous other rapidly evolving technologies are the tools with which logistics contributes to competitive advantage for businesses. Not surprisingly, as logistics have become more complex many businesses that used to do their logistics in-house have outsourced to specialized third-party providers, which are able to integrate and customize logistics functions into seamless supply chain management.

Today, logistics is a key value-added service for business. In fact, it is one of the leading determinants of the prices of goods and the quality of customer service. In major corporations, logistics and supply chain management have become senior management functions.

Governments also benefit from the added value that new technologies are bringing to transportation. Municipalities benefit from the capacity to quickly identify and clear road blockages by providing drivers with real-time information on travel conditions and by controlling traffic signals. Traffic can be managed to reduce congestion, spread traffic efficiently across the network, and give transit priority to navigate through the network. The net result is improved traffic flow, less idling and lower vehicle emissions.

Several U.S. state transportation departments and commercial carriers rely on ITS and electronic links to centralized databases for their Commercial Vehicle Regulatory Systems at truck weigh stations, border crossings and safety inspections. Eliminating long queues and improving collection of regulatory data can lead to higher productivity levels for carriers and state agencies, safer highways and weighing facilities, and less damage to the environment from excess idling at weigh and safety stations and border crossings.

The added value in implementing information technologies and ITS does not just result from better information systems or trip efficiency. In many cases, technologies can increase efficiency by reducing the need for trips altogether. Telecommunications technologies have rapidly permeated all aspects of business and personal activity in ways that allow telecommunications to reduce or substitute for travel, including:

- Telecommuting to avoid trips to work;
- Teleconferencing and videoconferencing to avoid trips to out-of-office meetings;
- Telemedicine and distance learning to avoid trips to access health care services and education opportunities;
- Internet access to information that once required travel to libraries, government offices and other information sources; and
- E-commerce that allows business and personal purchasing over electronic channels, avoiding trips and allowing deliveries through efficient, consolidated distribution systems.

2.5. Meeting the Demand for Clean Transportation

New Mobility products and services are responding to increasing demand for environmental performance. In today's context of greenhouse gas emission reduction targets and emissions trading, this is not just a social or environmental benefit. Environmental performance can be a bottom-line competitive advantage in the marketplace, especially when dealing with public sector clients. Depending on the specific application, New Mobility may address air pollution, fuel consumption and greenhouse gas emissions, land use, noise pollution, resource conservation or some of the other environmental impacts of traditional transportation.

Advanced vehicles and fuels comprise one facet of New Mobility that contributes to cleaner transportation. Alternative fuels—including biodiesel, electricity, natural gas and hydrogen fuel cells—are a key element of strategies to mitigate environmental impacts such as smog and climate change and offer a potential approach to meeting energy security objectives. They all offer the benefit of moving people and goods with fewer emissions and reduced dependence on fossil fuels. Advances in vehicles include both major advances in engine technologies—such as the recently introduced hybrid vehicles—as well as vehicle improvements including advanced materials, smaller dimensions, improved aerodynamics, and advances in pollution control systems.

A second way in which New Mobility mitigates the environmental impacts of transportation is by increasing the modal share of more sustainable transportation modes. For example, New Mobility systems and technologies can be used to increase the attractiveness of sustainable transportation options by making them more convenient. Illustrative programs include:

- **GO Boulder**—Since 1989, Boulder, Colorado has pioneered innovative programs including the ECO Pass for businesses, CU Pass for students and a neighbourhood pass for residents. Total enrolment in these bus pass programs is close to 50% of the population. They have also established two new transit services the HOP and SKIP that carry over 2.7 million passengers, and have created over 100 miles of new bikeways. Between 1990 and 1998 GO Boulder's programs shifted close to 9% of vehicle miles of travel from Single Occupancy Vehicles to other modes.[10]

- **Rovaniemi, Finland Smart Card**—Rovaniemi experienced a 30 percent increase in transit ridership when Smart Card payment enabled transfers between five local transportation service providers and a flat fare was introduced.

A third way that New Mobility diminishes the adverse environmental impacts of transportation is by making it more convenient to avoid taking trips altogether. Many companies are achieving this by encouraging their employees to telework. British Telecom, for example, boasts that their 3,500 teleworkers save 424,000 car miles, and 190,000 rail miles per week, thereby avoiding 152 tonnes of CO2, as well as the time spent travelling.[11]

For moving goods, environmental goals can be achieved through increased efficiency of fleet operations. In Canada and abroad, numerous fleet operators—including shippers, couriers and governments—are working to improve the environmental performance of

their fleets while also generating cost savings. Fleet managers are implementing vehicle-purchasing policies that emphasize fuel-efficient or alternative-fuelled vehicles, improved maintenance practices, reduced idling and route optimization. Impacts on vehicle emissions and bottom-line savings are real and measurable. For example:

- **Toronto's Green Fleets Initiative**—This program includes a route optimization initiative for garbage and recycling collection. Through such measures as shifting to ten hour days and thereby reducing trips to transfer stations, the program reduced the fleet's vehicle kilometres travelled. This has generated substantial savings in fuel and maintenance costs, reduced the number of vehicles required and lowered emissions of greenhouse gases and other air pollutants.

Growing demand for products and services which improve environmental performance is also reflected in the tourism sector. Ecotourism is the fastest growing segment of the tourism industry (4-10% per annum,) [12] and as cities become more popular as destinations, urban ecotourism is also growing niche. A number of jurisdictions have established urban green tourism initiatives in order to protect the environment and quality of life that attracts visitors to their cities.

- **Network for Soft Mobility in European Tourism**—This European Union network recognized that for many tourists, an important criteria for choosing a destination is the quality of the environment there. Traffic congestion and its negative externalities had become such troublesome factors that a model project for "soft mobility in tourism destinations" was developed. The working group consists of 12 destinations and 6 expert organisations from three countries (Austria, Germany and Italy). Their goal is to create a Europe-wide network to exchange know-how and expertise. With partners in tourism, transport, and environment, they seek to implement environmentally sound transportation solutions at the destinations and on-the-journey, and to improve the quality of life in the participating communities.[13]

- **Toronto's Green Tourism Association**—Over 16.1 million people visited Toronto in 2000, bringing $3.34 billion in revenue, but also imposing a substantial strain on the city's environment and infrastructure. Toronto's Green Tourism Association works to address this by cultivating a green tourism industry within the Toronto region that is ecologically sound, fosters appreciation of and respect for diverse cultural & natural heritage, and strengthens local economies and communities. The GTA's work has been recognized internationally and its model is currently being developed into a multi-city package to support development of similar initiatives in other urban areas. [14]

Because tourists are major users of urban transportation systems this trend to urban green tourism also contributes to growing demand for clean transportation and New Mobility. While the preceding examples demonstrate that there is a growing demand for clean transportation, not all trends in transportation are showing positive environmental impacts, and this is particularly true in goods movement. In the 20th century there was an explosion of freight activity. The unprecedented urbanization of the world's population has meant that the vast array of goods and services needed by today's three

billion city dwellers must be sourced, created, transported and distributed to their final destinations. Freer trade and the emergence of large corporations serving a world market or sourcing materials and labour on a global basis means that transport routes are longer and more complex.

As goods movement continues to grow and become more complex, so does the search for better and more efficient means. Just-In-Time (JIT) manufacturing methods reduced inventory costs, but also resulted in smaller orders and more frequent deliveries, increased the economic importance of having a free flowing transportation network, and contributed to the shift of goods from rail to more energy-intensive trucking. Similarly, e-commerce offers the potential to reduce trips, but left unchecked may end up expanding distribution systems and increasing the frequency of small deliveries.

2.6. Shifting to a Service-Oriented Business Model

A current trend in the way businesses provide value for their customers is a shift of emphasis away from selling products towards a greater focus on providing services. New Mobility reflects this trend by shifting the emphasis in transportation away from selling vehicles to providing mobility services. In essence, through New Mobility, **access to mobility is being decoupled from motor vehicle ownership**. This is particularly true in the arena of goods movement, where third-party logistics professionals offer clients goods movement services and coordination. They are thereby providing their clients with "mobility" for their goods, while also relieving the clients of the need to own a fleet of vehicles.

- **Third-Party Logistics Professionals:** As globalization has produced more distant and complex value chains, logistics has become a key component of business activities and a source of competitive advantage. Third-party logistics providers have emerged to design and implement customized logistics solutions tailored to the needs of individual clients.

In moving people, carsharing services provide mobility without the need for vehicle ownership by allowing people to pay only for their actual vehicle use through an "organized short-term car rental" arrangement.[15],[16] Typically, motor vehicles have high fixed costs and are used for just a short time each day while the vehicle sits parked most of the time. The idea of carsharing is that motor vehicles can be used as a shared resource, so that people who do not want to own one can still access a vehicle when needed. Many organizations are neighbourhood-based, catering to residents who need vehicles for short round trips. Subscribers can retrieve vehicles at a nearby location and pay a user fee based on the distance driven and the time used. Insurance costs, maintenance costs and gasoline purchases are often included in these rates. The more advanced organizations use smart technologies, such as smart cards for payment, internet-based reservations and wireless vehicle tracking.

- **Toyota's Crayon Program**—In May 1999, three hundred Toyota employees in Japan began an experiment in a smart car sharing system known as 'Crayon'. This system employs a suite of advanced electronic features including smart cards, an

automatic vehicle location and information system, and a fleet of electric cars known as 'e-com'. Toyota employees reserve the vehicles and drive them between their homes and work sites.[17]

- **Toronto's Autoshare**—In the Toronto region, Autoshare began offering car-sharing services in 1998. Only four years later they have a fleet of 38 vehicles and over 650 members.[18]
- **Shared Bikes**—In some parts of the world, sharing and rental concepts are being successfully applied to bicycles. Areas in Singapore, Norway, France and the United Kingdom are demonstrating the high-tech approach to bicycle sharing, incorporating smart cards for payment and positioning, and wireless technologies to track and manage the dispersion of bicycles across rental locations.

The service intensification within New Mobility also refers to a growing set of services related to the management and coordination of trips. As noted above, Third Party Logistics providers offer services related to the management and coordination of freight shipments. In a similar vein, a growing array of services are becoming available that assist travellers and commuters in the management and coordination of their daily journeys. For example:

- **Transportation Management Associations**—TMAs have formed in major cities across the U.S. They typically offer regional services such as ride matching and guaranteed ride home, assistance to local businesses in establishing vanpools, and a central source for information about transit and other mobility options. In short, the associations offer a one-stop source of a range of services that individuals can package and tailor to meet their specific commuter transportation needs.
- **Mobicenter**—Wuppertal, Germany established the "Mobicenter," a multi-modal travel information call centre open to the public. It provides access to information on all locally available forms of transportation and gives customers assistance in mode and route selection. It sells tickets for public transit and railways, operates carpooling and carsharing services, and provides a home delivery service. Through these services, the centre seeks to reduce travel or shift it to more environmentally sound modes.[19]
- **Tous Azimuts**—La Société de transport de Montréal (STM) and the Groupe MADITUC of the École Polytechnique de Montréal have developed an innovative online tool that assists customers in reaching a specific location and planning their trip. Tous Azimuts (all-out search) suggests one or several itineraries to the user, taking into account the traveller's departure and arrival points, as well as the day and time of the trip. This online traveller information tool provides the user with several options for getting the information he/she needs. The user can search by either clicking on a map, or through text searches by address, intersection, station or important place lists.
- **InfoMobility Network**—Moving the Economy's InfoMobility Network initiative is working on one project to bring together traveller information from urban regions across Canada through a one-stop online portal. The Network also works collaboratively with representatives of these regions to support and stimulate ongoing enhancements to traveller information services and technologies for users and operators.

- **Walking School Buses**—Canada's Active and Safe Routes to School program promotes the "walking school bus" concept. Walking school buses address the growing portion of morning peak period traffic accounted for by parents driving children to school as a result of safety concerns. Instead of driving their children to school everyday, the program organizers determine routes for organized walks, and coordinate parents to take turns leading "walking school buses." Exercise, social opportunities for parents, reduced congestion and better air quality around schools are among the benefits.

In addition to enhancing the movement of goods and services, the service intensification involved in New Mobility can also reduce the need for travel. This is achieved by providing access to services without the need to travel to get them. Examples include New Media applications such as distance medicine, distance psychiatry and distance learning. In each case, telecommunications substitute for travel. In cases where travel is difficult (such as remote areas or when people lack access to motor vehicles), electronic access enhances service levels and flexibility for the customers.

2.7. Increasing Capacity for User-Focused Customization

Increasingly, transportation products and services are tailored to the specific needs of particular users. This can offer a competitive advantage in the marketplace. Lifestyle and demographic dimensions significantly influence the choice of transport modes by users, and marketing strategies are taking this into account as customers become more discerning about the services that fit their specific lifestyle and daily needs. One example of such an approach to user-focussed customization is Switzerland's Mobility CarSharing, which offers three mobility service packages for customers to pick from, depending on their mobility needs:

- **Zuri Mobil**—This package includes a regional transit pass linked with carsharing and car rental.
- **Zuger Pass Plus**—This package offers a discounted combination of carsharing, public transit, car rental, taxi and bicycle, plus loyalty programs for other non-transport related services (similar to a frequent flyer program.)
- **Easy Ride Switzerland**—In 1998 the company partnered with the Swiss National Rail System to offer a mobility package to 1.5 million rail pass-holders that provides rail users with special discounts and easy smart-card access to carsharing vehicles, rental cars, and transit.[20]

As initiatives like these expand and technologies improve, travellers may ultimately be able to pick mobility packages like cable channels, and pay-as-they-go only for the transportation services they want.

User-focus is also beginning to permeate public transit. Transit operators are paying increasing attention to the door-to-door experience of the customer by providing a range of flexible services to meet the specific routes and timing preferences of individual riders. For example:

- **SaFIRES**—The Smart Flexroute Integrated Real-time Enhancement System in Prince William County, Virginia consists of six routes that deviate from the assigned route within a 2.5 km corridor. The service operates with 12 vehicles during the peak period and averages over 1,000 trips per day. Since door-to-door service is provided, this eliminates the need to provide para-transit service for people who are physically handicapped. The service is enabled by GPS vehicle location, real-time scheduling and dispatching software, and GIS mapping. Communications between vehicles and the dispatch centre are accomplished through in-vehicle mobile data terminals.[21]

- **Taxitub**—This service offers transit-on-demand with 50 "virtual" routes in the outlying residential ring of Saint Brieuc, France where low density makes regular transit routes impractical. Taxitub routes are virtual in the sense that they are activated only at the request of a customer. Transportation is provided by the local taxi service. A computer collects requests, seeks opportunities to group customers and calls up taxis until one is found. Users pay an amount equivalent to a transit fare, while the taxis are paid the amount that appears on their meters. The District covers the difference. In 1995 Taxitub transported an average of 800 people per month with 520 trips. Operating the service cost the District about 250,000 francs per year compared to 4,000,000 francs that would have been needed to operate an equivalent bus system.[22]

Customization does not just relate to services, it can also apply to vehicles by making available **the right vehicle for the right job**. For example, station cars are small electric rental vehicles that allow patrons to connect from home to a transit station or from a transit station to a work site. The concept evolved because many people choose to drive alone to work, even when their destinations are within a few miles of transit, because of a lack of guaranteed parking at transit stations. Station cars have dedicated parking spaces at the transit station to allow for recharging, and since the cars are smaller than conventional vehicles, they allow for additional parking at the transit station. Station cars are particularly well suited for suburban transit rail stations, where employment sites are widely dispersed.

In contrast with conventional transit bus service, **station cars** offer time savings and superior convenience because the vehicles can be driven directly to the desired destination. The same station car used to get to a suburban station by commuters going downtown in the morning can be used again to go from a suburban station to a suburban office work site and returned in time for commuters coming from downtown to use it for the evening return trip. Currently, there are 11 station car programs underway or being planned in the United States. The largest program is in the San Francisco Bay Area and involves over 40 vehicles at four Bay Area Rapid Transit (BART) stations. Since the vehicles are electrically powered, they offer potential reductions in air pollutant and greenhouse gas emissions compared to traditional automobiles.[23]

In the arena of goods movement, user-focussed customization through home delivery systems is becoming commonplace. Internet-based retailers provide consumers with access to goods and services directly to their doorsteps. For those with limited time or limited access to transportation (such as lower income and elderly people) such services

are rapidly becoming an important way to avoid the inconvenience and expense of travelling to central stores. Grocery Gateway, often seen in the Toronto region, is one example.

- **Grocery Gateway**—This business offers internet and telephone-based customer ordering with a home delivery service. The company provides consumers access to shopping from their home without the inconvenience and expense of travelling to central stores.

Such internet-based retailers succeed largely on their logistics, and seek cost savings by achieving economies of scale in delivery. The greater their concentration of deliveries, the lower their transportation costs and the greater their competitiveness vis-à-vis traditional retailers. Even greater fuel efficiencies could be achieved through the use of smaller, better designed vehicles and/or alternative fuels.

In the arena of moving less or reducing unnecessary trips, **telepresence** companies are enhancing the personal experience of the user in teleconference situations. Toronto-based Telbotics is developing specialized teleconferencing modules that simulate the key elements of face-to-face interaction much more effectively. The modules include swivelling monitors that simulate real eye contact, a robotic arm that can be manipulated to indicate the wish to speak, and an on-board printer to allow documents to be transferred in the meeting context. Trials are underway with purpose-built modules linking hospitalized children to their school classrooms.

Section 3 Emerging Global Markets for New Mobility

The trends described in Section 2 suggest a future transportation system quite different from the system of today. From a cluster development perspective, the key is to understand the economic opportunities that will emerge as a result of those trends: the significance of the markets, what's driving demand, who's investing and where is the export potential for Toronto-based businesses.

Worldwide, transportation is big business. In Canada, expenditures on goods and services related to transportation account for 12.8 percent of our gross domestic product and there are an estimated 854,000 workers in jobs related to transportation services and infrastructure.[24] This is typical of most developed countries. In many developing countries, transportation is rapidly reaching similar prominence.

