

Development of Transportation and Telecommunication and Urban Regional Structure in Canada

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Abstract

Transportation and Communication played a very important role in the historical development of Canada. Urban development was based on the spatial extension of transportation network and the diffusion of telecommunication. Motorization especially had a lot of influence on the formation of urban area after World War II, and low densely urbanized areas were developed with the diffusion of automobile. Motorization, indeed contributed to the improvement of daily life of Canadian, but made an undesirable situation that public transportation was insufficient to use in a city. A lot of effort has been made to improve such a condition in several metropolises. Telecommunication industry, on the other hand, has developed in Canada like other advanced countries. One of the reasons why this industry has so much developed is that Canada is a large country to be maintained with a sophisticated communication means. The Internet is the most representative way of communication to people for various purposes of every day life. The regional difference of the rate of using the Internet is explained by the socio-economic conditions that characterize each province and city.

Key Words : Canada, transportation, motorization, communication, urban regional structure

I. Introduction

Transportation and communication are two important means to maintain the urban system consisting of not only a set of cities but also a group of areas within a city. These two ways of transferring people, goods and information have been innovated, and a new innovation has been introduced by and by in the historical development of urban system. The general features or functions of transportation and communication are common to any country, but the spatial pattern resulted from the introduction of these infrastructures varies among both countries and cities. The reason is that every country and city has its own unique physical condition and socioeconomic background. Policies employed in order to construct and manage these

infrastructures are different from each other.

Canada, a large country in size but comparatively less populated country in the world, shows a typical process that advanced countries have developed with the stepwise introduction of transportation and communication means. The development of transportation and communication contributed to not only socioeconomic growth but also people's daily life, and an urban systematic structure has spatially changed with it. Because of the close relationship between transportation and communication and urban structure, it has to be paid attention to the use of these infrastructures in order to understand urban structure itself. How transportation is used in a city and what is the main purpose of using the Internet are typical questions for clarifying the mechanism of urban area as a central place attracting and dispatching goods and services.

Although Canada belongs to North America same as the United States of America, the most developed and advanced country in the world, Canada's urban structure is somewhat different from that of the United States. The reason of this difference comes from the policy of transportation that the public transportation in a city should be maintained (Mercer and England, 2000). Most of main cities that public transportation has an important role in North America are included in Canada (Miller, 2000). Nevertheless, there are several transportation problems in Canadian cities. Most of them are common to cities in other countries, so we can find some clues to solve urban transportation problems. Trial and errors carried out in Canadian cities are suggestive for thinking about an ideal situation of urban transportation system.

After the privatization of communication in the advanced countries, telecommunication has an important meaning not only in the industrial sector of a country but also in the socioeconomic and cultural condition of the country. In this respect, Canada shows an excellent performance in the research and development of products based on high technology. These communication equipments are highly estimated in the world market, and the advanced companies of communication in other countries have established their research and development departments in Canada. Canada is one of the well - known countries that sophisticated communication means like the Internet is greatly used among people. The orientation to a highly communicated society contributes to the development of telecommunication industry.

II. Transportation and Urban Structure

1. Transportation and Urban Regional Structure in Early Historical Stage

It is not limited to Canada that urban activities are firmly related with the transportation system. Activities in a city are carried out in housing, factories, stores, schools, etc., and the movements among these facilities are observed before and after such activities happen. Journey to work,

going to school and going shopping are included in these movements. We need to treat these movements as the activity systems because there is a relationship among the location of facilities, the selection of sites and the schedule and frequency of activities. Transportation networks and means have to be prepared for these activities to be carried out smoothly. Road networks, subway systems and bus services exist to sustain the activities, and people can drive only if they have their own cars. The spatial patterns of the movement with these transportation means vary according to the object and schedule of the activity. The movement to the downtown in the morning, for example, has a lot of traffic in volume, and the inverse flow to the suburb is large in the evening. Thus, there exists a reciprocal relationship between the system of activity people do considering the facilities and the transportation system consisting of transportation networks, means and demands.

The relationship between the activity system and the transportation system changes with the development of society and economy. The change of facilities and their locations accelerates the transforming of transportation networks and means. In the historical development of a city, the urban area expanded to the periphery, and a new transportation means was introduced in order to cope with such an expansion. Before the middle of the 19th century, walking and horse-drawn carriage were the main transportation means for people living in Canadian cities (Yeates and Garner, 1980). Therefore, the built-up area was compact and the population density there was very high. The spatial figure of many cities was circle or semicircle. These characteristics remain in the spatial structure of modern cities, and their typical ones can be seen in the central areas of historical cities in Maritime Province (Miller, 2000). The old districts of Quebec cities are characterized by such elements, too.

