

Urban Transportation Patterns in Selected Canadian and Korean Cities: A Comparison

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Abstract

This paper compares urban transportation patterns in selected Canadian and Korean cities. The results of the comparative analysis indicate that in general, cities with higher population and employment densities, higher transit service provision and lower road infrastructure supply have lower levels of car ownership and car use, and higher levels of transit use. The Canadian urban areas are more automobile dependent with high levels of car ownership. This is likely due to the fact that most Canadian urban areas developed during a period when car ownership increased rapidly. These trends supported the development of sprawling, low density, auto-oriented suburbs where transit services have not been competitive with the automobile, except for trips downtown. The Korean urban areas, in contrast, have highly dense urban forms with high levels of transit use, service, ridership and shorter trip lengths. However, Korean urban areas are suffering from extremely high levels of congestion given their high density and limited road capacity.

Introduction

Metropolitan areas are becoming more alike in this era of globalization (Sorensen et al. 2004). A key thesis is whether similarities can be found in urban cities of different nations, and if so, the cause of those similarities. This may give evidence of a common urban transportation phenomenon catalyzed by the globalization of the modern lifestyle.

This paper compares the urban transportation patterns in the large Canadian urban areas of Toronto, Ottawa-Gatineau, Calgary and Vancouver to the Korean cities of Seoul and Incheon, which are large urban areas in the capital region of Korea. The study uses a series of indicators developed by the Transportation Association of Canada and a transportation census from the Seoul Metropolitan Government. The use of urban indicators is a practical way to gather and organize data to identify comparative trends and patterns in urban studies. The indicators also help to describe and measure the differences and similarities between the Canadian and Korean urban areas.

Population and Employment Characteristics

Table 1 presents population and employment information for each city. Seoul is a highly dense city with the highest population and employment, and the smallest land area. The Canadian urban areas are of low population and employment density, in contrast with Seoul's density which is 10 to 22 times higher. In Canadian cities, the trends of urban sprawl, decentralization of population and employment, and inner city decline evolved over the last three decades (McCann 1999).

In the case of Seoul, the central area still keeps its function as a dominant employment centre with strong business, commercial and civic activities. The

Table 1: Patterns of population and employment distribution in Existing Urban Areas (EUAs)

	Seoul	Incheon	Toronto	Ottawa-Gatineau	Calgary	Vancouver
Population	10,469,852	2,320,791	3,970,000	807,555	768,000	1,680,000
Employment	4,045,537	664,108	1,940,000	448,175	390,000	797,000
Population density (people/km ²)	17,289	2,428	1,726	786	1,067	1,292
Employment density (jobs/km ²)	6,680	695	843	436	542	613
Land area (km ²)	605	956	2,300	1,027	720	1,300

Note: Transportation Association of Canada defines Existing Urban Area (EUA) as currently built-up area which is a large urban area together with adjacent urban and rural areas that have a high degree of social and economic integration with the urban core.

Canadian urban areas, on the other hand, have central cores that have become areas of high employment concentration but with increasingly significant residential populations. Many Canadian cities have high levels of downtown residential population living in condominiums and apartments. This is particularly true for Toronto and Vancouver, where new, high-density residential developments have proceeded rapidly while office growth has stagnated. It can be beneficial to have employment densities close to the pattern of population density in order to reduce the distance of home to work travel. The new residential developments in Canadian cities have tended to reduce trip lengths, as the new residents have tended to live and work downtown, with most walking to work.

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Transportation Supply Patterns

Table 2 provides transportation supply information such as length of arterials, expressways, and high occupancy vehicle (HOV) lanes. Numbers of automobiles and transit seat-kilometre per capita in the morning peak hours, and off-street parking spaces per employee in CBD are also presented.