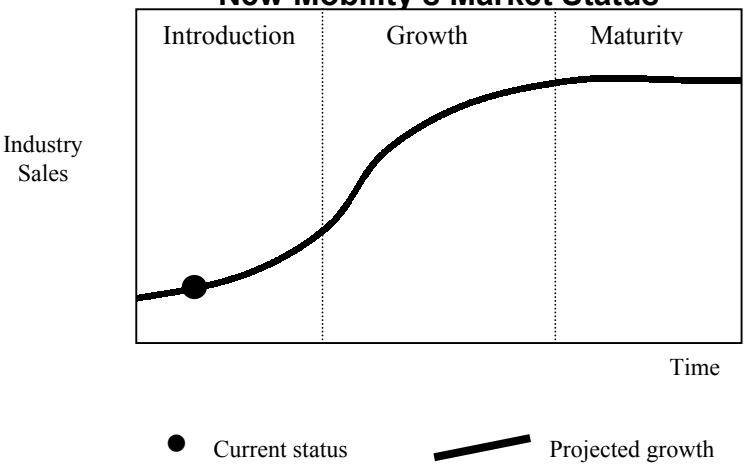
New Mobility comprises a growing segment of current transportation markets. This section begins to describe those global markets, both current and future, for New Mobility services and technologies. Much remains to be learned. New Mobility merges a wide range of services and technologies, crossing traditional industry boundaries and posing a challenge for using existing sectoral data. Furthermore, New Mobility services and technologies are dynamic and continue to evolve.

Nonetheless, available evidence suggests that New Mobility already offers significant business opportunities, that many New Mobility services and technologies do have export potential that could be served by a regional cluster, and that the trends driving demand for New Mobility point to accelerating growth.

3.1. New Mobility is Already a Substantial Market… and Growing Fast

Bringing new services and technologies to market follows a process of introduction, growth and evolution into a mature market. Though some New Mobility services and technologies might be characterized as pre-introduction (still in the incubation stage), many other New Mobility services and technologies have reached commercialization and are finding buyers. The current value of these markets is substantial—certainly measured in the billions of dollars. Yet current market value is only the tip of the iceberg, according to the forecasts presented below.

New Mobility's Market Status



3.1.1. Markets for Intelligent Transportation

The smart features of New Mobility already have significant markets. Current U.S. markets for Intelligent Transportation Systems (ITS) have been estimated at about US$2 billion, with similar demand in Europe and Japan.[25] Developing countries are also rapidly beginning to emerge as important markets. For example, in 1999 China imported US$42.3 million worth of electronic signalling and traffic control equipment.

By all estimates, demand for ITS applications will soon dwarf current markets. Within five years, wireless applications alone are expected to have an annual market value of US$8 billion in the United States and US$5 billion in Europe, creating significant opportunities for cellular system providers. [26],[27] For all ITS applications, average annual growth exceeding 20 percent has been projected for the United States, with annual market valued at over US$13 billion in 2010 and the cumulative market from 2000 to 2020 valued at US$81 billion.[28]

Other countries are also investing heavily in ITS. Hong Kong's New ITS Strategy, for example, calls for a Traffic Information Management Centre for real-time traffic information (among other features) requiring expenditures of C$600 million.[29] The Department of Foreign Affairs and International Trade suggests that Hong Kong will be buying over $100 million of ITS services and technologies annually and noted that ITS is also expected to be an important focus of China's next Five Year Plan.[30]

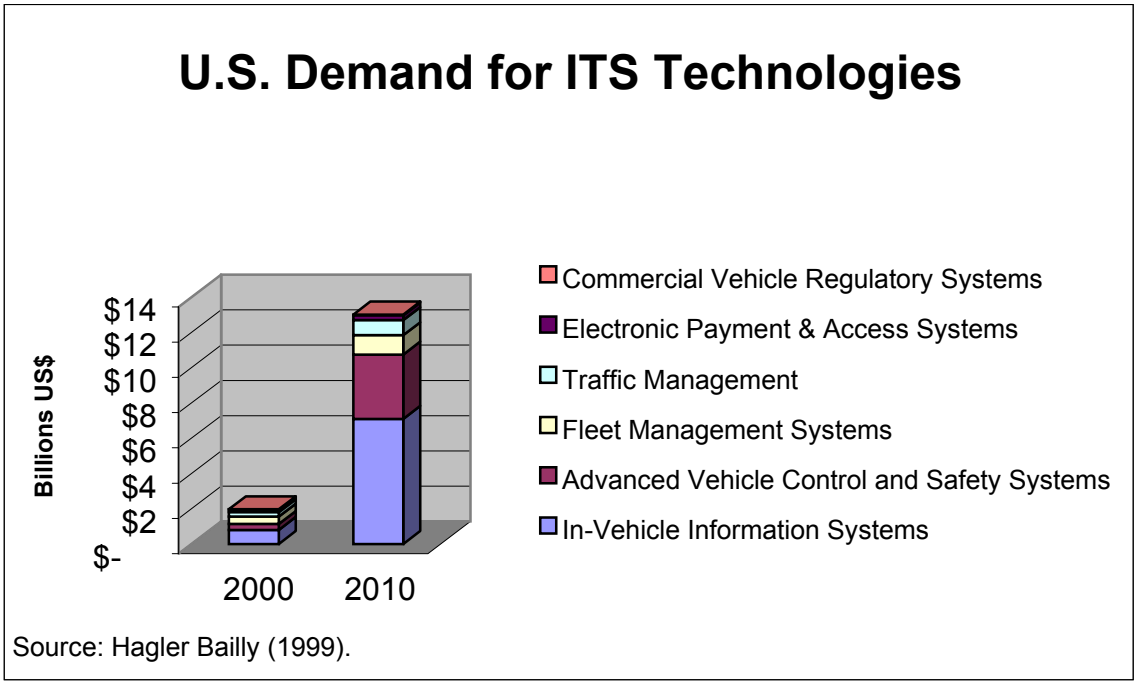
ITS-related New Mobility market segments appearing to offer the greatest opportunities include:

- **Traveller Information and Traffic Management**, including:
  - Video monitors, kiosks, talking signs and trip-planning systems to deliver real-time and static information to transit users,
  - Real-time data gathering and congestion-relief activities for freeways,
  - Traffic signal control systems for arterial roads, and
  - Emissions monitoring.

- **Fleet Management Systems**, such as:
  - Real-time unit tracking and automated driver data for long haul commercial fleets,
  - Dispatch functions for short haul commercial fleets and maintenance fleets,
  - Positioning and data exchange for emergency fleets,
  - Positioning, data exchange, electronic fare collection, signal priority, video monitoring and other technologies for transit fleets.

- **Advanced Vehicle Control and Safety Systems** encompassing a range of features that enable vehicles to sense and respond to their surroundings, including systems for hazard warning, adaptive cruise control, collision avoidance, vision enhancement, driver drowsiness warning, crash safety management and automated vehicle control.

- **In-Vehicle Information Systems**, including traveller information, navigation, and mayday and security, plus integrated systems combining features.



Source: Hagler Bailly (1999).

Smart Cards

Applying the concepts and technologies of the cashless society also promises to be a major market for a range of smart technologies, such as stored value cards, magnetic ticketing and smart cards (both contact and contactless). Such technologies facilitate financial transactions among bundles of integrated mobility services, including various forms of transit, ferries and parking. Internet access to accounts allows passengers to order new cards, reload their cards with extra value, verify purchases and get account histories quickly. In the process, travellers get increased convenience, transit agencies can reduce their costs of fare collection and other participating businesses can increase customer convenience.

Over 20 cities in Europe, East Asia and North America have already implemented or are implementing smart card systems for mobility services. The overall market for smart card applications in transportation is not well documented, but is clearly seeing major growth.

Cities with Integrated Smart Card Systems for Transportation and Other Urban Services

Barrie, Canada
Brisbane, Australia
Burlington, Canada
Chicago, United States
Christchurch, New Zealand
Hong Kong
Germany (52 transit operators)
Gothenburg, Sweden
London, United Kingdom
Manchester, United Kingdom
Melbourne, Australia
Montreal, Canada
Oslo, Sweden
Paris, France
Rome, Italy
San Francisco, United States
Seattle, United States
Seoul, South Korea
Shanghai, China
Singapore
South Wales, United Kingdom
Stockholm, Sweden
Washington DC, United States

Most systems have been established within the last several years, and many new investments are being planned. A sampling of existing investments (all in Canadian dollars) include: [31]

- Manchester—$35 million for a smart card system covering 2,700 buses
- Maryland—$60 million for Phase I of implementation for a state-wide smart ticketing program
- Rome—$425 million over nine years for a smart card system for bus, heavy rail and light rail services
- San Francisco Bay Area—$180-250 million (depending on rider usage) to integrate fare collection for 26 transit agencies in the region
- Singapore—$105 million for a smart card system covering all modes of public transport
- Sydney—$255-425 million over 10 years for a fully integrated smart card system for bus, rail and ferry across Sydney's entire transit network

3.1.2. Markets for New Mobility Services

As services continue to account for a higher portion of the world's economy, the trend from manufacturing towards services is also evident in transportation. Both goods movement and passenger movement are being affected. Third-party providers are filling the need for information services, vehicle access without ownership and a wide range of other mobility services.

From Vehicle Ownership to Vehicle Access

"Wheels when you want them," the motto of a Massachusetts-based carsharing organization, reflects a general trend away from the transportation sector's traditional business of selling vehicles to the growing business of providing access to motor vehicles, bicycles and other transportation modes on an as-needed basis.[32] Even some major auto manufacturers have taken initial steps to reposition themselves as purveyors of mobility, such as Volkswagen having established a carsharing service in 1997.

Vehicle leasing was a first step to decoupling mobility from vehicle ownership. Leasing has seen enormous success. In the United States, leasing captured one-third of the passenger vehicle market, up from less than 10 percent a decade ago.[33] In 2001, market share dropped to 28 percent as low interest rates made ownership more attractive, but medium term prospects remain solid. Leasing is also common for freight vehicles, with 70 percent of speciality freight cars now owned by leasing companies, and with leasing becoming more popular for all rail cars.[34]

Carsharing goes further, relieving people from having to own vehicles at all. While carsharing has yet to capture more than a tiny fraction of current markets, carsharing organizations have emerged in numerous cities in Western Europe, Canada and the United States. Various studies have identified significant market potential.[35] Mobility CarSharing Switzerland is perhaps the most ambitious, aiming to capture 12 percent of its target market. In Germany, market potential has been estimated at three percent of the total population, or about 2.45 million people. In North America, where the lower density

of many cities makes carsharing less convenient, 1.5 percent of the personal passenger transportation market has been suggested as a more realistic target.[36]

Station cars also provide short-term access to vehicles when needed. Station car programs offer vehicle rental services (often electric vehicles) located on-site at major mass transit hubs, making transit more attractive to people with final destinations off the transit corridors. Usually formed as innovative partnerships between transit agencies, auto manufacturers and car rental companies, such programs now exist in over a dozen U.S. cities and more are being planned.[37] The number of station cars involved is currently less than a thousand, but is growing rapidly. Vehicle manufacturers are recognizing it as a potentially significant market and working to create specialized vehicles to meet the need. The National Station Car Association has estimated that the optimistic market could be up to four million vehicles in the United States.[38] Alongside the vehicles themselves, programs would also create demand for a range of technologies, including:

- On-Board Technologies:
  - Vehicle access control systems
  - Real-time vehicle information systems
  - Crash avoidance systems
  - Navigation assistance systems
  - Pre-heating and cooling systems

- Off-Board Technologies:
  - Reservation, accounting and billing systems
  - Fleet management systems
  - Real-time vehicle information system
  - Vehicle access management systems
  - Queue and docking management systems [39]

Third-Party Logistics Service Providers

Logistics—planning, implementing and controlling the flow and storage of goods, services and related information from point of origin to point of consumption—is a massive industry, typically accounting for 10-13 percent of gross domestic product in most developed countries. In Canada, logistics firms generated revenues estimated at $50 billion in 1997 and employed over 400,000 people in 1998.[40]

A growing number of manufacturers, wholesalers and retailers are turning to third-party logistics firms to provide increasingly complex and tailored solutions. The trend towards third-party service providers is driven largely by:

- The increasing importance of logistics and supply chain management in business strategy and their direct impacts on profitability and market success,
- The growing sophistication and technology-driven nature of logistics, including the rapid evolution in business-to-customer and business-to-business transactions, and the introduction of advanced wireless, positioning and internet technologies to increase efficiency, reduce processing errors, reduce inventories and speed delivery, and

- More widespread acceptance of outsourcing as a business practice.

In the U.S., third-party logistics accounts for an estimated US$450 billion.[41] The **supply chain software** market alone was valued at US$3.1 billion in 1999, up 20 percent from the previous year and predicted to grow an additional US$1.4 billion in 2000 (not including revenues of US$522 million generated by vendors).[42]

While the Canadian market in third-party logistics generally lags behind the US, research by the University of British Columbia indicates that the sector may be undervalued in Canada.[43] Industry Canada estimates that already about 15 percent of all logistics activities in Canada are outsourced to service providers, and that "the demand for third-party logistics firms will continue to accelerate."[44]

Increasing emphasis on sustainable development is also creating demand for reverse logistics—operations related to reuse or recycling of products and packaging materials. Traditionally, most manufacturers did not take responsibility for the reuse, recycling or safe disposal of their products after consumer use. The bulk of used products were dumped or incinerated with considerable damage to the environment. More stringent waste management legislation to protect the environment has led to higher disposal costs and a growing emphasis on manufacturers actively managing their products through the complete life cycle. Already, businesses in the United States spend an estimated US$35 billion on reverse logistics, and that will likely continue to grow.[45]

Related IT Services

New Mobility's heavy reliance on information technology is creating demand for services throughout the IT supply chain. IT-related services can be expected to grow at a pace similar to the trends seen in intelligent transportation systems technologies. For example, US$150 million worth of traveller information technologies were bought in the year 2000 in the United States, with the annual market projected to reach US$1 billion in the next decade.[46] Services to back up this technology must grow at an equal pace. Required services include software development, data management, wireline (copper or fibre optic) and wireless communications (dedicated short-range, cellular, radio, satellite-based and microwave) and marketing.

3.1.3. Markets for Cleaner Modes, Vehicles and Fuels

New Mobility services and technologies generally promote a cleaner transportation system by expanding consumer choice and enhancing the operational efficiency of transportation networks. Some modes, vehicles and fuels are also cleaner on a per-vehicle kilometre basis.

Urban Transit Equipment

Environmental and traffic congestion concerns are spurring massive investments in urban transit across major cities in both developed and developing countries. Industry Canada suggests that over US$20 billion worth of guided urban transit equipment will be bought in the United States alone between 1995 and 2005.[47] Across North America, the market for urban transit vehicles has averaged about 550 vehicles per year and is projected to

increase to 650 vehicles per year. Major federal funding programs in the U.S. are well endowed. The Transportation Equity Act for the 21st Century (TEA-21) provide US$41 billion for transit investments over the six years of the program (1998-2003), with US$36 billion of this amount guaranteed.

Other developed countries are also undertaking massive investments in transit. In Europe, for example, in the year 2000 the United Kingdom launched a 10-year plan for transport that aims to double journeys by light rail and increase rail based passenger-kilometres by 50 percent by 2010.[48] The Government has committed £60 billion for railways and an additional £60 billion for local transport.

Though facing severe financial constraints, many developing countries are also treating mass transit as a priority in public infrastructure plans for major metropolitan areas. Pakistan, for example, has signed a US$500 million contract for a mass transit system in Karachi.

Alternative-Fuelled Vehicles

Scenarios for the penetration of alternative-fuelled vehicles (AFVs) vary considerably depending on assumptions about supportive government policies and technological advances. Optimistic scenarios show quite dramatic growth, while conservative scenarios that assume no further policy initiatives to require or promote alternative-fuelled still show substantial increases from today. For example:

- The U.S. Energy Information Administration predicts that, with current policies (i.e. no additional incentives or regulatory initiatives), U.S. light-duty vehicle consumption of motor gasoline will increase by 1.6 percent annually, but annual growth in alternative fuel consumption will be:

  Ethanol—5.7 percent
  Compressed Natural Gas—6.3 percent
  Liquefied Petroleum Gas—4.9 percent
  Electricity—14.3 percent
  Distillate (diesel)—9.0 percent [49]

- The U.S. Energy Information Administration also predicts that "advanced technology vehicles," including vehicles using alternative fuels or advanced engine technologies, will reach 12 percent of new U.S. vehicle sales by 2020.[50] This projected 2.1 million advanced vehicles sold per year is expected to include annual sales of 628,000 hybrid electric vehicles, 644,000 alcohol-flexible-fuelled vehicles, and 476,000 turbo direct injection diesel vehicles. Eighty percent of the market is expected to result from federal and state mandates for fuel economy standards, emission standards and other energy regulations.

- Under more optimistic assumptions than the U.S. Energy Information Administration, a U.S. Natural Gas Vehicle Industry Strategy was developed by the Gas Research Institute, the U.S. Department of Energy and other industry stakeholders. It estimates a market potential in 2010 of 1.6 million natural gas vehicles, up from current levels

of 65,000 vehicles.[51] To achieve this, a cumulative investment of $7.8 billion over the next decade will be required.

- Allied Business Intelligence, a marketing and strategy consulting firm, predicts that 1.5 million electric (fuel cell) vehicles could be on the road by 2011, reaching a market share of 2.7 percent.[52] However, if regulatory incentives are established and key technical challenges overcome, that number may increase to 2.4 million vehicles, or 4.3 percent of global automobile production.

- The European Union's Transport Policy for 2010 has established a goal that renewable fuels will comprise 20 percent of the market by 2010.[53]

- Long-range forecasts of the European fuel cell market show revenues reaching $16.3 billion USD by 2020 and $45.8 billion USD by 2040.[54]

3.1.4. Markets Related to Moving Less

New Mobility solutions aimed at moving less often rely on information and communications technology and urban planning to replace the need for unnecessary physical travel. Common applications include e-commerce, electronic conferencing, telework and distance education. The market demand estimates presented below capture the growing participation in these activities, but do not capture the value of economic "spin-off" benefits associated with expenditures on IT hardware, software and related services.