Urban transportation means changed greatly between the latter part of the 19th century and the early 20th century, and urban regional structure also transformed with time. Railway, the greatest product by the industrial revolution, was constructed and began to transport people and many kinds of commodities. Factories were located along the railways so that firms could easily deal with raw materials and products transported by them. The residential area of factory workers was formed close to the factories because they were not rich enough to commute by train like upper classes, and they were forced to live in a poor environmental condition. The agglomeration of commercial and office functions in the center of the city attracted people commuting from the higher-class housing districts in the suburbs. Steam train connecting the high-density and bad conditioned central area with the low-density wealthy suburb in the early stage of development changed into electric car and diesel car later.

As transportation means, people used not only the train running intra and inter urban area but

also the streetcar running through a city. Electric railcar taking over from horse-drawn carriage running over the street expanded its network with the growth of a city. Retail and service activities were located in alignment with the streetcar and the electric railcar, and these activities served consumers using these transportation as well as people living in the neighborhood. It was approximately this period that a general relationship emerged between the transportation network and the location of urban functions. A similar pattern of urban structure began to appear in the main cities such as Montreal, Toronto, and Vancouver. This pattern of structure consisted of several districts such as the central business area, the industrial area close to factories, the residential area for workers and the residential area for middle and higher class. Urban facilities such as establishments and houses were allocated depending on the spatial convenience defined by the transportation network and the ability of paying for their location.

2. Automobile Transportation and Urban Regional Structure

Motorization was the most important factor that changed urban regional structure in a large scale since the early 20th century. People began to use automobile just after the debut of T-type Ford in 1908 (Jones, 1985). The use of public transportation seemed to decrease with the advance of motorization, but the impact that a city accepted from automobile was less in that time. Substantial influence appeared after World War II, and it was clearly observed in the spatial development of suburban area. In Canada, like other countries, there needed much housing for baby-boomers after the war, and the urban peripheral area was developed for these housings. The residential area developed in the suburb had low population density, and it was not easy to find the places of work and stores within the range of walking. That is to say, suburban development was planned on the assumption that people use automobile anytime and anywhere. Factories, stores, and service facilities were allocated in consideration of the people's behavior of using automobile. These facilities have gradually been located along the main lines of roads and near the intersection of roads. The un-planned spatial pattern of development at the early stage has been modified by administrative control into an orderly development.

It goes without saying that automobile was used not only in the suburb but also in the urbanized area. Roads were widened to facilitate driving cars, and parking lots were kept in the urbanized area. As a result, the urbanized area changed to the space with low density, and the average distance of traveling became longer than before in the city. It was very popular that a variety of urban functions should be agglomerated within the range of walking because the basic transportation means was walking until the middle of the 19th century. It was based on the idea that land should be used efficiently in a limited space. However, this idea became the thing of the

past with the advance of motorization. In the suburb, especially, urban planning was introduced to allocate homogeneous land use separately. This was done on the administrative policy that the orderly land use by zoning was the best way to employ because heterogeneous land use surely caused disturbance in the suburb.

In any way, it was certain that the urban land use pattern and the urban regional structure changed greatly with the advance of motorization. The most typical example showing such a change is the edge cities that can be seen in the metropolitan areas of the United States (Garreau, 1991). Business, retail, service, and housing functions are agglomerated in the peripheral parts of the metropolitan areas, and they have a strong centrality comparable to that of the central business districts. There is no such large-scale agglomeration centers in the suburb of Canadian cities. Rather in Canada, urban functions are still located in the central area of a city, and this trend is now continuing. Metro, streetcar, bus, and highway are used to connect between the central area of the city and the suburb, and the radial transportation pattern is predominant. In the suburb, on the contrary, movement by automobile is very popular, and there exists no clear center attracting transportation flow from a wider area. The most popular pattern of transportation is that a number of origins and destinations are connected each other through numerous paths and routes.

3. Urban Transportation Problem

The advance of motorization, a big movement in the development of transportation system, contributed to the change of socioeconomic activities in a city, and changed the urban area into the space with low density. The close relationship between transportation and urban activity can be seen in this spatial change. The urban area with low density, which was brought about by motorization, has a possibility that the low density of a city is fortified and fixed by the excessive use of automobile. Basically, the transportation system heavily based on automobile has a number of problems. In spite of many countermeasures to cope with these problems, a complete solution has not been found yet. It is hope that not only the transportation system but also the urban activity system should be modified to ameliorate such a troublesome situation. But, the fact is that the number of roads and the volume of transportation flow have increased without modifying the locational pattern of land use and facilities.