Table 2: Characteristics of transportation supply

	Seoul	Inchon	Toronto	Ottawa-Gatineau	Calgary	Vancouver
Arterial lane-km per 1,000 capita in EUA	0.27	0.30	2.52	3.81	5.22	3.32
Expressway lane-km per 1,000 capita in EUA	0.11	0.09	0.50	0.77	1.74	0.33
HOV lane-km per 100,000 capita in EUA	4.17	2.44	2.34	6.07	N/A	1.85
Automobiles per capita in EUA	0.21	0.22	0.55	0.57	0.76	0.56
AM peak period transit seat-km per capita in EUA	0.51	N/A	2.42	2.60	2.07	1.59
Off-street parking spaces per employee in CBD	1.27	0.23	0.18	0.36	0.51	0.38

Canadian cities have a higher road supply than their Korean counterparts. This is further evidence of the very different urban form of the two groups of cities. Most Canadian cities have a more dispersed spatial structure with significant automobile use for peak hour travel and thus higher infrastructure requirements. The Korean cities, in contrast, have evolved a more compact form that is highly dependent on public transportation.

While the two groups of cities have taken very different paths to their present status since the mid 1980s, increasing automobile use in Korea has significantly changed the urban spatial structure with a growing demand for more road and parking spaces. High demand for high-rise apartments with cheaper land values in outlying areas or new towns has contributed to outward movement of population. This trend suggests that newly developing areas in Korean cities are becoming more automobile-oriented and need to be carefully managed in the planning process. This is likely attributed to the fact that the growth rate of car ownership (3.7% in Seoul and 7.9% in Incheon between 1994 and 2004) is much greater than the population growth rate (-0.006% in Seoul and 1.6% in Incheon during the same period). The annual economic growth rates of 7.8% in Seoul and 8.4% in Incheon between 1995 and 2004 have contributed to rising car ownership of the Korean cities.

Values of HOV lane-kilometre per capita provide an indication of the priority of bus- and carpool-exclusive lanes. Ottawa-Gatineau shows the highest HOV lane-kilometres, followed by Seoul and Incheon. It should be noted that Ottawa-Gatineau has a transitway system consisting of 26 km of two-way bus-only roadway and 28 km of bus lanes and bus-only shoulder lanes. Ottawa also has a short diesel light rail transit (LRT) system using existing track, fully integrated with the transitway system in terms of fares, schedules and terminals. Calgary has no HOV lanes but maintains a successful LRT system, as does Vancouver. Seoul has had exclusive bus lanes on the existing road network since early 1990s to improve the quality of service for bus passengers. The designation of the bus-only lanes has contributed to a better flow of the bus fleet operating in and around Seoul.

Most of the exclusive bus lanes in Seoul used to be along the curb. These lanes did not function well due to conflicts with other vehicles. Since July 2004 exclusive bus lanes have been constructed in the median of six major corridors in the outlying parts of the city. These exclusive lanes are restricted to trunk-line buses to maintain high travel speeds and have contributed to faster bus travel times (SMG 2005). The intent is to continue expanding the lanes on the main arterial roads in other parts of Seoul.

Comparing car ownership across the urban areas shows an interesting contrast. Car ownership per capita in the Canadian urban areas is higher compared to that in Seoul and Incheon. Among the Canadian cities, Calgary has much higher auto ownership. High auto ownership is generally associated with a combination of lower densities, lower transit service provision and higher road supply dedicated to the automobile. Toronto and Vancouver show relatively lower levels of car ownership and correspondingly higher population and employment densities.

Table 2 shows the transit seat-kilometre per capita for the morning peak hour, estimated based on average transit seats and revenues (TAC 1999). These numbers help to roughly compare the amount of public transportation service provided in the cities. The high transit supply in the Canadian cities results from high average trip lengths and the provision of extensive CBD-focused transit systems such as the Ottawa-Carlton Regional Commission (OC Transpo), the Toronto Transit Commission (TTC), the Government of Ontario (GO) Transit, and Calgary Transit.

Seoul's central business district has the highest supply of off-street parking space, whereas Toronto has the lowest. In the case of Seoul, all new construction or modification of all buildings in excess of a certain size are required to provide underground parking garages. These garages account for 81 percent of off-street

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supply encourages greater car use, Seoul has recently introduced a policy that limits the number of parking lots for certain categories of building and land use type in the central and sub-central areas. However, the tighter parking policy has not significantly reduced car use or illegal parking in the areas mainly due to lack of parking enforcement.