E-Commerce

E-commerce relies on information and communications technologies to facilitate the ordering and purchasing of goods and services, while minimizing the need for buyers to travel. In Canada, one out of every ten companies is now selling goods and services over the internet. Canadian companies received $4.2 billion worth of orders in 1999 from business-to-business and business-to-household sales.[55] The business-to-household market was worth $417 million, with over 806,000 households placing 3.3 million orders over the internet.[56] By 2000, total internet sales rose 73 percent to $7.2 billion. [57] Household activity expanded greatly, with 1.5 million households placing 9.1million orders worth $1.1 billion.[58]

Similar growth is occurring throughout developed countries. In 1998, North American online transactions were worth an estimated US$35 billion to US$100 billion. Due to the fast developing nature of this sector, projections of performance vary widely, from between US$0.86 trillion to US$2 trillion by 2003.[59] In the European Union, e-business revenues were estimated at US$87.4 billion in 2000 and are projected to grow to US$1.5 trillion by 2004.[60] In the United Kingdom, the first e-commerce survey by the Office for National Statistics estimated internet sales of nearly £57 billion in 2000, with private forecasts predicting that the UK e-commerce market will reach £189 billion by 2004. [61]

Electronic Conferencing

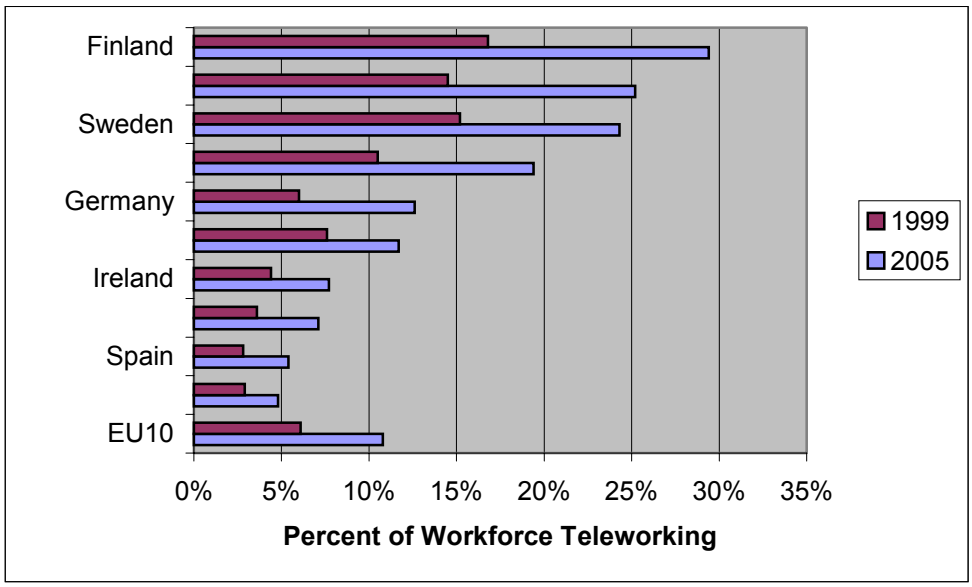
Driven by businesses seeking to cut travel costs and enhance worker security, world demand for electronic conferencing is expected to grow significantly. The United Kingdom, for example, has already seen revenues from videoconferencing increase to £122 million in 2000 – a 28.4 percent growth from 1999. Continued growth is projected to result in a U.K. market worth £332 million by 2005. [62] Worldwide, one estimate projects that demand for both video and audio conferencing will reach US$9.8 billion by 2006.[63]

Telework

The growing popularity of teleworking is creating demand for a wide range of information technologies, including computer and communications hardware, high-speed bandwidth and telephone services. Within Canada, federal government surveys show the number of teleworkers rose between 1991 and 1997 by 40 percent (from 600,000 to over 1 million). Further growth of 50 percent to reach 1.5 million workers by 2001 was predicted.[64]

The trend in Canada is mirrored in other countries, particularly European countries. In the European Union as a whole, teleworkers numbered an estimated 9 million (6 percent of the workforce) in 1999. The European Union's Electronic Commerce and Telework Trends (ECaTT) Project expects 16 million teleworkers (11 percent of the workforce) by 2005.[65] A full 4 percent of the labour force is expected to rely on telework primarily to avoid commuting trips.

Teleworking Growth in Western Europe



Source: ECaTT, www.ecatt.com.

Distance Education

Like telework, distance education appears to be growing rapidly. Already, the global market for technology-based learning has been estimated to be worth $6 billion currently and is projected to increase to $26 billion by 2005.[66]

Smart Growth

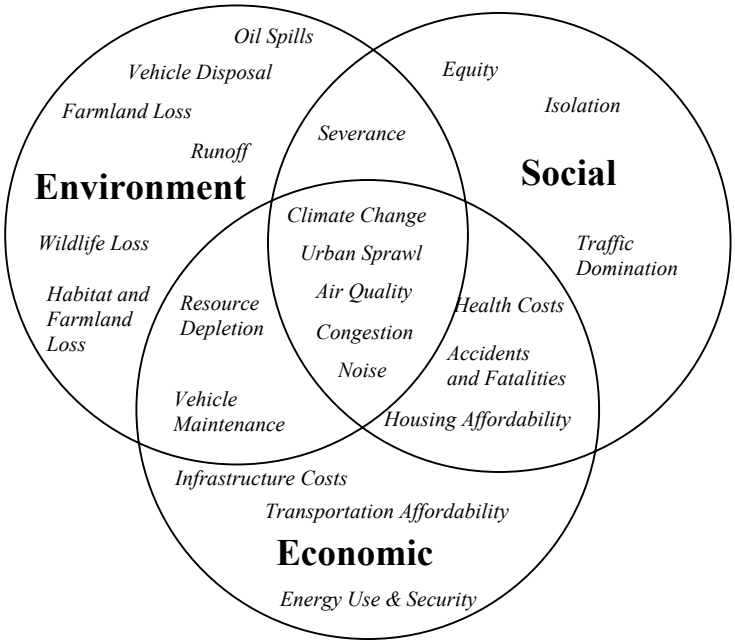
Smart Growth planning encompasses the goals of building communities where people and their needs are brought closer through mixed-use and higher density developments linked by transit and other sustainable transportation systems. As a movement, Smart Growth is likely to present a good opportunity in North America. The United States, in particular, has established a wide range of new programs and geared many existing programs to provide funding and other incentives for Smart Growth. This includes major programs for transit and highway funding, brownfields redevelopment, and air quality control. Much research is also underway to better understand the market potential of Smart Growth. Some research finds that demand for "New Community Design"—which includes features such as neighbourhood parks within walking distance, walking trails, bike paths and transit stops—could be as high as 33 percent among consumers.[67] Prohibitive local zoning codes, lack of financing and limited planning and design expertise are holding the current market to less than one percent of total housing construction.

Canadian governments are also expressing interest in Smart Growth, though are still in the early stages of implementing the major initiatives needed to make it a reality. Ontario, for example, has begun the process with five Smart Growth Panels to develop growth plans for different regions of the province. Growth plans will emphasize developing strong communities, a strong economy and a clean, healthy environment. Provincial level initiatives include a 10-year transit investment plan plus policies to redevelop brownfield sites and protect the Oak Ridges Moraine, a large, environmentally sensitive swath of land running just north of the Greater Toronto Area.[68]

3.2. What's Driving the Markets?

Today's transportation system will not meet tomorrow's needs, and transportation is so critical to economic, social and environmental well being that new solutions will be sought. New Mobility offers win-win-win solutions, responding to the growth in transportation demand in ways that address the economic, social and environmental challenges that render current transportation systems incapable of meeting demand in a sustainable way.

Challenges Facing Current Transportation Systems



3.2.1. Growth in Transportation Demand

Socio-economic and demographic trends virtually guarantee a continuation of the rapid escalation in mobility demand seen in the last 50 years in developed countries and even more so in developing countries. Mobility demand generally follows population, urbanization, economic activity, disposable income and per capita motor vehicle ownership, and all these are expected to grow substantially over the next 20 years.[69]

Population—The World Bank projects the total world population will grow by one billion by 2015, bringing the global population to seven billion.[70] Nearly all growth will occur in middle- and low-income countries, where the potential growth in mobility demand is greatest.

Urbanization—The move to urban areas continues unabated. Cities now claim 46 percent of the world's population, up from 39 percent in 1980. With urbanization comes a growing need to move goods and services to major population centres and to develop ways of moving people and goods within and between urban areas.

Economic Activity—In the last decade, worldwide gross domestic product rose by about 2.5 percent each year. Like population, economic growth has been higher in low- and middle-income countries, which have not yet reached high levels of transportation-intensity.

Disposable Income—Economic growth is increasing disposable income and consumption levels. Mobility, like most goods and services, is what economists call a normal good—as people's disposable income increases, demand for mobility increases as well.

WORLD BANK DEVELOPMENT INDICATORS

Projected Annual Growth in World Population, 1999-2015	
Low Income Countries	1.2%
Middle Income Countries	1.2%
High Income Countries	0.3%
Percent of World Population Living in Urban Areas	
1980	39%
1999	46%
Annual Growth in Gross Domestic Product, 1990-1999	
Low Income Countries	3.2%
Middle Income Countries	3.5%
High Income Countries	2.3%
Annual Growth in Private Consumption per Capita, 1980-1998	
Low Income Countries	1.4%
Middle Income Countries	2.2%
High Income Countries	2.2%
Growth in Motor Vehicles Per 1000 People, 1980-1999	
Low Income Countries	10%
Middle Income Countries	44%
High Income Countries	11%
Projected Growth in World Transport Oil Demand, 2000-2020	
International Energy Agency	2.5%
US Department of Energy	2.8%

Sources: Derived from World Bank Development Indicators, Tables 2.1 (Population Dynamics), 3.10 (Urbanization) and 3.12 (Traffic and Congestion).

Per Capita Motor Vehicle Ownership—Disposable income increases travel demand by, in part, making motor vehicle ownership more affordable. Worldwide, the last 20 years has seen the level of motor vehicle ownership rise from 118 to 122 vehicles per 1,000 people. Motorization rose by over 40 percent in middle-income countries and by over 10 percent in other countries. Dynamic urban regions, such as the largest cities in Russia, have experienced growth in vehicle populations by 50 percent or more in recent years.[71]

Tourism—An additional consequence of rising disposable incomes is increasing tourism-related travel. Tourism is already one of the largest industries in the world, and growth in this sector is expected to continue. World Travel & Tourism Council (WTTC) research projects a strong upward trend for the industry over the next decade with long-term annual growth at 4.5 percent in real terms for the global industry.[72]

Together these factors suggest that mobility demand will continue to grow into the foreseeable future. On a global basis, the International Energy Agency estimates that world oil demand for transportation will increase annually by 2.5 percent, while the U.S. Energy Information Administration predicts 2.8 percent annual growth.[73] In the developing world, the growth is much more dramatic, with a tripling of transportation

energy consumption predicted between 2000 and 2020. In the European Union, total kilometres travelled in urban areas alone are expected to increase by 40 percent between 1995 and 2030.[74]

This growing demand threatens the economic, social and environmental benefits of transportation, and heightens the need for New Mobility's win-win-win. A wide body of literature describes aspects of these economic, social and environmental drivers behind New Mobility.[75] The following sections do not aim to provide a comprehensive discussion of these drivers, but merely highlight some of the key points.

3.2.2. Congestion as an Economic Driver

Transportation is the lifeline of industrialized economies. Every good or service that is produced or consumed relies, in one way or another, on transportation. As economies around the world come to depend ever more on global trade, transportation becomes ever more important.

An efficient transportation system is a major factor in determining corporate competitiveness. Freight rates exert a great influence on trade patterns; however, direct shipping costs are perhaps the least significant way in which transportation affects competitiveness. Companies have woven logistics innovations into the core of their competitive strategies.

Given the importance of transportation to corporate competitiveness, a good transportation system is critical to a region's ability to attract new investment. In fact, surveys consistently rank transportation services as one of the most important considerations in business investment decisions.

Yet the ever-growing demand for mobility threatens the ability of many regions to deliver the needed levels of transportation service. Congestion has become a major concern as cities exhaust the available rights-of-way for new highways and face constraints on their abilities to finance new infrastructure. Aside from driver frustration, **congestion imposes real financial costs**.

- In the Toronto region, congestion-related costs were estimated in 1989 at over $2 billion annually. More recent suggestions are that congestion-related delays add 30 percent to the cost of moving goods in the Greater Toronto Area.[76]

- In the United States, the average annual delay per person in the United States has climbed from 11 hours in 1982 to 36 hours in 1999.[77] By the year 2000, the costs associated with rising congestion reached US$67.5 billion for 75 urban areas, including US$14.6 billion for Los Angeles, US$7.6 billion for New York City and US$4 billion for Chicago. Even smaller cities incurred high costs for congestion, such as US$105 million for Buffalo and US$50 million for Rochester.

- Elsewhere, congestion-related costs are equally problematic. World Bank studies found that downtown weekday traffic speeds in developing countries have slowed to

eight km/hour or less in Seoul and Shanghai, 10 km/hour or less in Bangkok, Manila and Mexico City, and 15 km/hour or less in Kuala Lumpur and Sao Paulo.[78] A World Bank study estimates that Bangkok loses up to six percent of the value of its regional economic production due to congestion.[79]

3.2.3. Environmental Drivers

New Mobility creates environmental benefits by helping to curtail the various environmental impacts of current transportation systems. This translates into a market driver because efforts to reduce land use impacts from transportation infrastructure, noise from vehicle operations, run-off from paved areas, wildlife deaths, and waste disposal all drive demand for New Mobility solutions. More significantly, vehicle exhaust emissions are a major environmental driver of demand for New Mobility, and this driver will grow in importance as commitments to respond to climate change promise to substantially increase the demand for New Mobility products and services.

If countries are to achieve their emission reduction commitments under the Kyoto Protocol and those expected to emerge from future rounds of negotiation, transportation must be part of the solution. Transportation produces 27 percent of all greenhouse gases from fuel combustion in developed countries, and up to 45 percent in countries like Sweden, Norway and New Zealand where hydroelectric facilities make up a significant portion of their power generating capacity.[80] In most regions, transport is also the source of greenhouse gas emissions that is growing most rapidly.

Already, most countries reporting their greenhouse gas (GHG) reduction activities to the United Nations Framework Convention on Climate Change identify a wide range of intended investments in New Mobility services and technologies, from transit, cleaner vehicle technologies and integrated traffic systems, to public education programs, road pricing and enhanced land use planning (see box next page). This demand is not limited to developed countries with specific emission reduction commitments under the Kyoto Protocol, but extends to many developing countries as well.

In addition to climate change considerations, efforts to improve air quality in urban areas are also driving demand for New Mobility. Regional air quality is a major concern across developed and developing countries, particularly within large cities. Transportation is a major source of sulphur dioxide, carbon monoxide, various toxic substances and the pollutants responsible for smog. While advances in emission control technologies and improved fuel standards have allowed reductions in these emissions on a per-kilometre basis, increases in vehicle-kilometres travelled continue to push up absolute levels of emissions in many regions of the world.

Governments are responding to air pollution because it imposes significant costs in terms of human suffering and environmental degradation, and also because it imposes real financial costs. In cities such as Jakarta, Kuala Lumpur and Manila, the World Bank's Urban Air Quality Management Strategy found that the costs of air pollution represented up to 10 percent of average urban income in the early 1990s.[81] In Bangkok alone, the

World Bank valued the health damages associated with poor air quality at US$500 million per year.[82]

Examples of New Mobility Investments Identified in Climate Change Action Plans[83]

Costa Rica (Percent of National Energy Consumption from Transportation = 46%)

- Investing in integrated traffic systems in the country's metropolitan areas to create a public transportation network that competes with other modes by using buses efficiently, optimizing routes, coordinating schedules and bus changes, and enhancing related transportation technology and infrastructure
- Re-opening its railroad system to provide national freight and passenger services
- Installing electric buses and other vehicles in the capital city and five other cities
- Implementing a fuel switching program to encourage use of liquefied petroleum gas

France (Percent of National GHGs from Transportation = 35%)

- Supporting new vehicle fuel efficiency standards
- Establishing institutional actions pertaining to freight transportation by road, compliance regulations, and pricing
- Increasing road-rail intermodal networks and improve waterway networks
- Developing markets for electric vehicles and vehicles powered by liquefied petroleum gas or natural gas
- Providing Economic incentives and minimum fleet procurement requirements for electric vehicles
- Requiring urban areas with populations over 100,000 to draft urban travel plans that focus on automobile traffic reduction, the development of inexpensive and low emitting transportation modes, and the development and use of transportation networks that includes electric high speed trains for inter-city travel

Republic of Georgia (Percent of National GHGs from Transportation = 31%)

- Monitoring exhausts and GHGs from motor transport vehicles
- Developing, rehabilitating and modernizing highways
- Developing aviation standards related to GHG emissions
- Investing in public transit (cable cars, monorail transportation and trolleybuses) and rail freight systems

Indonesia (Percent of National GHGs from Transportation = 24%)

- Promoting the use of public transportation, road pricing for congested areas, vehicle emission controls and the use of clean fuels
- Increasing transit capacity, with a focus on electric trains

Mexico (Percent of National GHGs from Transportation = 32%)

- Improving and replacing automobile fuels and vehicle inspection
- Providing environmental information and education programs
- Providing safe and efficient public transportation
- Integrating metropolitan policies (urban development, transportation and ecology)

3.2.4. Social Drivers

Trends in current transportation systems are undermining the social benefits offered by mobility. Rising congestion threatens to reduce the ease of access to work, recreation, cultural, social and retail that is critical to quality of life. The auto-dependency inherent in current transportation systems leaves those without vehicles—disproportionately, the young, the elderly and the handicapped—isolated or facing inconvenient, unsafe or costly trips using alternative modes.

Just as New Mobility offers economic and environmental benefits, so too does it generate social benefits by increasing transportation choices and allowing for services tailored to meet the mobility needs of individual users. For example, New Mobility offers:

- Improved urban planning to increase human interaction and community development;
- Reduced time spent commuting, leaving more time for social and recreational activities; and
- Safer streets and transport systems.