Transportation congestion is a typical example of transportation problems, and the throughput capacity of transportation has been heightened to ameliorate the congestion. But it was recognized that there was a limitation in the augmentation of supply capacity, so the recent transportation policy has been oriented to lessen and level transportation demand. The

introduction of road pricing system and advanced information system is the concrete countermeasure to solve the congestion. It is clear that there are several obstacles in currying out these methods in the real world. The introduction of flextime system and the encouragement of small office and home office are more reasonable to cope with this problem. Canada is one of the countries that the rate of using the Internet is high in the world, and the rate of person who works at home is high, too. If the transportation demand can be adjusted in terms of time or the outbreak of transportation itself can be restrained, they will contribute to lessen the congestion.

Vancouver is the city that urban activity itself has been reviewed in order to solve traffic problem, but this trial is not only for the solution of transportation congestion (Miller, 2000). As the central business district of Vancouver is in the vicinity of the root of a peninsula, going into and out of the downtown crossing bridges causes a chronic traffic jam. On this account, the regional future plan drawn up in 1993 did not suggest a simple prediction based on the present situation but recommended a plan taking account of policy intension. According to this plan, the downtown and its opposite shore bank, North Vancouver, maintain the present standard, and the district surrounding the downtown is suggested to raise the quantity of predicted activity. In the suburbs, on the contrary, the expected quantity of activity is encouraged to lessen. In short, it is recommended that population and urban facilities gather in the inner city, and the activities in the downtown and the suburbs are held down. If the activity in the suburbs is restrained, the quantity of traffic outbreak decreases and the traffic jam is relaxed. This is a remarkable trial that intends to review the existing urban structure oriented to the enlargement and make the city more effective by encouraging the location of activities within the inner city.

III. Transportation and Movement

1. Person Trip and Commuting Route

Movement of various kinds is done every day in a city. Each movement has its own purpose, means, space (origin, destination and path), and time (time of traffic generation and approximate time required). Personal attributes such as gender, age, occupation and educational status are also related with the movement. We can understand a part of the urban transportation system by clarifying the movement containing many elements. Of them, research investigation is generally carried out as to the purpose, means and origin and destination of movement. For example, according to a survey conducted in Edmonton in 1994, 74.4% of the total trips were based on home (Table 1). These trips were classified into several categories by purpose; others (24.2%), commuting (16.5%), going to school (14.0%), shopping (10.1%), social and recreational movement (9.6%). Other trips occupying 25.6% of the total were generated outside home. They consisted of

Table 1 Distribution of Trip Purposes by Mode (%) in Edmonton CMA, 1994

Trip Purpose	Auto Drive	Auto Passenger	Transit	Walk	Other	Total avg. (%)
Home-based work	23.2	5.3	21.3	7.1	6.7	16.5
Home-based post-secondary	1.7	0.9	14.9	3.3	2.1	2.6
Home-based school	0.6	16.1	21.0	36.1	64.7	11.4
Home-based shopping	11.7	9.0	9.4	7.1	2.0	10.1
Home-based social / recreation	8.6	14.6	3.6	8.6	3.9	9.6
Home-based other	26.5	28.4	12.1	14.5	8.2	24.2
Home-based subtotal	72.3	74.3	82.2	76.7	87.7	74.4
Non-home-based work	4.3	1.2	2.9	4.2	1.3	3.4
Non-home-based other	23.3	24.5	14.8	19.1	11.0	22.2
Non-home-based subtotal	27.7	25.7	17.8	23.3	12.3	25.6
Total trips	100.0	100.0	100.0	100.0	100.0	100.0

Source : Transportation Master Plan Household Travel Survey Project Report. Applications Management Consulting Limited, 1995.

the trips for other purpose (22.3%) and going to work (3.4%).

The survey in Edmonton revealed how people chose the transportation mode according to the trip purpose, too. Auto drive was the most popular trip, which explained 55.6% of the total movement. Auto passenger (24.3%) was second, which was followed by walk (10.2%), public transit (6.7%) and other (3.2%). Except for going to school, auto drive was the largest in every purpose of trip. It especially occupied 78.1% of the total trips for commuting. Trips for going to school were mainly performed by public transit (50.4%) and walk (45.7%). Auto drive, which explained 80% of commuting trips and 50% of social and recreational trips respectively, indicated the difference among people's behavior pattern. Auto passenger occupying 37.1% of social and recreational trips and 21.6% of shopping trips suggested that these movements were likely to be carried out with plural persons.