In contrast, most Canadian cities have parking policies to actively enforce tight parking supply in the CBD, although some cities have generous minimum parking standards. For example, Vancouver has introduced strategies such as parking maximums, reduced minimums and flexible requirements, and restriction of principal use facilities in the form of temporary parking operations (GVRD 1996). Ottawa central area encourages the provision of short-term parking and discourages long-term parking to sustain a high transit usage (RMOC 1994). Since the mid-1970s, Toronto has limited its parking supply in Downtown Toronto, with paid parking being the norm. The city has actively pursued parking management measures to reduce the attractiveness of automobile travel relative to public transit, walking or cycling.

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Transportation Demand Patterns

Table 3 presents transportation demand patterns such as the transit and automobile modal shares, automobile occupancies, morning peak hour and 24-hour person trips and annual transit rides per capita for the Existing Urban Areas (EUAs).

Toronto has the highest transit modal shares for trips to and from the central area in the morning peak period. This may be in part the result of an extensive CBD oriented transit network which includes the GO Transit commuter rail system and the Toronto Transit Commission (TTC) subway, streetcar and bus system.

Seoul and Incheon also show relatively high transit modal shares. The Korean cities' transit network includes several subway lines, commuter train

Table 3 : Characteristics of transportation demand

	Seoul	Inchon	Toronto	Ottawa-Gatineau	Calgary	Vancouver
AM peak period transit mode share to/from CBD	51.1	50.9	56.1	32.8	33.1	38.7
AM peak period automobile mode share to/from CBD (driver + passenger)	25.5	38.7	38.9	55.0	60.9	54.6
AM peak period automobile occupancy to/from CBD	1.60	1.63	1.21	1.28	1.30	1.19
AM peak period person-trips per capita for EUA	0.28	0.30	0.24	0.23	0.26	0.31
24-h person trips per capita for EUA	2.57	2.08	2.05	2.80	3.71	3.44
Annual transit rides per capita for EUA	376	217	111	102	91	73

and buses. As of 2006, there are 287 km and 22 km of rail transit lines beneath Seoul and Inchon respectively. There are also 178 km of regional surface rail linking Seoul with new towns, satellite communities and large cities such as Inchon and Suwon.

The Seoul Metropolitan Government (SMG) executed an innovative bus system reform in July 2004 (Pucher et al. 2005; Kim & Dickey 2006). Before 2004 there were 57 bus companies with about 8,000 buses operating 365 conventional bus lines in Seoul. Bus lines were reorganized as trunk, feeder and circular, and bus numbers were organized into eight areas. The monopolized route systems were reorganized as a semi-public operation with a route tendering system to induce competition between bus operators. The tendering system is based on contracts between Seoul city government and bus operators. The contract does not allow altering routes, fares and the subsidy level. A unified fare system was introduced with the development of a new card system which allows transfers between buses, buses and the subway, and other public transportation such as the community bus. The bus reform has increased the number of bus users by 11.2 percent and public transportation revenues (buses and the subway) by 12.9 percent between November 2004 and November 2005 (SMG 2005).

Comparing the automobile modal share to and from the CBD in the morning peak period shows that Canadian cities have much higher proportions than the two Korean cities. This comparison indicates that Canadian urban areas, except Toronto, have a more car-oriented dispersed urban structure than the Korean urban areas. While the Toronto area has become increasingly dispersed, most travel to the CBD continues to use transit because of a combination of good transit service and limited, expensive parking in the CBD. As former City of Toronto residents who work downtown move to the suburban Regional Municipalities, they cease to be TTC subway riders and become GO Transit commuter rail patrons.

Values of annual transit ridership per capita indicate the average rides on public transportation for the urban areas. As expected, this is much higher for Korean cities. This indicates that the more dense urban form is able to provide higher transit service intensity and thus can offer more frequent service to a greater number of people. The more compact cities with higher urban densities have higher transit ridership and lower dependency on car use. This confirms the findings presented by others (Newman & Kenworthy 1999; Litman 2005).