By reducing the need for unnecessary travel, making sustainable transportation more appealing and improving traffic flow, New Mobility can also help to curtail the apparent trend towards more aggressive driving (tailgating, deliberate obstruction, headlight flashing, verbal abuse, etc.) and "road rage." It may also help to alleviate traffic fatalities and injuries.

Where efforts are underway to alleviate the social costs of current transportation systems, this will increase demand for New Mobility solutions.

3.3. Who's Investing in New Mobility

The factors that are driving the demand for New Mobility are found worldwide, and buyers will be too. Capital constraints will challenge investors in developing countries, but with 21 cities with populations over 10 million and transportation systems becoming choked, investments will be a priority. Developed countries represented by the Organisation for Economic Co-operation and Development are already major markets. In these countries, investments are likely in both the largest cities and the medium-sized cities.

Players across the public-private spectrum can be expected to invest in New Mobility. They include multilateral organizations, all levels of government and the private sector.

3.3.1. Multilateral Investors

At the multilateral level, the Sustainable Mobility Project of the World Business Council for Sustainable Development is financed by twelve member companies: Volkswagen, General Motors, Ford, Daimler Chrysler, Toyota, Nissan, Michelin, Renault, Shell, BP, and Norsk Hydro. The aim is to provide a platform for the development of a global vision of possible pathways towards sustainable mobility of people, goods and services that will address societal, environmental and economic concerns.[84] The US$12 million project is an indicator of the world business community's recognition that new transportation approaches and investments are needed.

The World Bank also recognizes the need for comprehensive investment strategies and is developing an Urban Transportation Strategy to guide its efforts.[85] The Bank's current portfolio of urban transport projects is valued at US$10.7 billion, with the Bank's contributions amounting to US$4.4 billion in loans and grants.[86] Of that amount, 35 percent is for suburban rail projects (mainly in Latin America) and 14 percent for buses, busways and other high-occupancy vehicle facilities. As the Urban Transport Strategy aims to focus the Bank's investments more directly on sustainable transportation, these funds will be critical to developing country markets for New Mobility.

3.3.2. Public Sector Investors

Governments will continue to be major buyers of mass transit systems and equipment, Intelligent Transportation Systems, green fleet technologies, planning and consulting services and other New Mobility goods and services.

In the United States, the Transportation Efficiency Act for the 21st Century (TEA-21) allocated US$1.4 billion to implement community-based, non-motorized activities to enhance transportation and over US$8 billion to support cleaner fuels, improved transit, and bicycle and pedestrian programs to reduce congestion and emissions.[87]

In Europe, the European Union (EU) is supplementing individual country spending with a number of major programs:

- **CIVITAS**—The Union is spending up to 50 million Euros on the CIVITAS initiative, aimed at supporting transportation demonstration projects in 14 "laboratory cities" across Europe.[88] CIVITAS will fund projects combining:

  - Clean vehicles and fuels
  - Demand management
  - Integrated pricing schemes
  - Stimulation of collective passenger transport
  - New forms of vehicle ownership and use
  - New concepts for the distribution of goods
  - "Soft" measures for mobility management
  - The integration of intelligent systems for transport management and passenger services

- **TEMPO**—The Trans-European Intelligent Transportation Systems Project 2001-2006) has a budget of 192 million EUR from the EU for ITS investments in the road sector.[89] With leveraging from member countries, the investment in TEMPO projects will be nearly 1.2 billion EUR. Initially, TEMPO is funding six projects:

  - Streetwise (Seamless Travel Environment for Efficient Transport in the Isles of Europe) aims to deliver seamless, reliable, accessible and competitive travel information services to road users in the United Kingdom and Ireland.
  - ARTS (Advanced Road Telematics in the Southwest) co-ordinates regional, national and multilateral ITS projects covering the Atlantic coasts of Portugal, Spain and France.
  - CENTRICO (Central European Region Transport Telematics Implementation Project) coordinates implementation of traffic management and user information services for centrally located countries in Europe with very dense motorway networks.
  - CORVETTE (Co-ordination and Validation of the Deployment of Advanced Telematics Project) is emphasizing "infomobility" services and covers the development, infrastructure and operations for traffic and traveller information services.
  - SERTI (Southern European Road Telematics Implementation) covers a range of traffic management, data exchange, pre-trip information services, safety/incident response and other ITS within southern European regions with heavy seasonal traffic flows.
  - VIKING coordinates traffic management and other ITS implementation projects, with a particular emphasis on managing weather information.

- **Marco Polo**—With an annual budget of 30 million Euros (115 million Euros for the years 2003-2007), this new program aims to promote intermodality. Marco Polo takes over from PACT (Pilot Action for Combined Transport), a program that launched 167 intermodal projects between 1992 and 2000 with a budget of 53 million Euros.

These new and ongoing projects follow five years (1995-1999) in which the EU invested 93 million EUR in road traffic management projects, with overall investments in studies and telematics infrastructure of EUR 550 million.[90]

Among developing countries, East Asia, South Asia, Latin America and South America are seeing the highest growth in transportation demand, but governments face relatively greater capital constraints. Large infrastructure projects—such as transit and intelligent highways—will continue to see greater reliance on public-private partnerships. More and more public sector opportunities will likely require New Mobility businesses to bring to the table a range of financing, turnkey integration and operating services. Suppliers with experience in the broad-based consortia required for build-own-transfer and build-own-operate projects will be at a premium. Niche suppliers with specialized services and technologies will be needed within the consortia.

3.3.3. Private Sector Investors

Little data exists on private sector investment plans for New Mobility. Buyers will include both individual consumers (purchasing mobility services, cleaner and smarter vehicles, Smart Growth housing, etc.), as well as those shipping goods (purchasing advanced logistics services and technologies, cleaner and smarter vehicles, etc.)

3.4. Export Potential

As the demand for New Mobility matures, it will become clearer which New Mobility markets can be served by importing services and technologies from outside the area of demand, and which markets are likely to be met solely by local suppliers. This is an important point, if a New Mobility cluster is to be catalyzed in the Toronto region. By definition, industry clusters are led by export-oriented companies. Clusters create wealth and jobs for their region by successfully competing in global markets, with the aid of a network of regional suppliers and strong economic foundations. While the cluster's spin-off effects benefit the region as a whole, exports are the key to generating those regional benefits.

At this stage, it appears that a significant portion of the demand for New Mobility could be met through global suppliers (i.e. suppliers outside the area of demand). The clearest evidence of the export potential of New Mobility can currently be seen in technologies and equipment. Major trade flows are already evident in intelligent transportation systems, urban transit equipment and information technologies for use in transportation. For example, in 1996, Canadian companies captured an estimated US$248 million of the US$4.5 billion world market, and projections to 2011 suggest Canadian ITS sales might increase to nearly US$4.8 billion.[91] Domestic demand accounts for only a small portion of those estimates.

While the export potential for New Mobility technologies is already evident, the export potential for New Mobility services is less well understood at present. Service exports are emerging in at least two areas:

- **Technology-Related Services with Export Potential**—Already, companies exporting New Mobility technologies are also exporting related services such as feasibility analysis, project design and management, project implementation, training, operations and maintenance.

- **Other Services with Export Potential**—Interviews conducted for this study with Toronto-area companies also identified a range of other currently exported services unrelated to technology sales, including consulting, planning and software programming.

Perhaps the most significant sign that the markets for New Mobility are global (i.e. can be served through exports) is that many niche companies have successfully transitioned from local suppliers to global suppliers with leading market positions. Examples of such companies include:

- **Adshel**—Founded in the United Kingdom, Adshel supplies innovate transit shelters incorporating real-time information systems on routes and services. The company is now active in 65 countries and is using its work with 6,000 municipalities and transit authorities to market the SmartBike, a smart card-based bicycle-lending scheme with real-time bicycle tracking. Currently, the company has SmartBike projects in Singapore, Norway, France and the United Kingdom.[92]

- **Bombardier Transportation**—Bombardier is a Montreal-based supplier of equipment and services for inter-city rail, regional and commuter trains, rapid transit systems and light-rail vehicles. The company grew from a 1974 contract to build the rolling stock for Montreal's subway systems to capture 24 percent of the global market for rail equipment. In 2001, Bombardier Transportation generated revenues of $3 billion, more than 90 percent originating outside of Canada.[93]

- **Cubic**—Cubic is a San Diego-based supplier of integrated ticketing and automatic fare collection systems, including stored value cards, magnetic ticketing and smart cards for rail, bus, subway, tolls and parking. As of 2001, the company has installed more than US$2 billion worth of fare collection systems. Worldwide, nearly 10 billion transactions are made each year with Cubic smart cards.[94]

- **ERG**—Competing with Cubic, ERG is an Australia-based supplier of automated fare collection systems for transit, including contact and contactless smart cards. ERG has provided automated fare collection systems to over 200 cities around the world, handling 29.6 million transactions per day. In 2001, ERG generated global sales of $240 million in its transit and smart card business. Recent winning bids in France, Sweden and the United Kingdom are valued at over $100 million.[95]

Although New Mobility does appear to have significant export potential that Toronto-based firms could attempt to harness, several limiting factors characteristic of many emerging industries must be addressed in developing an effective cluster development strategy for the Toronto region.

- **Barriers to Trade**—At the outset, governments will be the buyers for many of the large investments in New Mobility, and public procurement is often subject to various non-tariff and other barriers to trade. For example, U.S. procurement policies such as the "Buy America" provisions of the Transportation Efficiency Act for the 21st Century require that 60 percent of urban transit rolling stock content value and final assembly be sourced in the U.S. This is a major barrier for Canadian producers of guided urban transit.[96]

  Such discriminatory procurement policies lead Canadian companies to serve global markets through foreign direct investment (i.e. building manufacturing capacity in target market countries) rather than domestic manufacture in Canada for export. For example, a large portion of capital investment by Canadian manufacturers of rail and guided urban transit systems has been made in the U.S., Mexico, European and Asian countries.[97] While such investments can still generate local benefits through patriation of profits and centralizing R&D and other corporate functions in home markets, domestic job creation is limited.

- **Exporting Intellectual Property Instead of Goods and Services**—R&D investments leading to new technologies do not always lead to significant job creation for the region in which the investments occur. For example, innovations leading to the commercialization of advanced materials for on-road vehicles, alternative fuel production processes or fuel cell technologies are all likely to be exported as intellectual property with minimal job growth, rather than using the innovations for production and export from the region.

- **Dominance of Local Suppliers for Some New Mobility Services**—Demand for some New Mobility services may never be served by export-oriented companies located in other regions. Though these New Mobility services may be very beneficial to local regions in terms of improving the competitiveness and quality of life in the region, local suppliers of these services will tend to dominate any competition from outside companies. For example, to date transit and car sharing services have tended to be provided almost exclusively by local operators.

While it is too early to say how significant these limiting factors will be, the evidence of export potential cited earlier indicates that many types of New Mobility goods and services will not be affected and will still be procured through global markets. These are the opportunities for which the Toronto region can position itself through a solid understanding of the region's supply capacity and proactive cluster development actions tailored to the region's niche strengths.

Section 4 Foundations of a New Mobility Cluster in Toronto

So far this study has reached two overarching conclusions:

- Trends point to a massive change in transportation over the next several decades, with New Mobility offering new ways of moving goods, moving people and moving less that respond to the economic, environmental and social needs facing cities worldwide (Section 2); and

- The shift away from traditional transportation to New Mobility promises to create significant economic opportunities, including sizeable global markets for a range of traded services and technologies (Section 3).

This section begins to address how Toronto can position itself to benefit from these new global markets. The starting point is to recall the new realities for economic success described at the beginning of this study and the important role that industrial clusters play in competing in global markets. Cluster analysis then provides a framework for understanding how regional industries form, compete and succeed in global markets. In the case of catalyzing a New Mobility cluster in the Toronto region, an understanding of how clusters operate and the region's current supply capacity is essential to developing a strategy to help grow a cluster from the existing strengths.

4.1. How Clusters Are Structured

Clusters are interrelated, geographically concentrated exporting industries, their key suppliers and supporting economic institutions. The exporting power of clusters results from these exporters, suppliers and institutions linking together in ways that allow the exporters to develop more competitive offerings. Simultaneous competition and collaboration within the cluster helps industries make the most of worker skills and new technological opportunities, thus assisting them to improve efficiency, develop innovative products and succeed in global markets. The result is the creation of a dynamic concentration of skills, a thriving industry and the quality of life benefits that wealth creation and high value-added jobs can bring to a region.

Clusters are so important to economic prosperity that regions frequently develop international identities based on their most successful clusters—Los Angeles for film and media, California's Silicon Valley for a range of high tech industries, Detroit for auto manufacturing, and New York, Hong Kong, Frankfurt and London for financial services. Others may be less well known but equally successful in their own niches, such as Dalton, Georgia (home to 85 percent of carpet manufacturing in the United States) and Grand Rapids, Michigan (where three of the four largest U.S. makers of office furniture are located).

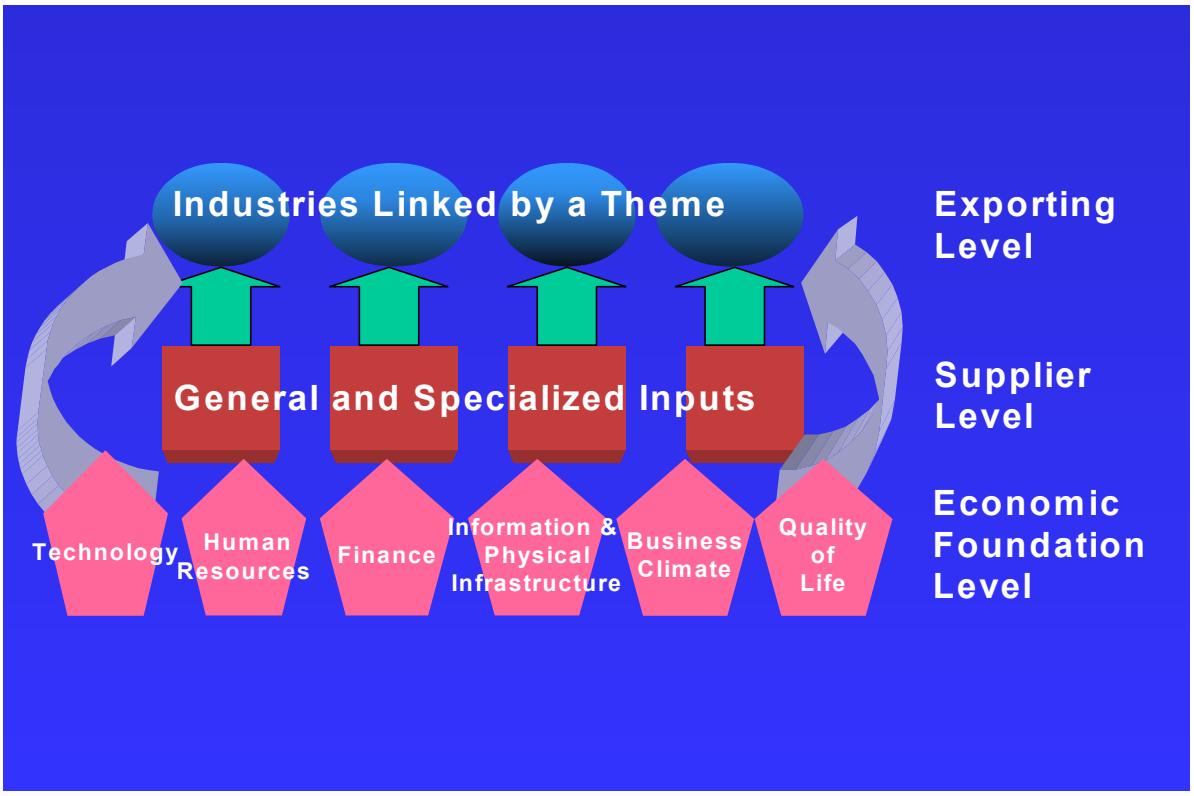
As illustrated in Figure 1, industrial clusters comprise three levels of activity:

- **Exporting Level:** In today's global economy, economic prosperity requires successful export-oriented clusters. Clusters are led by companies focused on serving global markets. This level provides the export base for the region, which in turn drives demand for local, non-traded sectors of the region's economy.

- **Supplier Level:** The exporting companies of a cluster are supported by a range of suppliers providing the raw materials for exported goods and services. In many cases, the distinction between exporters and suppliers are blurred. Vertically integrated companies source supplies internally, and other companies may both supply exporting companies and also be exporters themselves.

- **Economic Foundation Level:** Successful clusters are based on competitive advantages in economic inputs. These inputs are created by strong and responsive institutions that provide the region's exporters and suppliers with adaptable human resources, accessible technology, available financing, adequate physical infrastructure, advanced information and communications infrastructure, an acceptable business climate and an attractive quality of life. In each type of input, institutions must provide distinctive sources of competitive advantage to meet the specific needs of each cluster in the region.

Figure 1 Basic Structure of an Industrial Cluster

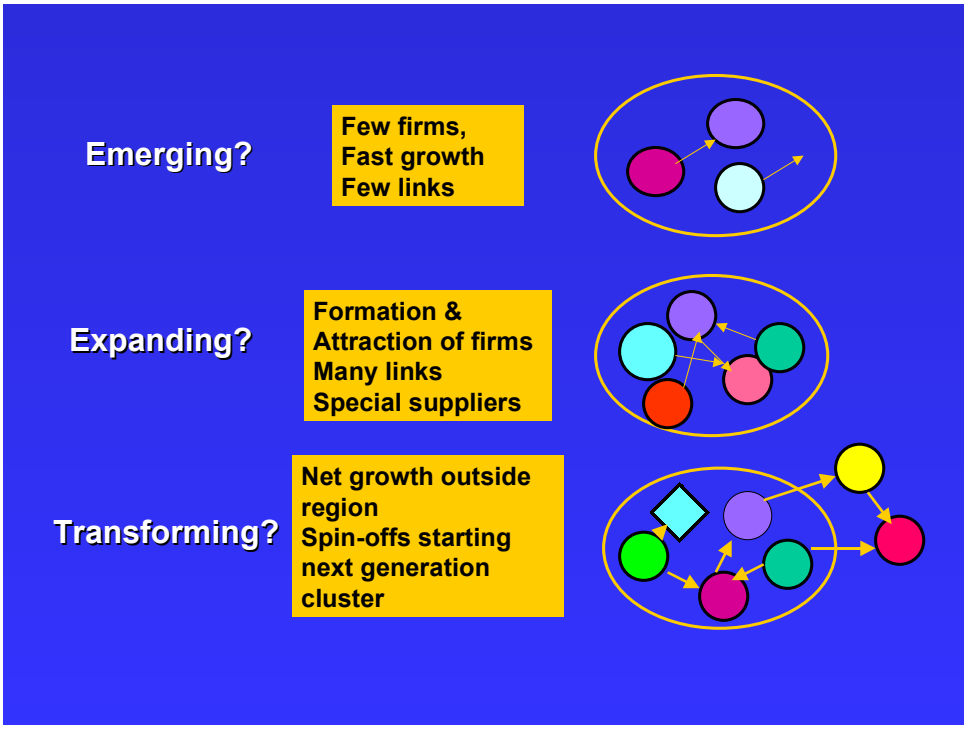


4.2. The Stages of Cluster Development

Of course clusters do not emerge fully developed, but grow through different stages. As illustrated in Figure 2, healthy regional economies feature a portfolio of clusters in various stages of development, including:

- **Emerging or "Seed" Clusters** characterized by a small number of fast growing firms, relatively weak links with suppliers, and economic institutions that are just beginning to respond to the specific needs of the cluster for specialized inputs;
- **Expanding Clusters** that have reached a critical mass for sustained growth, acting as magnets for customers, expertise, capital and other resources; and
- **Transforming Clusters** that are responding to new challenges and opportunities, and spinning off new clusters.

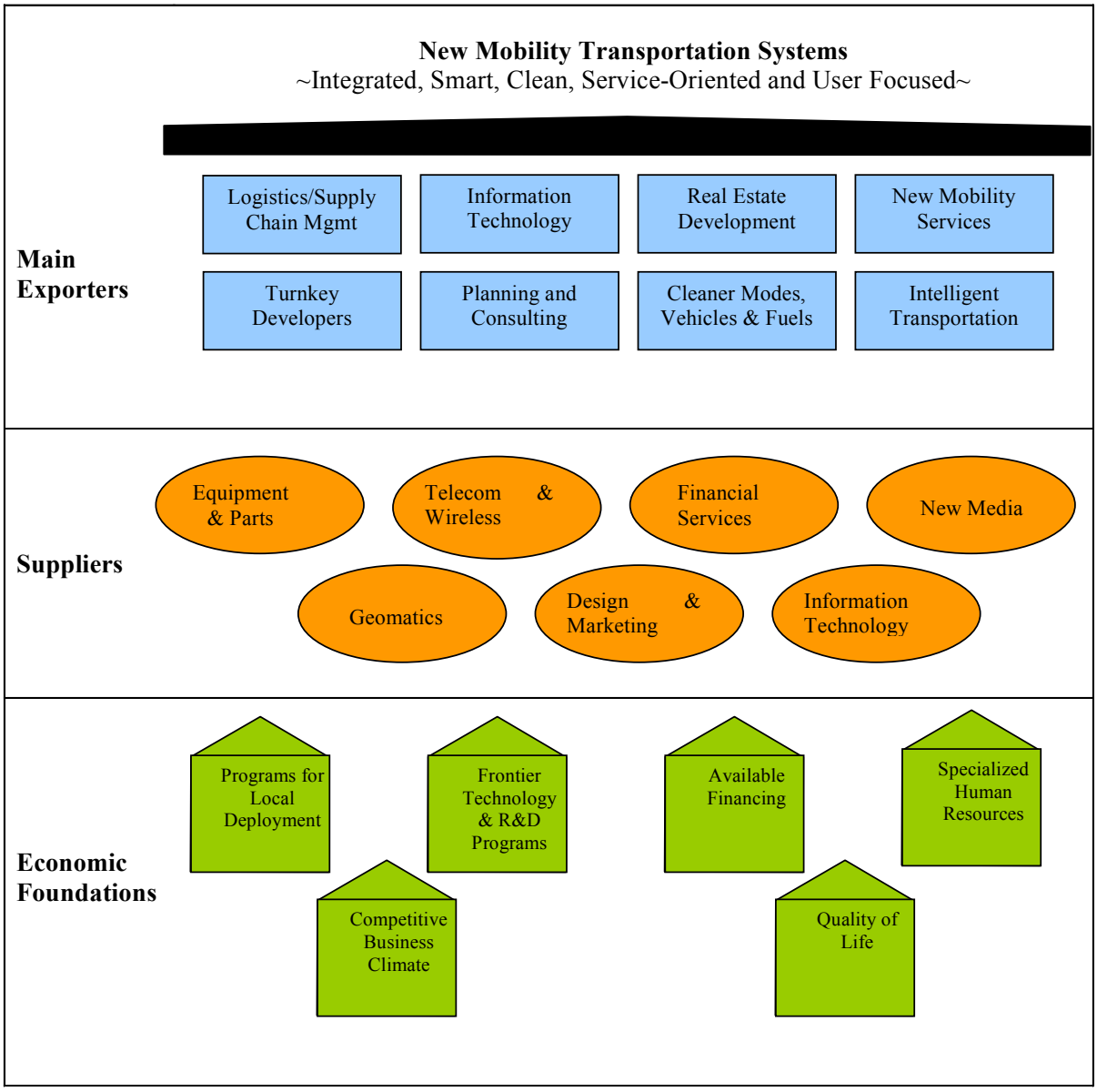
Figure 2 Different Types of Clusters



4.3. What a New Mobility Cluster Could Look Like

The broad scope and early stage of development of New Mobility makes it challenging to predict what a fully developed New Mobility cluster could look like, in part because it is not yet clear how all the different cluster elements would inter-relate. Nonetheless, the diagram below attempts to illustrate some of the key providers, suppliers and economic foundations that could comprise a New Mobility cluster.

Figure 3 Preliminary Vision of a New Mobility Cluster



At the exporting level, a New Mobility cluster could include a wide range of interrelated businesses selling services and technologies, ranging from Smart Growth real estate development and Intelligent Transportation Systems, to next generation logistics and supply chain management, cleaner modes, vehicles and fuels, and various planning and consulting services. Given the broad scope of New Mobility, it is likely that regions will emerge as centres of expertise for a sub-set of these types of New Mobility services and technologies, rather than try to position themselves as leaders across the entire spectrum of New Mobility.

At the supplier level, a New Mobility cluster would require a range of firms providing exporters and turnkey application developers with various goods and services in telecommunications and wireless, information technology, geomatics, financial services, design, marketing and related services. New Media companies might also be involved in the efforts to promote and market New Mobility.

At the economic foundation level, the most critical foundations for a New Mobility cluster were identified through interviews with local businesses. Based on that input, the ideal regional support for a New Mobility cluster would include the following:

- **Programs for Local Deployment**—The region is committed to becoming a showcase for New Mobility. The best innovations from regional suppliers have been successfully implemented in full-scale local applications. The region's international reputation as a centre of excellence in New Mobility is generating much interest from foreign buyers. Local applications have also generated significant economic, environmental and social benefits for the citizens of the region.

- **Specialized Human Resources**—The region offers a workforce that is highly educated in the full range of skills needed for New Mobility. Education institutions provide a range of courses and programs, with emerging crossover between traditional program silos (sociology, marketing, design, real estate, civil engineering, information technologies, environmental studies, urban planning, etc.). Training programs exist to keep New Mobility workers abreast of new applications, service developments and state-of-the-art technologies.

- **Frontier Technologies and R&D**—The region is home to well-funded public and private sector research institutions and programs covering various aspects of New Mobility. A high level of patents results from their efforts. Researchers work aggressively to commercialize their innovations. Governments support commercialization efforts by providing ample opportunities to pilot promising innovations.

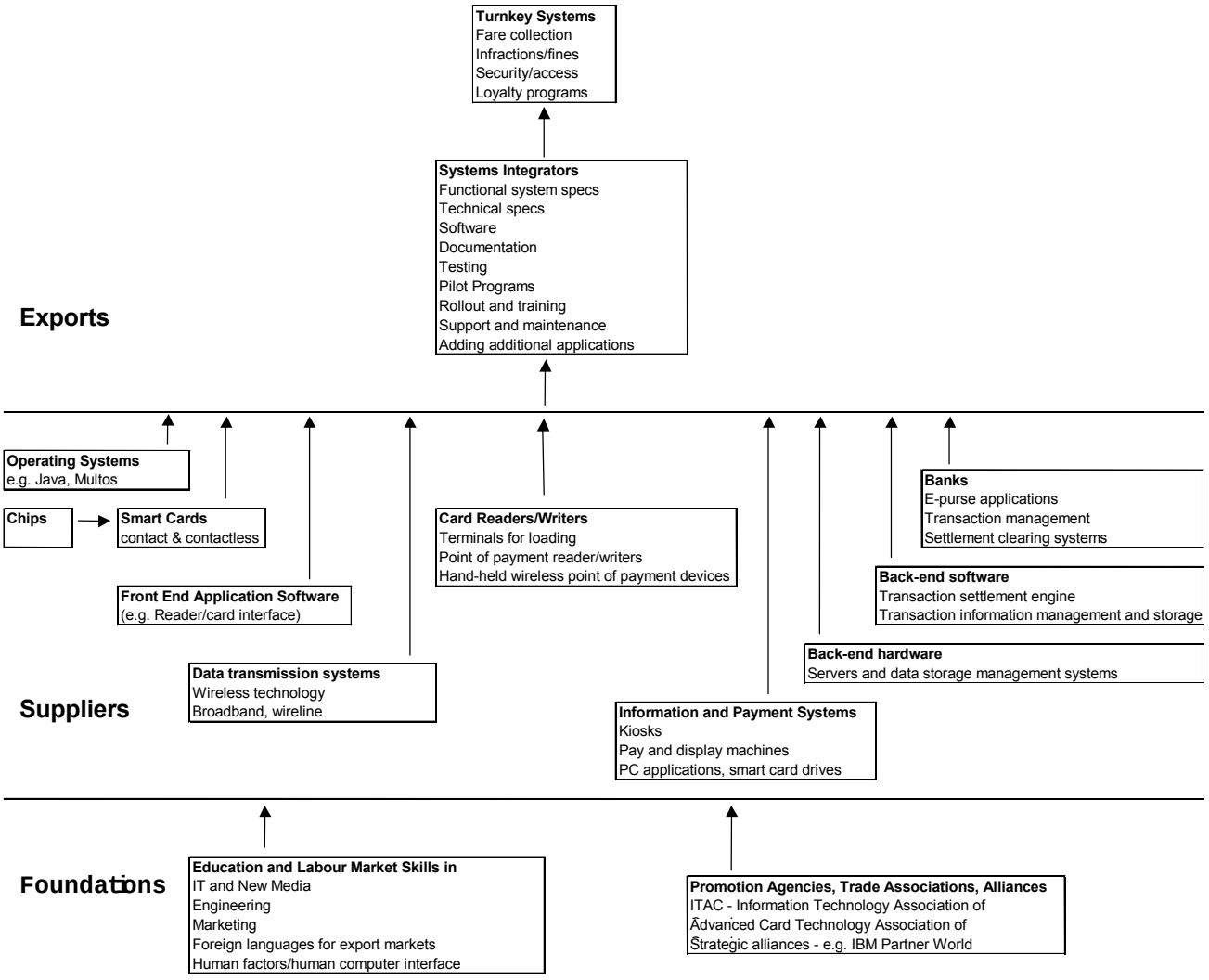
- **Available Financing**—The region offers access to a range of financing opportunities to meet the various stages of establishing and growing business enterprises. This includes venture capital and angel investor groups serving start-ups, as well as traditional debt financing for more established companies. Venture capitalists are aware of the New Mobility industry and its growth opportunities.

- **Competitive Business Climate**—The region offers comparative advantages in terms of the costs and efficiencies of business transactions. This includes tax rates and production costs.

- **Quality of Life**—Skilled workers are attracted to the region because of its overall liveability. This includes a clean environment, safe neighbourhoods, adequate and affordable housing, good schools, quality health care services, and a range of cultural, multicultural, and recreational amenities.

Strong relationships would link the various levels of the cluster, depending on the supply chain requirements of individual services or technologies being offered. For example, a sample supply chain for a hypothetical smart card system integrator is shown in the following figure.

Figure 1 Sample Value Chain for a Smart Card System Integrator [98]



4.4. Toronto's Current Competencies in New Mobility

Success in catalyzing new clusters depends on the strength of the economic foundations that a region offers and how well those foundations can be linked to private sector competitiveness needs. Indeed, economic foundations are so critical that cluster development strategies aim largely at strengthening the region's foundations to better serve the region's key exporting industries. For regions that can successfully align their economic inputs with competitive needs, wealth creation, high value-added jobs and improved standards of living are the end result.

Given the economic opportunities created by New Mobility, the key issue is how Toronto can position itself to take advantage of this emerging demand. What unique strengths exist in the region that New Mobility companies could exploit to gain competitive advantage in the emerging global markets? What will it take to capitalize on these strengths? What weaknesses might impede market success?

This section focuses on these questions. It provides a diagnosis of the economic foundations that the Toronto region could offer a New Mobility cluster. The diagnosis draws heavily from interviews with New Mobility stakeholders to identify what foundations are most important in developing a New Mobility cluster and the extent to which these foundations are currently present in the Toronto region.

4.4.1. Human Resources

Broadly speaking, human resources are one of Toronto's major competitive strengths, attracting investment and jobs to the region. Drawing from three local universities, five community colleges and a wide array of not-for-profit and for-profit training providers, Toronto boasts one of the most highly educated workforces available. Nearly 50 percent of residents have a post-secondary education, with 27 percent holding university degrees.[99] Toronto also benefits from its proximity to many educational institutions, including the University of Waterloo and its associated research triangle.

Despite the general strengths of these institutions, they are only in the very early stages of tailoring their educational offerings to New Mobility needs. Significant human resource challenges for New Mobility are already evident. For example, the evolution in logistics and supply chain management has resulted in an estimated 25 percent of current logistics personnel being under-educated for their jobs.[100] Both retraining to upgrade existing skills (such as incorporating the use of new information and telecommunications technologies into transportation services) as well as bringing in completely new skills will be needed. Skill sets in demand for New Mobility include:

- **Entrepreneurial Skills:** Entrepreneurial skills are needed at all levels to commercialize new services and technologies to market, to manage and grow start-up companies, and to position medium- and large-sized companies (right up to the auto manufacturers) to succeed in the growing global markets for New Mobility.

- **General Marketing Skills:** Moving to a greater service-orientation in the transportation sector will require people who can compellingly communicate and market new ways of meeting mobility and access needs.

- **International Marketing and Business Skills:** While domestic demand for New Mobility is substantial, achieving a cluster with critical mass in the various specialized services and technologies that comprise New Mobility will require the region's firms to succeed in international markets. This will be a particular challenge for the many small- and medium-sized enterprises active in New Mobility, and the numerous start-up companies built around specific technology innovations.

- **Team Management Skills:** New Mobility will challenge managers to create effective multi-disciplinary teams encompassing a range of traditional skills and new skill sets.

- **Business and Finance Skills:** From building the new revenue streams associated with New Mobility to structuring public-private partnerships for major infrastructure investments, New Mobility firms will need financing skills, expertise and knowledge. Currently, many New Mobility firms are small and medium-sized enterprises, which frequently lack in this important area.

- **ICT Skills:** Building information and communication technologies (ICT) into transportation—part of the "smart" aspect of New Mobility—will require hard technical skills (e.g. software development) as well as retraining for transportation service providers in applying the technologies.[101] With ICT technical skills already at a premium on the market, New Mobility firms face significant competition to attract qualified workers.

- **Information Management Skills:** New Mobility increases the information-intensity of the transportation system and will require transportation service providers to upgrade their information management capacity, fleet management, traveller information systems, and financial tracking systems.

- **Design Skills:** Incorporating New Mobility concepts into urban design, planning and development, vehicles and transportation systems will require designers with integrated knowledge of economic, environmental and social needs and the emerging technologies and systems that can meet those needs.

- **Engineering Skills:** Growth in New Mobility will increase the demand for a range of engineering specializations, including sustainable infrastructure, civil, environmental, mechanical, industrial, chemical, electrical and computer engineering.

- **Mathematics and Sciences:** Knowledge workers with science backgrounds will also be in high demand for New Mobility innovation and R&D. Areas include environmental science, mathematics, physics, geology, biology, chemistry, as well as the health sciences, kinesiology, and physiology (e.g. human movement/mechanics and human powered vehicles).

- **Communication Skills:** As the transportation sector becomes more service-oriented, "softer" skills related to communications, adaptability, and relationship management will take on greater importance. This will include having to understand demographic shifts in the population, such as aging and immigration.

- **R&D Skills:** Technological and knowledge-based innovation, the driving forces behind New Mobility, will require strong R&D skills, from new applications of information and communications technologies, to reverse logistics, human factors design, and new vehicle and fuel technologies.

The Toronto region's educational institutions are beginning to offer training in some of these areas. For example:

- **The Toronto region is emerging as a centre for ITS education.** The University of Toronto, Ryerson Polytechnic University and the University of Waterloo comprise three of the four Canadian universities investing in undergraduate and/or graduate ITS education.[102] This includes the recently announced ITS Laboratory and Testbed at the University of Toronto that will give students direct networked access to Toronto's real-time traffic management system.

- **Local Educational Institutions are offering significant opportunities in telecommunications.** The University of Toronto's Nortel Program in Telecommunications now offers a Master's degree in telecommunications, and Centennial College is home to the Bell Centre for Creative Communications.

- **A relatively high proportion of environmental content has been built into transportation curriculum in Ontario.** Research for Canada's national Centre for Sustainable Transportation found that Ontario's transportation curriculum offers the highest amount of environmental content of any region in the country.[103]

- **Ontario faculty is most receptive to expanding sustainable transportation content in transportation curriculum.** The Centre for Sustainable Transportation also found that Ontario faculty "offered the most promising indicators of receptivity and efficacy for developing and implementing curriculum related to sustainable transportation."