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Among Canadian cities, Toronto and Ottawa-Gatineau have the highest transit ridership. It can be interpreted that Toronto has relatively high population and employment densities, and transit-oriented urban form, particularly in the central area. As mentioned above, Toronto maintains an extensive network of public transit that plays a role in keeping high levels of transit service, while limiting automobile use on arterial and express roads. In the case of Calgary, transit supply has significantly increased over the last years. However, as a result of road and parking infrastructure provisions and outward urban expansion, Calgary has experienced the loss of transit modal share (City of Calgary 1995). Vancouver's low transit use is partly because a much higher proportion of downtown workers live in or near the downtown and walk to/from work, compared to other Canadian cities.

Discussion and Summary

The findings of this study can be used to suggest the relationships between land use and transportation, and help policy makers to change or establish policy measures which might enhance integration of land use and transportation in support of more sustainable transportation systems.

The study indicates that in general, urban areas with higher population and employment densities, higher transit service provision and lower road infrastructure supply have lower levels of car ownership and car use, and higher levels of transit use. The Canadian urban areas are more automobile dependent with high levels of car ownership than Korean urban areas. This is likely due to the fact that most Canadian urban areas developed during a period when car ownership increased rapidly. These trends supported the development of sprawling, low density, auto-oriented suburbs where transit services have not been competitive with the auto, except for trips to downtown.

The Korean urban areas, in contrast, have highly dense urban forms with high levels of transit service and ridership and shorter trip lengths. However, Korean urban areas are suffering from extremely high levels of congestion given their high density and limited road capacity.

Some Canadian urban areas such as Toronto seems to have the potential of attaining much higher levels of transit use and lower levels of automobile use given their land use and transportation planning policies. Toronto has a higher transit modal share than the Korean cities which have a fraction of the car ownership and eight times the density. This makes the point of Bernick and Cervero's findings (1997:83): "The biggest benefits come from going from very low to moderate densities, say from an average of 4 units per acre to 10 to 15 units per acre... Increasing densities to mid- and high-rise apartments add relatively smaller benefits in terms of trip reduction. One doesn't need Hong Kong-like densities to sustain mass transit". As Kenworthy and Newman (1994) observed, Toronto is unique in its land use and transportation patterns. Despite Toronto's success in achieving relatively high transit use, it still has much higher auto use than in Korean cities. This is probably because relatively

few Toronto residents walk to/from work, something that is much more common in Korean cities.

There is something of a “chicken-and-egg” dilemma with causal statements about car and transit use, population and employment density. Density seems to be driving the evolution in urban form and transit modal share but it is strongly influenced by the mode choices available to the population. However, Korean urban areas are losing their spatial and transportation efficiencies as cars become more popular. These patterns may be evolving in the opposite direction from some Canadian urban areas which are trying to introduce policy alternatives to car dependence with sustainable urban development schemes and more sustainable modes of transportation.

It has been argued that urban structure with higher densities will encourage transit use. However, the data from Toronto show that urban density is not the only key factor. Likely transit use and rates of car ownership reflect the patterns of land uses in a city and the availability of competitive transit services. For example, while many people living in the city can live without a car (25 percent of City of Toronto households do not own a car), because of land use and transit service factors, about 95 percent of households in the suburban areas around Toronto own at least one car. Planners and policy makers should therefore find ways to make car use less attractive or public transportation use more affordable.

Conclusion

In conclusion, lessons that Korean urban areas and cities in other countries can learn from Canadian urban areas are to improve air quality by reducing levels of traffic congestion, support tighter enforcement of parking restrictions in central areas, and provide more travel choices by building LRT systems or alternatives to LRT. On the other hand, Korean urban areas show that higher urban densities with mixed-use development in extended urban areas and enhancing public transportation use are important. Urban transportation and land use policy must adopt a fully integrated approach. While excessive transportation demand resulting in congestion may need to be more closely

regulated, policy must continue to focus on infrastructure restraints so as to suppress freedom of mobility through car dependency.

The limitations and comprehensiveness of the indicators used in the study should be noted. In particular, the data set of indicators did not include all relevant modes such as rail transit, cycling and walking. The conclusions require further research or analysis to be of better utility to planners and policy makers. Subsequent research should move beyond the description of different transit systems and urban forms, to the implications for planning practice.

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