But despite these efforts, more is needed to aid the formation of a New Mobility cluster. Given the early stage of development of New Mobility, there is much promotion that needs to be done about New Mobility career opportunities to attract students into relevant fields of study. Promotional tools—such as occupational profiles, job listings, career fairs, etc.—will need to be developed. Furthermore, much more tailoring of existing curriculum is needed before graduates will emerge with a solid understanding of most New Mobility concepts and skills.

Moving the Economy has initiated steps in this direction by establishing the Network of Excellence for Sustainable Transportation (NEST). NEST aims to build long-term capacity in the sustainable transportation sector. NEST nurtures R&D and stimulates collaboration between academic, private and public players to meeting the following objectives:

- **Coordinated Education and Professional Development**—To cultivate a talent pool of professionals to provide leadership and fill key jobs in the emerging sustainable transportation (New Mobility) industry.

- **Basic and Applied Research**—To stimulate R&D in areas critical to sustainable transportation (New Mobility).

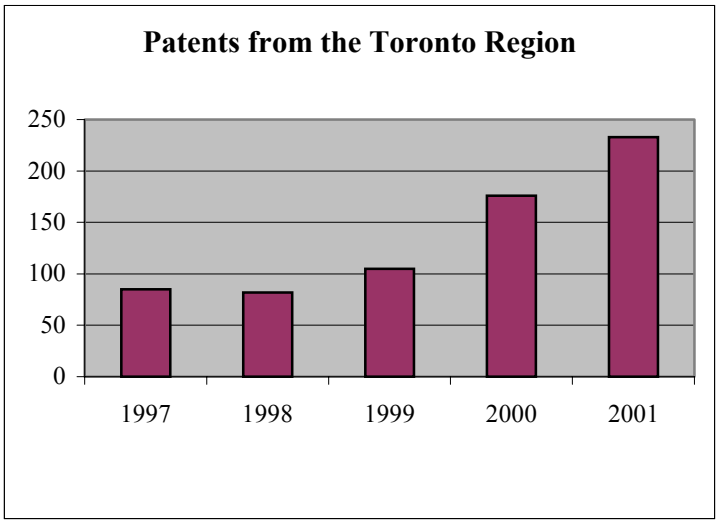
- **Pre-Commercial Technology Development/Transfer**—To accelerate knowledge exchanges and applications, using the Toronto region as a leading example of such innovations.

To date the response to and involvement in NEST has been extremely positive, indicating a clear need for continued effort.

4.4.2. Technology

To respond successfully to the growing demand for New Mobility, Toronto region providers will need the ability to develop and deploy new services and technologies that respond to the economic, environmental and social challenges facing transportation systems worldwide. To that end, research and development (R&D) is critical to the formation of a New Mobility cluster.

The Toronto region appears to have significant strengths in this foundation that could be focused and further advanced so that the region becomes a New Mobility R&D hub and leader. The region is already Canada's R&D hub. Toronto accounts for less than 10 percent of national employment, yet about 30 percent of patent registrations in the country originate from the Toronto region. On the global stage, Toronto has consistently ranked 18th or 19th of the world's cities in the number of patents issued per year. Though well behind the leaders such as Tokyo, Osaka, London and Paris, Toronto's performance is on a par with Dallas, Singapore and Los Angeles, and ahead of cities such as Melbourne, Amsterdam, Sydney and Hong Kong.[104]



These general strengths in R&D capacity have already been harnessed to some extent to serve the

transportation sector. Between 1987 and 1996, transportation innovations generated nearly 800 patents in Canada, ranking transportation third across all sectors in patent generation.[105] In contrast, transportation innovations ranked eighth in the United States as a generator of patents. This suggests that Canada concentrates its R&D activities on transportation to a greater degree than the United States.

A significant advantage is the proximity of three key universities to the region's providers and suppliers: University of Toronto, Ryerson University, and York University. Each of these institutions has renowned research centres and institutes that are generating innovation, knowledge and highly skilled labour in areas related to New Mobility (see box below). The presence of the technology triangle in the nearby Waterloo area also benefits Toronto region providers. Its research areas are very strong in engineering, mathematics, and environmental science, and researchers have come together to form the ITS Research Group.

New Mobility-Related Research Centres at Toronto Area Universities

Ryerson University	
Centre for Learning Technologies	E-learning and telepresence
Centre for the Study of Commercial Activity	Spatial analysis, data visualization, retailing, commercial structure, e-commerce
Rogers Communications Centre	Interactive media, telecommunications, conferencing
Canada Research Chair in Multimedia	Electrical engineering
Vehicle Safety Research Centre	Vehicle safety
University of Toronto	
Bell Canada Multimedia Lab	New media
Communications Group	Telecommunications and signal processing
Integrated Manufacturing and Logistics Engineering Group	Logistics and supply chain management
ITS Laboratory and Testbed	Intelligent transportation systems
Joint Program in Transportation	Transportation engineering
Network Architecture Lab	Active networking, programmable node, voice over IP, mobile IP
Wireless Communications and Systems Lab	Radio networks, mobile communications, indoor wireless communications, personal communication networks, error control techniques
York University	
York Centre for Applied Sustainability	Sustainable development
Centre for Atmospheric Chemistry	Air emissions
Centre for Research in Earth and Space Science	GIS and GPS
Centre for Research on Work and Society	Labour and training
Institute for Research on Learning Technologies	Distance learning

In addition to universities, the region's **colleges** are developing research capabilities in areas such as geomatics, GIS, wireless and telecommunications technologies, and more. While the colleges have been more focused on training related to employment and job transitions/opportunities, they are starting to break into applied research and development. In particular, the Colleges of Ontario Network for Education and Training (CON*NECT) has been proactively investigating and working towards academic and industry connections in New Mobility.

There also exists a wide range of R&D programs and institutions researching areas related to New Mobility. Though New Mobility is not currently a direct focus of their research efforts, the potential is there to link New Mobility issues to their research agenda. For example, the Networks of Centres of Excellence, part of the Federal Government's Innovation Strategy, offer excellent opportunities for Toronto region researchers for project funding, exchange of knowledge, and potential collaborators. Many of the region's academic institutions, such as the University of Toronto and University of Waterloo are already participating in the following NCEs:

- NCEs in Information and Communications Technology:
  - Canadian Institute for Photonics Innovations (applied to telecommunications and pollution detection)
  - Canadian Institute for Telecommunications Research
  - Geomatics for Informed Decisions Network
  - Institute for Robotics and Intelligent Systems
  - Mathematics of Information Technology and Complex Systems
  - Micronet - Microelectronic Devices, Circuits and Systems
  - TeleLearning Network of Centres of Excellence

- NCEs in Engineering and Manufacturing
  - AUTO 21 - The Automobile of the 21st Century (centred at the University of Windsor)
  - Intelligent Sensing for Innovative Structures (civil engineering and construction, Integrated intelligent fibre optic sensing, and advanced composite materials)

At the provincial level, the Ontario Centres of Excellence also provide opportunities that could support research in New Mobility areas. Among the relevant centres are:

- Communications and Information Technology Ontario (CITO)
- Materials and Manufacturing Ontario (MMO)
- Photonics Research Ontario (PRO) (conducting research into optical communications, processing and sensors (telecommunications))
- Centre for Research in Earth and Space Technology (CRESTech) (conducting research into environmental and resource management, the atmospheric environment and land resources)

More generally, the Organisation for Economic Co-operation and Development has concluded that Canada offers the most generous R&D tax incentives in the world.[106]

The federal government offers a 100 percent deduction for R&D expenditures, including the costs of R&D equipment, plus a 20 percent credit for other qualifying R&D-related current and capital expenditures. Ontario's "R&D SuperAllowance" and other incentives supplement these federal programs.

4.4.3. Government Policies and Programs for Local Deployment

The Toronto region has a history of transportation innovations. In decades past, the region boasted one of the world's first deployments of traffic management systems and a transit system that captured the highest mode share of any similar North American city. In more recent years, the region established the world's first fully electronic toll highway, an extensive program of transit priority signalization, an extensive network of bicycle rights-of-way as well as early experiments with innovative fare collection systems for transit.

Currently, New Mobility innovations are supported within the City of Toronto's Official Plan. In addressing a framework to deal with growth in the region the Plan calls for Toronto to work with neighbouring municipalities and the Province based on priorities which include:

- focusing urban growth into a pattern of compact centres and corridors connected by an integrated regional transportation system, featuring direct, transfer-free, inter-regional transit service
- making better use of existing urban infrastructure and services
- reducing auto dependency and improving air quality
- increasing the efficiency and safety of the road and rail freight networks in the movement of goods and services
- increasing the supply of housing in mixed use environments to create greater opportunities for people to live and work locally
- recognizing the importance of Union Station as the major hub in the regional transit system
- improving the competitive position of the Toronto regional economy internationally[107]

Funds from the municipality for implementing the Plan are quite limited. The City of Toronto and, to a lesser extent, other municipalities in the Greater Toronto Area are under significant financial pressure. Capital for investing in new infrastructure is scarce and, in some cases, maintenance of existing infrastructure is being deferred.

The federal and provincial governments (summarized in the table which follows) offer various opportunities to make up for the funding limitations at the local level. Programs cover transit investment, showcases of sustainable transportation, ITS development and implementation and urban renewal.

Though this array of programs offers opportunities for local deployment, funding programs in other developed countries appear to be at least as strong, even after adjusting for country size. For example, public investments in Intelligent Transportation Systems

appear to be significantly greater in both the United States and Western Europe. Furthermore, most of the programs in Canada are not aimed exclusively at the Toronto area. Funding will be shared across many other regions.

To truly become a showcase of New Mobility and provide opportunities to pilot new innovations, the Toronto region will require significantly more investment than offered by current programs.

Current Programs to Support Local Deployment of New Mobility

Programs	Investment	Goals
Partnerships		
Toronto Waterfront Redevelopment Initiative (Federal, provincial and municipal governments)	$1.5 billion	Redevelop a large brownfield site in downtown Toronto. Potentially massive investment including addressing significant aspects of the transportation network and offering an opportunity for Smart Growth development
Green Municipal Enabling Fund Green Municipal Investment Fund (Federal Government and the Federation of Canadian Municipalities)	$25 million $100 million	Encourage municipal projects that improve the quality of the air, water, soil and protect the climate. Covers projects that reduce transportation energy demand or improve the effectiveness of public transportation services, including increased use of innovative public transit technologies
Motor Vehicle Fuel Efficiency Initiative (Natural Resources Canada, vehicle manufacturers and others)	$16 million	Voluntary initiative to improve motor vehicle fuel efficiency
Federal Programs		
Urban Transportation Showcase Program (Transport Canada)	$40 million	Demonstrate ways to reduce greenhouse gas emissions from transportation
ITS Deployment and Integration Plan (Transport Canada)	$30 million	Five-year plan (funded under the Strategic Highway Infrastructure Program) to develop, integrate and deploy Intelligent Transportation Systems, including advanced systems for traveller information, traffic management, public transport, commercial vehicle operations, emergency response management and vehicle safety
Canadian Transportation Fuel Cell Alliance (Natural Resources Canada)	$23 million	Investigate alternative fuelling options for fuel-cell vehicles
Moving on Sustainable Transportation (Transport Canada)	$3.5 million	Eight-year program (1999-2007) offering small grants to community, academic and business groups conducting projects related to sustainable transportation

Programs	Investment	Goals
Climate Change Action Fund (Federal Climate Change Secretariat)	$150 million	Established in 1998 to help meet Canada's Kyoto Protocol obligations. Budget 2000 extended funding until 2003 at $50 million per year. Includes investigating fuel efficiency and renewable energy sources under the Fund's Transportation Energy Technologies Program, as well as outreach and other activities under the Fund's other programs
Freight Sustainability Demonstration Program (Transport Canada, Natural Resources Canada)	$4.5 million	Five year program offering support for projects that demonstrate effective and innovative measures to decrease greenhouse gas emissions from freight transport
Ontario Programs		
Provincial Transit Investment Plan (Ontario SuperBuild Corporation)	$3 billion	Ten-year investment plan for transit expansion and renewal in the province. Seeking matching funds from federal and municipal investments to bring the total investment to $9 billion
Smart Growth Panels (Ontario Ministry of Municipal Affairs and Housing)	None	Encourage Smart Growth in Ontario through multi-stakeholder groups developing regional Smart Growth plans
Brownfields Redevelopment Strategy (Ontario Ministry of Municipal Affairs and Housing)	None	Removes various impediments to brownfields redevelopment

4.4.4. Business Climate

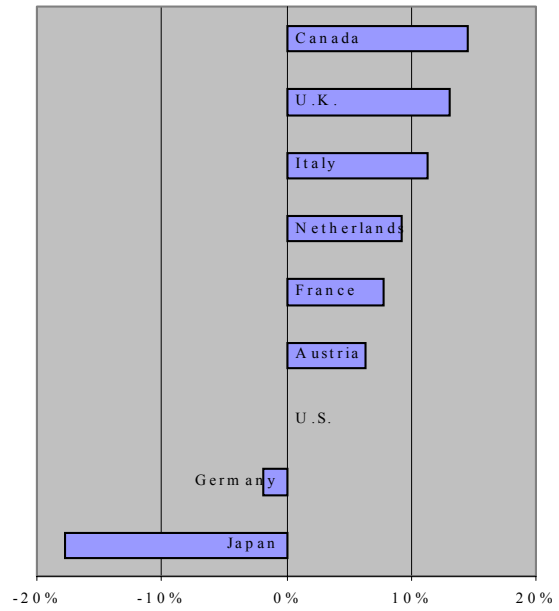
Business climate refers to the overall cost competitiveness of a region. Major elements of business climate include production costs, tax rates, costs of living and regulations.

Canada ranks as the most cost competitive country among the G7, Austria and the Netherlands.[108] Relative to the costs of doing business in the United States, Canada offers a 14.5 percent business cost advantage overall. The cost advantage is significantly greater for individual sectors, including:

- Electronic Systems—33.0 percent
- Research and Development—30.6 percent
- Software Development—22.3 percent
- Corporate Services—19.7 percent

Toronto builds on Canada's cost competitiveness, with a 12 percent advantage over the United States national average. Among U.S. cities, only San Juan, Puerto Rico offers lower business costs than Toronto.[109] Federal and provincial tax rates for Toronto businesses are now more competitive with tax rates in the United States than they have

been in the past. The Canada-U.S. exchange rate and the costs of electricity and building construction also remain highly favourable. For middle-income families, the cost of living remains lower than most major North American cities, and certainly one of the least expensive of the world's major financial centres.[110] Such factors helped propel Toronto to be declared the best global city for business by *Fortune* magazine.



Source: KPMG (2002)

4.4.5. Financing

Toronto offers the most concentrated set of financial services within Canada, encompassing 1,700 financial service firms.[111] The country's five largest banks and 80 percent of the foreign banks operating in Canada are headquartered in the city. The Toronto Stock Exchange is the country's largest. As a whole, the sector accounts for about 10 percent of the city's employment.

Nonetheless, availability of financing will be a major challenge in developing a New Mobility cluster. While some large firms operate in New Mobility markets, most New Mobility firms in the Toronto region are likely small or medium-sized. Firms of this size nearly always report difficulties in accessing traditional debt financing from banks. Like other high-tech clusters, many New Mobility enterprises will likely have to rely on venture capital.

As reported in *Toronto Competes: An Assessment of Toronto's Global Competitiveness*, Canada lags 10 years behind the United States in developing a venture capital industry.[112] Furthermore, availability of venture capital in Ontario is weak relative to many other North American centres, though compares favourably to Quebec and neighbouring U.S. states.

4.4.6. Quality of Life

As the knowledge economy takes hold and most industries become high tech, a region's ability to attract and retain skilled workers has become a prime consideration in the location decisions of New Economy companies. Factors such as personal safety, the quality of neighbourhoods, schools, community centres and parks, the richness of cultural and arts opportunities, levels of pollution, and the ease of moving around the city all contribute to quality of life.

Toronto boasts a particularly strong quality of life, particularly relative to many U.S. cities. Toronto has been ranked as the safest large metropolitan area in North America. It

is considered one of the most multicultural cities in the world, with about half of the City of Toronto's residents born outside Canada. Its green spaces, cycling trails, arts and entertainment community, and extensive transit system enhance its liveability, and the Waterfront Redevelopment Initiative promises to create significant new housing and recreational opportunities.

Nonetheless, recent years have seen numerous challenges to Toronto's strength in quality of life, including:

- Net loss in low-rent housing supply;
- Increasing number of people at risk of homelessness;
- Rising number of Smog Alert days;
- Greater congestion levels and lengthening of the peak traffic period;
- Significant financial pressure on the City of Toronto's ability to maintain affordable quality community services and programs, leading to service and funding cuts and rising user fees; and
- Restrictive changes to provincial funding of education, social services and welfare.

In addition, relative to U.S. cities, Toronto has less support from higher levels of government and more restrictions on its options for reinvesting in public infrastructure. In contrast, many U.S. cities, with significant support from their federal and state governments, are spending heavily on urban regeneration and crime reduction.

4.5. Toronto's Current New Mobility Providers and Suppliers

Like the demand profile in Section 3, available data sources provide limited insight into crossing-cutting industries such as New Mobility. A detailed assessment of Toronto's supply capacity would require primary data collection, such as a business survey. Such an effort is outside the scope of this study.

Nevertheless, currently available information suggests that the Toronto region exhibits strengths in many of the areas related to New Mobility.

- **Intelligent Transportation Systems**—The Transport Canada-Industry Canada report *Strategy for Developing an ITS Industrial Base in Canada* concludes that "Canada has a small but well-respected base industry with a substantial potential for significant future development in conjunction with enabling technology providers not currently active in the ITS marketplace."[113] Based on the membership distribution of ITS Canada, the country's ITS sector association, the majority of Canada's ITS suppliers are based in the Toronto region.

  The Strategy finds that Canada has world leading ITS companies and that they are concentrated in technologies with the greatest demand growth, including commercial vehicle operations, electronic tolling and advanced passenger transportation systems. In the longer term, traveller information systems are also expected to be a capacity area for Canadian suppliers.

The strategy also reports that Canada has strengths in the key enabling technologies (GIS, displays, sensors, system integration and software, and positioning and navigation technologies.)[114] Nonetheless, the report identified a need for additional R&D funding to update these technology capacities.

Alongside these strengths, the strategy identifies several weaknesses. First, a lack of showcase projects is hindering Canadian businesses' ability to progress in offshore markets. Second, efforts to coordinate Canada's ITS activities, covering both the public and private sector, are limited and need to be improved to allow Canadian ITS companies to compete better in world markets. Third, Canada's participation in international and U.S. standards committees has been limited. Efforts in this regard must be increased to protect and promote Canadian interests.

- **Logistics Suppliers**—As Canada's logistics hub, the Toronto region is the Canadian base of international third-party logistics providers, including Exel, Ryder, TNT, Kuehne & Nagel, Tech Data, Tippet & Britten, PBB Global Logistics and Global Express.[115]

- **Information and Communications Technologies**—Nearly 40 percent of Canada's $65 billion IT sector is located in the Toronto area.[116] The City of Toronto is home to seven of the top ten IT companies in the country, including the Canadian headquarters and research centres of Apple, Hewlett-Packard and Sun Microsystems.[117] The region has the fourth highest concentration of commercial software companies in the world. The sector is supported by one of the best telecommunications networks in the world, with the highest percentage of fibre optic cable installed anywhere in North America.

  While the Toronto region ICT cluster is substantial, its growth has lagged behind the North American average. Unlike many other areas with ICT clusters, Toronto's has remained highly diversified between software and hardware, which may be hindering reaching a critical mass for more rapid growth. Weaknesses in moving from specialized niche roles to global dominance in a larger niche market have also inhibited achievements of higher productivity levels. Lack of venture capital has also been identified as a key factor inhibiting the sector.

- **New Media**—New Media will play a key role in the evolution of New Mobility, since many New Mobility applications involve digital delivery of products and services that make use of graphics, text, audio and video. These include interactive wayfinding and mapping, digital access technologies such as distance learning and distance medicine, digital marketing (through the internet, kiosks, etc.) of New Mobility products and services, and visualization and simulation technologies for planning and R&D.

  Toronto has long been the media and cultural industry capital of Canada, and in recent years has seen a rapid growth in film production and post-production processing. Toronto is now the fourth largest media cluster in North America, the

third largest film production centre and the second largest centre for TV production.[118] New Media, a set of IT-related products and services used in the convergence of traditional media and telecommunications is also growing rapidly, though data are limited. The Toronto New Media Works study identified 400 New Media companies in the region employing 4,000-8,000 people and generating revenues over $1 billion.[119] Most companies are small, young, entrepreneurial companies. Many lack managerial expertise and financial resources. Financing was identified as a particularly significant barrier.

- **Geomatics**—In 1994, the Canadian geomatics industry employed about 21,000 and generated $1.6 billion in revenues. Though data on the industry's concentration in the Toronto region are not readily available, Ontario appears to account for about one-third of national employment.

  Fifteen percent of sales were to customers outside Canada. Ninety percent of sales were for services, with the remaining ten percent for software and equipment. Canadian geomatic companies are recognized as leaders in land information registration systems and electronic charting systems, with additional strengths in surveying, mapping, remote sensing and geographic information systems (GIS.)

  Industry Canada's 1997 Sector Competitiveness Framework for the geomatics industry found that U.S. firms have higher levels of capitalization and incur lower costs, resulting in higher profitability than Canadian firms. Nevertheless, the Framework suggests that growth prospects are high if firms can gear up for the higher costs of international marketing and meet their needs for venture capital financing.

- **Design Services**—Design is a "knowledge-based discipline that determines the shape, processes and specifications for products, environments, and information. Design contributes to increased competitiveness, product and service differentiation, export growth and economic diversification."[120] Design plays a fundamental role in New Mobility from the design of new lighter and more compact vehicles to enhanced service processes, communication graphics, technological interfaces and many other applications in moving people, goods and moving less. Cleaner and smarter designs can make transportation more efficient, user-friendly, aesthetic and marketable. Canada's design industry is heavily based in Ontario and Quebec, with 75% of the industry's revenue earned in these two provinces.[121] Toronto is a leading centre within the Canadian industry, and its prominent Design Exchange is already very active in New Mobility.

- **Financial Services**—Financial services are both an economic foundation for providing financing, as well as participants in developing new approaches to financial transactions associated with New Mobility. Toronto is the country's undisputed centre for financial services.[122] Over 1700 financial services firms make their home in Toronto, including the headquarters of all of Canada's major banks and the headquarters of four of the five largest foreign banks operating in Canada. Toronto's financial services cluster has more jobs than Philadelphia and Minneapolis and the same number as Boston, but ranks well behind New York and Chicago. It grew by

38% between 1981 and 1996, exceeding growth in Boston, Chicago and San Francisco, but lagging behind emerging U.S. financial centres such as Atlanta, Dallas and Seattle. The financial services cluster is a major driver of the region's business services sector and IT sector, with an international reputation as a leader in e-commerce applications.

- **Rail and Guided Urban Transit Equipment**—In 1994, the Canadian rail and guided urban transit equipment sector employed about 10,000 workers and generated about $2.2 billion worth of shipments. Seventy percent of production ($1.3 billion) is exported, mainly to the United States. About 50% of Canadian production is located in Ontario, focusing on guided urban transit vehicles, passenger rail cars, locomotives, freight cars and speciality tank cars. As noted above, Buy-America policies are hindering exports and leading companies to locate new facilities abroad. Export financing for large projects is also a weakness.

- **Motor Vehicles**—The automotive sector is the mainstay of Ontario's manufacturing sector, and the largest manufacturing sector in the Greater Toronto Area.[123] Ontario is second only to the Detroit region in automotive jobs in North America, and has recently been growing faster than Detroit. The sector has been strong in recent years, but is threatened by expected industry rationalization due to North American-wide excess capacity in vehicle manufacturing, increasing congestion along major trade corridors and border crossings between Ontario and Michigan, and other factors.[124]

- **Niche Sectors with Cumulative Potential**—Many other businesses related to New Mobility are found in Toronto, but little data exists with which to characterize them. These include businesses offering consulting and planning services, plus a variety of niche businesses serving specific New Mobility markets, such as car sharing and bicycle rentals. While each of these niche business areas may appear small when observed alone, taken together—as successive links in a chain or synergistic network that provides access and mobility—the cumulative potential is significant. At a recent Mobility Conference hosted by the World Business Council for Sustainable Development's Sustainable Mobility Project, one discussion emphasized the importance of investing in niche innovations. It cautioned against over emphasis on trying to measure projected revenues beforehand, as the cumulative effect of niche markets may be unknown and unaccounted until the markets develop more fully. The potential economic significance of niche markets, however, should not be overlooked.

4.6. Conclusion: Proactive Steps Are Needed to Grow a Cluster

A full diagnosis of Toronto's New Mobility industry, including benchmarking its size and growth relative to the industry in other regions, would help assess whether the region truly has a comparative advantage in New Mobility. Unfortunately, given that the industry is crosscutting and just emerging, the data available at the time of this study precludes applying the typical sort of cluster analysis. In its absence, the research indicates that the Toronto region has the building blocks of a seed cluster, namely:

1. A range of **producers** offering various New Mobility services and technologies, with apparent strengths in Intelligent Transportation Systems, wireless applications, global positioning systems and vehicle parts and assembly;

2. Numerous **suppliers** that provide New Mobility firms with the "raw materials" of New Mobility, especially the advanced information and communication technologies that enable New Mobility; and

3. Various **economic foundations** to support a New Mobility industry, including educational institutions providing R&D and human resource development, a strong business climate and desirable quality of life.

If successfully nurtured into much higher levels of activity and stronger relationships, these building blocks may evolve into an expanding cluster.

Section 5 A New Mobility Seed Cluster Strategy for Toronto

Let us not ask what the future holds in store. It is ours to build.

Koji Kobayashi in *Information Technology and Civilization*

This study has identified major trends pointing to a global-wide transformation of transportation systems. Evidence suggests that over the next 20 to 30 years transportation systems will undergo an intensive transformation, becoming more integrated, smarter, cleaner, service-oriented and user-focused. The urgent social, economic and environmental needs that are driving this trend exist worldwide, in developed and developing countries alike.

This transformation is creating a major economic opportunity. Data suggest a global market demand for New Mobility services and technologies that is already measured in tens of billions of dollars annually and increasing rapidly.[125]

As shown in Section 4, the Toronto region appears to have many of the key elements needed for a competitive New Mobility cluster. Nonetheless, proactive steps will need to be taken if the cluster is to grow at a competitive pace.

If embraced in these early stages of the emergence of New Mobility, Toronto might benefit from a first mover advantage. First mover advantage was a term popularized in the dot.com heyday to denote the advantage a company might gain by being first to market a new product or service. Companies like Amazon.com in the book business, E-Bay in online auctioning and Yahoo in Web directories were touted as evidence of the dominant market position that first movers might attain. Of course, many more first movers achieved no market success. Moving first does not in itself confer an advantage and is no substitute for solid business strategy. It can, however, provide important advantages in publicity and a jumpstart in building a brand and attaining economies of scale, provided that the offering has solid market viability.

The research for this study suggests that buyers of certain New Mobility services and technologies are attracted to purchase from suppliers located in areas where successful applications exist. Hong Kong's integrated Smart Card system, Portland's Smart Growth initiatives and Toronto's fully automated electronic toll road and COMPASS traffic management system are cases in point that have attracted widespread attention. In some documented cases, like AdShel's worldwide success in supplying information-intensive transit shelters, moving first complemented by a truly innovative product has conferred dominant market positions.

To establish itself as a first mover in New Mobility, the Toronto region would have to move quickly to become an incubator of a wide range of New Mobility services and technologies, demonstrate successes in local applications, and undertake concerted efforts

to promote its successes and offerings to global buyers. In short, Toronto requires a cluster development strategy.

Drawing from this study's research into demand opportunities (Section 3) and Toronto's current supply capacity (Section 4), this section begins to articulate a New Mobility seed cluster strategy for the Toronto region. It starts by reviewing a basic framework for cluster development strategies and how this framework can be applied to seed clusters. It then identifies major action areas for the Toronto region and specific steps under each area.

5.1. Cluster Development Strategies

Cluster-based initiatives vary widely from region to region, responding to and building on each region's unique economic circumstances. Yet most strategies follow a similar pattern, consisting of four stages of activity.

Four Key Stages of Cluster Based Economic Development

Stage 1 Mobilization	Stage 2 Diagnosis	Stage 3 Collaborative Strategy	Stage 4 Implementation
Engage regional stakeholders	Measure regional performance	Build working groups and networks	Establish strategy implementation mechanisms
Establish stewardship groups	Identify, analyze and benchmark the cluster	Identify shared challenges	Launch initiatives
Secure resources	Assess economic foundations	Develop cluster vision and collaborative actions	Measure performance

Stage 1: Mobilization

> *Cluster-based economic development is not simply a project involving data collection, analysis and planning, but is instead about mobilizing leaders and institutions in the regional "marketplaces" to act in new and more productive ways*[126].

In the larger sense, clusters are all about creating strong responsive links between the region's businesses, institutions and governments in ways that enhance economic inputs to give exporting industries a competitive edge. Mobilization sets the stage for this

collaboration among stakeholders, collaboration which can ultimately take many forms:

- Business-to-business—through consortia, buyer-seller networks, shared service groups and other arrangements
- Business-to-institution—joint design and financing of training and R&D
- Institution-to-institution—joint provision or reform of services, shared facilities, etc.
- Public engagement—community and government representatives

Mobilization is a key first step in cluster development because a sector development agency acting without meaningful stakeholder involvement will struggle in all aspects of its mandate, including securing resources, evaluating the sector's competitive needs, defining actions to enhance the cluster and implementing the action plan. A successful cluster initiative requires widespread interest and participation. Constituencies to be mobilized at this stage thus range from senior executives of businesses (both large and small) and industry associations to representatives of government and local academic institutions to the public that might be funding the initiative with their tax dollars.

Stage 2: Diagnosis

> *Once there is a degree of participation and commitment on the part of stakeholders, a region should carry out a thorough assessment of the industry cluster... Without adequate mobilization prior to this diagnostic stage, any analysis is likely to simply sit on a shelf collecting dust. Moreover, without thorough analysis, later stages of cluster development will be hampered by inadequate understanding of the region's assets and liabilities*[127].

Accurately defining specific industry challenges and opportunities is the key to developing a sound cluster development strategy. A diagnostic assessment uses data and analysis to understand how the cluster works (its structure), how it is performing (historically and relative to competitors), the benefits the cluster is producing (e.g. jobs and wages), the region's sources of competitive advantage, and the threats and opportunities on the horizon. Comparison with competitor regions is essential. Only this kind of benchmarking can reveal how well positioned the region's firms are to take advantage of global demand, and the relative weaknesses that might hinder market success.

Stage 3: Collaborative Strategy

> *The collaborative strategy stage of cluster-based development has the mission of bringing together stakeholders along each cluster's value-chain (e.g. the businesses and institutions that provide the continuum of basic inputs to intermediary supplies to final products) in an inclusive process to define mutually beneficial actions with measurable outcomes*[128].

With stakeholders engaged and a strong cluster diagnosis in place, the challenge becomes to find the common denominators in the region that define economic development

opportunities and to craft a strategy of specific actions to enhance the region's ability to capitalize on those opportunities. During the collaborative strategy stage, key stakeholders work together to understand what is needed to enhance the region's economic inputs and allow its businesses to be more competitive in global markets.

Stage 4: Implementation

> *If the collaborative strategy stage has been well structured, there should be a core group of enthusiastic participants who are committed to implementing the action plans. The implementation stage then needs to be concerned with devising appropriate institutional structures and marshalling resources to carry out action plans.*[129]

Cluster initiatives most often falter at the implementation stage. Highly committed leadership is needed to sustain action, allocate responsibility and accountability, and see the changes through. Changes may include businesses forming new relationships with each other and suppliers to conduct research, improve productivity or engineering or manufacturing, organize training in key skill areas, meet specialized financing or undertake joint marketing and promotion. Changes may also include developing or improving the quality of regionally supplied economic inputs, such as the physical, environmental, communications, research, training, policy or regulatory infrastructure provided by public and private institutions.

5.2 Catalyzing Seed Clusters

In many cases, a region will have the building blocks or "seeds" for a cluster but the cluster will not yet have emerged in a mature state. Such is the case with New Mobility in Toronto. The region appears well on its way to have a strong set of export-oriented producers supported by suppliers and foundation institutions, but still has some way to go.

The basic principles of the cluster-based economic development model still apply to seed clusters. Growing the cluster requires mobilization, a rigorous diagnosis of the region's competencies and competitive needs, and a collaborative approach to identify and implement actions to strengthen the cluster. But there are also differences in the approach to growing seed clusters and expanding clusters.

One key difference is that growing seed clusters requires much more active roles for leaders in industry, economic development, planning, and human resources. More intensive efforts are needed for mobilization and, during the diagnosis stage, data collection. Leadership also must frequently be proactive in tracking the emerging supply and demand trends, laying out a vision of the cluster and identifying actions that can promote cluster development.

Even with a strong role for such cluster development agents, the greater the degree of industry involvement in the process, the greater is the likelihood of success. It is essential that cluster development agents continually verify their understanding of the emerging cluster with representatives of both the supply and demand side of the cluster, and work to achieve the level of mobilization necessary to secure resources for adequate diagnosis, to develop and implement a collaborative strategy.

A second key difference is that seed cluster strategies serve as a stepping stone to prepare the region for a full-fledged collaborative process. Seed cluster strategies aim to kick-start cluster formation and mobilization to the point where industry players are sufficiently active to play a full role in defining and implementing a competitiveness strategy. The goal should always be to reach the stage where cluster groups encompassing the industry producers, their suppliers and intermediaries, and the institutions that support them, work together to craft action initiatives that enhance the cluster's competitive advantages.

5.3. Major Action Areas for New Mobility Cluster Development

Can Toronto capitalize on the emerging markets for New Mobility, become a recognized centre of expertise and grow an active exporting industry that brings new jobs and economic opportunity to the region? Growing a cluster is a challenge for any region. Taking Toronto's New Mobility assets and focusing them to successfully respond to the global opportunity will require sustained leadership, an inclusive and collaborative process, appropriate resources, and rigorous analysis and creativity. Above all, growing a cluster will require an integrated public-private commitment to change and work in new ways that will enhance the competitive advantage of local producers.

While the challenges of cluster development are always significant, the potential returns on the investments are no less than Toronto's continued prosperity. Actively nurturing new clusters to capitalize on major global trends and transformations, such as those occurring in transportation, is critical to positioning the region for success in the global economy. Furthermore, local applications of New Mobility can also contribute to quality of life and quality of place, factors that enhance competitiveness of urban regions as places to live and do business. Inaction may be costly, both in terms of time and effort to deal with the results of projected trends. As the *Toronto Economic Development Strategy* declares, "We can take risks or be at risk."[130]

This study focuses on New Mobility cluster development opportunities in the Toronto region; however it suggests national and international opportunities as well. As emphasized in Section 1, success in today's global economy requires recognition of the fact that clusters drive regional economies and, in turn, regions drive the world economy. Building strong clusters in Canada's main regions, including Toronto as Canada's largest regional economy and manufacturing centre, contributes to the country's economic success. National benefits would result from a number of factors:

- Some of the suppliers required by a regional New Mobility cluster would undoubtedly be outside the immediate region, generating employment opportunities in diverse parts of the country.

- There is potential for other major Canadian urban areas to benefit from the cluster development model in terms of building on their own existing strengths and innovation capacities related to New Mobility. A number of Moving the Economy partnerships and initiatives have evolved into national consortia for the purpose of information and research exchange and cost sharing. This benefits both the regions themselves and the country as a whole in terms of developing Canada's New Mobility industry.

On the international scale, while a Global Reference Group has informed the research for this study, there have as yet been no similar on-the-ground initiatives identified anywhere in the world. As such, Moving the Economy has already begun to serve as a hub of a network of city regions and international players interested in exploring and applying the cluster development approach to New Mobility.

The actions described below are intended to advance the Toronto region along the path to a full-fledged cluster development strategy for New Mobility. More generally, they are also intended to refine and share the cluster development model for New Mobility for application in other urban regions. The listed actions are focused on Moving the Economy's role as a catalyst in speeding the pace of industry development in New Mobility. At this early stage in cluster development, there is a need to bring key players together from the business, government, labour, academic and NGO sectors to catalyze initiatives for accelerating New Mobility innovation and commercialization. In producing this report, Moving the Economy aims to support actions by organizations, leaders and frontline players in both private and public arenas that contribute to New Mobility industry development.

Given that New Mobility is just now emerging as an industry, the action plan focuses on:

- **Mobilization**—Promoting cluster awareness and expanding involvement in the seed cluster development strategy.

- **Further Diagnosis**—Building on this study to develop a more thorough understanding of the Toronto region's core competencies and competitive needs upon which a full collaborative strategy can be based.

- **Stimulate Cluster Growth**—Initial steps to enhance opportunities for Toronto's New Mobility providers to access global markets.

5.3.1. Action Area 1—Mobilization

Action 1.1 Use this Study as a Consultative Tool

As perhaps the first comprehensive investigation anywhere into New Mobility as an emerging cluster, this study attempts to profile what a New Mobility cluster might look like and suggest actions that would help grow the region's "seeds" into an expanding cluster. It strives to capture the input received from a wide variety of the region's New Mobility stakeholders.

Nonetheless, the scope of New Mobility is very broad and, as a result, consultations for this first cluster study have necessarily been limited. This has been a first pass, and the selection of people the study team met with is not intended to reflect a thorough or representative survey of the New Mobility industry or all the related key stakeholders.

Widespread feedback on the ideas in this study is essential for informing further action. Furthermore, this study is intended to stimulate thinking and discussion about what is and what might be possible.

To support cluster development Moving the Economy should widely disseminate this study and develop a mechanism for gathering responses from New Mobility businesses, suppliers, institutions and other stakeholders through such mechanisms as workshops, symposia and on-line forums.

Action 1.2 Expand Outreach to the Region's Providers, Suppliers and Institutions

Direct discussions with the region's New Mobility providers is the most effective mechanism for testing the concept of New Mobility as a cluster and mobilizing stakeholders who see the benefit of collaborative action to enhance their competitive advantages.

Workshops, symposia, and on-line forums are excellent elements of a mobilization strategy, as they are excellent mechanisms for outreach and also create ideal situations to begin developing strong responsive links between the region's businesses, institutions and governments.

Moving the Economy has a history of initiating such discussions, in both formal and informal venues, and expanding these efforts would support cluster development. A particular focus should be on recruiting highly committed leaders that can mobilize action around specific activities.

Action 1.3 Gather Industry-Relevant Information and Develop Industry-Targeted Communication Tools

Targeting business-relevant information at Toronto's New Mobility industry will help build the private sector constituency for Moving the Economy's efforts, grow cluster awareness within Toronto's relevant businesses, and support cluster growth. Information of bottom-line interest to companies includes:

- Market intelligence
- Marketing venues (such as trade missions and conferences)
- Sources of seed capital, R&D funding and export assistance
- Availability of local research expertise
- Training opportunities
- Major news from local businesses (such as significant market successes and senior hires)

To support cluster development Moving the Economy should initiate and further expand its own industry-targeted communication tools, and work with partners to increase the amount of business-relevant information available to the industry on New Mobility. MTE's proposed NMX (New Mobility Exchange) on-line forum is one way to serve this function. Current and potential government partners for this type of activity include Industry Canada, Transport Canada, Environment Canada, the Department of Foreign Affairs and International Trade, the Ontario Ministry of Economic Development, the GTA Economic Development Partnership, TradeLink Toronto, and others.

Action 1.4 Integrate New Mobility into Green Industry Strategies

The Ontario Green Industries Strategy has the mandate of growing Ontario's environmental protection industries. To date, however, the strategy has involved little focus on the transportation-related services and technologies that can reduce or mitigate the environmental impacts of transportation. Similarly, at the federal level, Industry Canada operates a range of programs to promote environment industries, but New Mobility has not yet been included.

To support cluster development Moving the Economy should work with the appropriate federal departments (including Industry Canada, the Department of Foreign Affairs and International Trade, Environment Canada) and provincial ministries (including Environment and Economic Development and Trade) to ensure that New Mobility is considered for inclusion in Green Industry Strategies.

5.3.2. Action Area 2—Diagnosing Toronto's Competencies and Competitive Needs

Action 2.1 Survey in Detail the Region's New Mobility Providers

Toronto lacks a comprehensive picture of firms active in New Mobility markets. Basic diagnostic data—number of companies, employment, training and skills requirements, wages, value added, growth rates, etc.—are completely lacking. In common sources of sector information, such as Statistics Canada, New Mobility activities remain buried among a number of traditional sectors.

A survey of the region's providers is needed to properly diagnose the industry. The survey should cover current activities, historical and anticipated changes in activity, the value chain, the labour market, and competitive challenges, and perhaps solicit input on actions needed to enhance the industry. The survey could also be used to provide the information base on which to compile the industry guide described later, in Action 3.6.

To support cluster development Moving the Economy is best positioned to initiate this action, and implement it in collaboration with industry associations and government economic development and human resources development officials.

Action 2.2 Assess the Region's New Mobility Labour Market Supply and Demand

Many of the companies interviewed agreed that Toronto's labour force is highly skilled, well educated and is a significant draw for companies to locate in the region, especially in the areas of information technology, telecommunications, engineering, and new media. There was also agreement that Toronto must not rest on its laurels and should continue to invest in its human resources in order to maintain a competitive advantage.

While there is a base to build on to meet the labour needs of the region's providers, there are still some gaps in New Mobility, especially for systems integrators, marketing/sales, finance/investment and professionals with cross-specializations (e.g. knowledge of urban planning, human factors, public transit and ITS). This study's research found that a common challenge is finding professionals with an understanding of New Mobility trends and an awareness of how their skills and capabilities contribute to an overarching cluster. Further investigation will help assess the region's New Mobility human resources and address gaps in education, training and research.

To support cluster development Moving the Economy, in collaboration with a working group of industry representatives, educational institutions and others, should guide this assessment and use it to work with educational institutions, professional associations and the various sector councils related to New Mobility as a means of promoting discussions on how best to meet the New Mobility industry's human resource requirements.

Moving the Economy's NEST initiative is already participating in the Transportation Association of Canada's Education Coalition. Within the Coalition, transportation associations and professional and technical associations that share an interest in this area

are collaborating to develop strategies to deal with more imminent labour shortages in the transportation sector.

Action 2.3 Build a Collaborative Process to Support Competency Mapping

Competency mapping involves developing a clear picture of the industry's products and services, as well as its structure, strengths and weaknesses along the complete value chain. It is a powerful tool to identify common needs and interests by multiple players. In turn, this allows informed discussion of how the region can better harness its existing assets and what investments are needed to enhance the foundations (economic inputs) of the cluster.

Competency mapping is best done at expert-facilitated sessions, often using preliminary competency mappings incorporating information such as in Section 4 (Toronto's New Mobility Cluster Foundations) as departure points. In its sector development role, Moving the Economy is best situated to initiate the process that might draw on workshops, online forums, personal interviews, and networking sessions to harvest the information. Given the complexity of New Mobility, competency mapping would best be done for selected components of the industry at any one time.

Action 2.4 Prepare a Technology Road Map for New Mobility

Industry Canada uses a valuable framework, called "Technology Road Maps," for understanding and supporting emerging technologies. Given the early stage of development of the New Mobility industry, applying the rigour of the industry-led road map framework would advance understanding of the emerging cluster and the actions required to support research, development, innovation and growth.

To support cluster development Moving the Economy should work with Industry Canada and industry partners to develop a technology road map for New Mobility and explore opportunities to work with Industry Canada's Innovation Agenda.

Action 2.5 Benchmark the Region's Performance

Fundamentally, cluster development is about relative competitiveness. Benchmarking provides essential information on how one region is performing relative to its competitors.

Benchmarking data for New Mobility will not be available in other jurisdictions (as it is not for Toronto). However, benchmarking the currently classified sectors that contribute to New Mobility will provide a strong indication of the likelihood of success in catalyzing a New Mobility industry. In addition, information should be collected to benchmark research and development (R&D) – such as institutes, investments, incentives and programs – in sectors that contribute to New Mobility to assess Toronto's competitiveness on the innovation front.

Action 2.6 Identify and Develop Enabling Policies, Legislation and Financing
In order to support a positive business climate for cluster development, it will be critical to:

1. Identify and address policies, legislation, and regulations that hinder innovation and industry development.
2. Develop and apply policy and financing tools that enable New Mobility innovation, commercialization and application.

To support cluster development Moving the Economy should work to catalyse efforts aimed at exploring innovative financing approaches to support industry development, including venture capital, public-private partnerships, fiscal policies, etc. Moving the Economy should also work with relevant parties, such as Industry Canada's Innovation Agenda, to catalyze and stimulate research on policy, legislation and regulations that enable or discourage innovation across industries related to New Mobility. The areas of research should include financing, fiscal policies, transport legislation and regulations, as well as social and environmental policy tools. The objective would be to collaborate with others to develop enabling policies for New Mobility industry development and to remove barriers to innovation and application.

5.3.3. Action Area 3—Stimulating Growth

Action 3.1 Promote Toronto as a Living Laboratory for New Mobility Solutions
The region that moves first to address challenges creates a reputation for having solutions. Such a reputation attracts buyers from abroad and can propel local producers into leading positions in world markets. Local producers' initial experience within the region demonstrates the viability of their solutions and gives them the competitive advantage to export successfully.

This trend can already be seen in New Mobility in a limited way. Certain regions are becoming known for certain aspects of New Mobility. Examples include Portland, Oregon for land use planning, Hong Kong for integrated Smart Card systems, and Vancouver for fuel cell technologies. Toronto, too, has its cutting edge applications—the world's first fully automated electronic toll road, a top-quality transit system with one of the highest mode shares of North American cities, and a fully integrated traffic monitoring and emergency response system. No region, however, has yet established an identity for a wide and integrated range of New Mobility solutions.

Developing an international identity for the Toronto region as a centre of cutting edge integrated New Mobility solutions would provide a critical advantage to the region's emerging industry. It would involve both becoming a "living laboratory" and promoting

the region's efforts and successes to potential buyers from abroad. It will require:

- Support from multiple levels of government, transportation agencies and others to support implementation,
- Creative thinking to identify appropriate solutions to the region's transportation challenges and to overcome financing and other implementation hurdles, and
- Concerted efforts to promote the region's achievements.

To support cluster development Moving the Economy should work to catalyse local New Mobility applications. Quite separate from any cluster development benefits, there is a solid economic, environmental and social rationale for improving Toronto's regional transportation system. A wide constituency already supports this action, including local carriers and shippers, the Toronto Board of Trade, the Canadian Automobile Association, the Ontario Trucking Association, the Canadian Urban Transit Association, a range of environmental organizations and others.

To support cluster development Moving the Economy should disseminate the evidence in this study of the global opportunity and potential for the Toronto region to develop a vital New Mobility industry, and encourage stakeholders to integrate the cluster development benefits argument into their calls for action.

Action 3.2 Initiate Collaborative Demonstration Projects Responding to Local Transportation Needs

In addition to showcasing the region's capacities and developing a reputation as a centre of excellence in New Mobility, using local challenges to mobilize stakeholders in collaborative projects will help demonstrate the powerful synergies of cluster-oriented action. Such projects can also build lasting partnerships that can continue working together to pursue markets abroad.

Such collaborative projects work best when they are:

- Market-driven
- Link the value chain from suppliers to end producers
- Convene the entire market, bringing together producers and suppliers with representatives of the demand side and supporting institutions, and
- Set the stage for implementation.

Moving the Economy's Integrated Mobility Systems Project and the InfoMobility Network regional on-line traveller information initiative offer excellent examples of the type of demonstration projects that are needed. Many of the projects funded under Transport Canada's Urban Transportation Showcase Program are also relevant.

Because of the region's growing congestion problems and the direct economic cost it imposes on the region's economy, a promising new demonstration project appears to be a GTA Urban Goods Movement Council.

GTA Urban Goods Movement Council

The Toronto Board of Trade and others recognize the growing threat that inefficient, congested goods movement poses to the region's competitiveness. Congestion already costs local businesses billions of dollars. Ever growing population, economy and trade coupled with a lack of major rights-of-way for expanding highway capacity mean that only innovative solutions can avoid an increasingly choked road network.

Prior to being disbanded, the Greater Toronto Services Board began exploring the problem and identifying potential solutions. The Board's *Goods and Services Movement Strategy* identified lack of coordination among agencies and governments as a major constraint to improvements, and the need to establish partnerships for providing leadership, a forum for discussion and coordination of solutions. At the same time, Moving the Economy had also organized several urban goods movement workshops and collaborated with the Canadian Urban Institute in developing *Moving Goods in the New Economy: A Primer for Urban Decision Makers.*

> Traffic will flow efficiently, allowing our economy to flourish, our quality of life to improve, and our environment to sustain itself; or traffic will run into roadblocks, in which case businesses will move to locations where they can succeed, our international competitiveness will fail, our environment will suffer—and all the benefits that flow to every Canadian from a prosperous GTA and Hamilton area will begin to fade.
>
> Greater Toronto Services Board (2000) *Removing Roadblocks*

Recommendations by the Greater Toronto Services Board, MTE, the Canadian Urban Institute and the IBI Group all point towards the development of an industry forum on goods movement in the Toronto region, possibly in the form of an Urban Goods Movement Sector Council. Such a council should bring together:

- The region's major goods-related New Mobility actors;
- Transporters (such as representatives of marine, air, rail and trucking associations, and human-powered cargo businesses);
- The demand side (retailers, wholesalers, distributors and manufacturers such as the auto industry); and
- Government partners (such as the Ministry of Transportation, Transport Canada's regional division, the Ministry of Economic Development and Trade, the Ministry of the Environment, and municipal land use planners, economic development officials and specialists in local production and distribution).

An Urban Goods Movement Sector Council should focus on assessing goods movement challenges, identifying practical solutions, and moving towards implementation. In the absence of the GTSB, roles and responsibilities for organizing a region-wide initiative are unclear. To support cluster development Moving the Economy could adopt a facilitating role and emphasize that the partnerships established include among their aims the need for showcasing local expertise, services and technologies.

Action 3.4 Establish Toronto as a Hub of Research and Development in New Mobility

Three opportunities for investment in research and development (R&D) should be considered to accelerate R&D and commercialization of innovations developed by Toronto area researchers.

1. Toronto area universities could take up a central role in galvanizing Canada's disparate research activities in New Mobility into a network of centres of excellence. This would allow a coordinated approach to setting an effective research agenda on New Mobility, encouraging dissemination and, where appropriate, commercialization of the results.

2. Under the Social Sciences and Humanities Research Council's Initiative on the New Economy (INE) program, there is an INE Collaborative Research Initiative that supports proposals that bring together critical masses of research talent on complex New Economy issues. There is a strong case for developing collaborative New Mobility proposals, which have direct relevance to the New Economy.

3. The 1970-1980s Transport Canada model of investing in transportation R&D centres across Canada could be re-examined and applied to New Mobility. Regional R&D hubs could be revived and established by generating broader support from interested departments in addition to Transport Canada, for example potentially the National Research Council, Natural Resources Canada, Environment Canada, Industry Canada and Human Resources Development Canada.

Moving the Economy, through its Network of Excellence for Sustainable Transportation (NEST), is already working to support R&D in New Mobility by collaborating with key academic, industry and government representatives. Enhancing these efforts and working towards models such as those mentioned above should be considered.

Action 3.5 Create and Market an Identity for Toronto's New Mobility Capabilities

Successful clusters are known worldwide—California for Silicon Valley, Detroit for transportation equipment, London and Hong Kong for financial services. In each case, the regional brand is an important competitive advantage for the cluster.

Establishing a Toronto identity for New Mobility would attract buyers and complement local exporters' marketing efforts. It would also help attract new businesses and professionals to the area.

To support cluster development Moving the Economy could spearhead this action by establishing a working group of industry representatives to plan and implement the action. The action can have modest beginnings, such as creating a regional New Mobility presence at GLOBE and other international venues, but could grow as resources and interest permit.

Action 3.6 Develop a Guide to Toronto's New Mobility Industry

A guide to the region's providers could send a powerful message to buyers that Toronto is the place to look for New Mobility solutions. Such a guide can also be useful in

promoting the cluster vision to the region's stakeholders. A simple model is provided by *Toronto 2001 Technology Industry Guide: The indispensable guide to Toronto's thriving technology industry* published by InBusiness Media Network in partnership with Smart Toronto.[131]

To support cluster development Moving the Economy should initiate the preparation of such a guide, in conjunction with industry associations and other economic development agencies. If upcoming MTE workshops or conferences include trade show components, the exhibitors list could serve as one foundation for such an industry guide.

Action 3.7 Develop Market Resources for New Mobility Providers

The Department of Foreign Affairs and International Trade, TradeLink Toronto and other export promotion agencies routinely develop and disseminate information on overseas markets by sector. To date, no targeted resources have been developed in the area of New Mobility.

To support cluster development Moving the Economy should encourage export development agencies to develop and disseminate market information on foreign demand for New Mobility services and technologies. Once developed, Moving the Economy can use its web portal and other outreach activities to help disseminate this information.

5.4. Conclusion

New Mobility presents a significant global economic opportunity. Urban areas around the world face the same urgent economic, social and environmental imperatives to improve their transportation systems. The investments needed for these improvements are massive. Markets for New Mobility services and technologies are already substantial and growing fast.

The Toronto region has the building blocks of a New Mobility seed cluster, including a range of businesses providing New Mobility services and technologies, numerous suppliers of inputs and strong institutions that could be harnessed to provide the specialized economic foundations required for a cluster. If successfully nurtured, these building blocks have the potential to grow into an expanding cluster, bringing job opportunities, wealth and continued economic prosperity to the region.

Multi-stakeholder collaborative actions are needed to realize the opportunity. Mobilizing stakeholders to participate in developing and implementing a cluster development strategy is essential for success. By bringing together knowledge, capabilities, entrepreneurship and resources, the actions recommended in this study provide for a strong beginning to move towards a seed cluster strategy in New Mobility for the Toronto region.

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