In every Canadian city, auto drive is the most popular mode of trip for commuting. However, there is a regional difference in the percentage explained by auto drive. This percentage ranges from the highest, Trois-Rivieres (84.1%) to the lowest, Ottawa-Hull (64.3%). Except for Ottawa-Hull, the percentage of auto drive for commuting is relatively low (below 70%) in Toronto, Halifax, Montreal, Victoria and Winnipeg. The common feature of these cities is that they are large in scale and blessed much with public transportation. Vancouver and Calgary are also cities that have lower percentage below the national average (73.3%).

Although auto drive is a very popular trip mode for commuting, it is clear that there are some differences between men and women as to this trip mode. For example, in Ottawa-Hull, which has the lowest percentage of auto drive for commuting among the main cities, the percentage of

auto drive by men is 71.7%, but this percentage by women is only 56.7%. The percentage of auto drive by men is higher than that by women in every city, and this difference reflects the differential pattern of commuting by gender. The percentage of public transit or auto passenger for commuting by women is higher than that by men. In the case of Ottawa-Hull, these percentages are 20.4% and 13.1 % respectively. Commuting trip using public transit is more popular in the large metropolitan areas such as Toronto and Montreal, which have the percentage of 22.0% and 20.6% for all trips respectively. If we look only as for women, the percentage is 28.4% in Toronto and 26.3% in Montreal. This fact indicates that although motorization spreads in North America, about 30 % of women use public transit to commute in Canadian cities.

2. Use of Public Transportation and its Promotion - the Case of Winnipeg -

The evaluation of public transportation such as bus, subway and streetcar has risen from a point that they have lesser burden for urban environment and bring much economic efficiency. However, passenger has stayed away from the public transit, and the management state of public transit has increased in pains. Every city has proposed the review measures of public transit, and has done various actions. Winnipeg, the capital city of Manitoba Province, is one of the cities that have coped with this problem. The number of trips in the city of Winnipeg has increased smoothly with the expansion of urban area until the end of the 1980s. However, the force of increase was small and the stagnation situation has continued after the economic recession at the beginning of the 1990's. It was auto drive and auto passenger that contributed to increase the number of trips. Proportions of the number of trip by public transit such as bus and train in the total trip have decreased from 28% in 1962 to 20% in 1992.

There is a regional difference in the ratio for which the public transit is used, and the ratio is 35% in the downtown, 56% in the district near Manitoba University, and 35% around Winnipeg University. This reflects that the main purpose of trip by public transit is for commuting and going to high school and university. The rate of using public transit around Red River College exceeds the average percentage (20%). According to the survey for citizens older than 15 years old, the person using public transit more than six times a week accounts for 19% of the whole. The person who use from three to six times occupies 12%, one or two times 8%, less than one 12% and the person who do not use it all 39%. The average ratio of using public transit varies between the age group to 24 years old and that of 25 years old and more. It is more than 45% in the former while it is lower than 35% in the latter. Moreover, the usage ratio of men exceeds women in the age group to 24 years old, but in the age group of 25 years and more the ratio of women exceeds men.

The main users of public transit in Winnipeg are the class of youth of 15-24 years old, but the change of population structure has a negative impact on the use of public transit (Figure 1). The population of this generation included 108,000 people about the middle of the 1980's, but it decreased up to 86,000 people ten years later. It was the reason of decreasing the number of people using public transit for 1988 - 1995 that the baby boomers grew up and did not use it. According to the population prediction by the city, it is anticipated that the population of this generation recovers to the standard of the middle of the 1980's by 2011. Nevertheless, there is not a guarantee that such a prospect realizes to increase the number of people using the public transit. As for the class of old and middle (45-64 years old), the average ratio of using the public transit is 30% and more for women and about 20% for men. It is very important how the mobility of this generation change with the advance of aging, and it is necessary to review the role of public transportation from such a viewpoint.

Generally speaking, two persons use public transit out of ten persons in Winnipeg, but when the purposes of using this trip mode are examined in detail, it is clear that they vary among users. The survey for the person older than 15 years reveals that 14% of the total use public transit for every purpose. 11% are the users only for commuting and 22% are the users of which purposes are not defined. People of the latter sometimes use public transit besides choosing to drive, walk

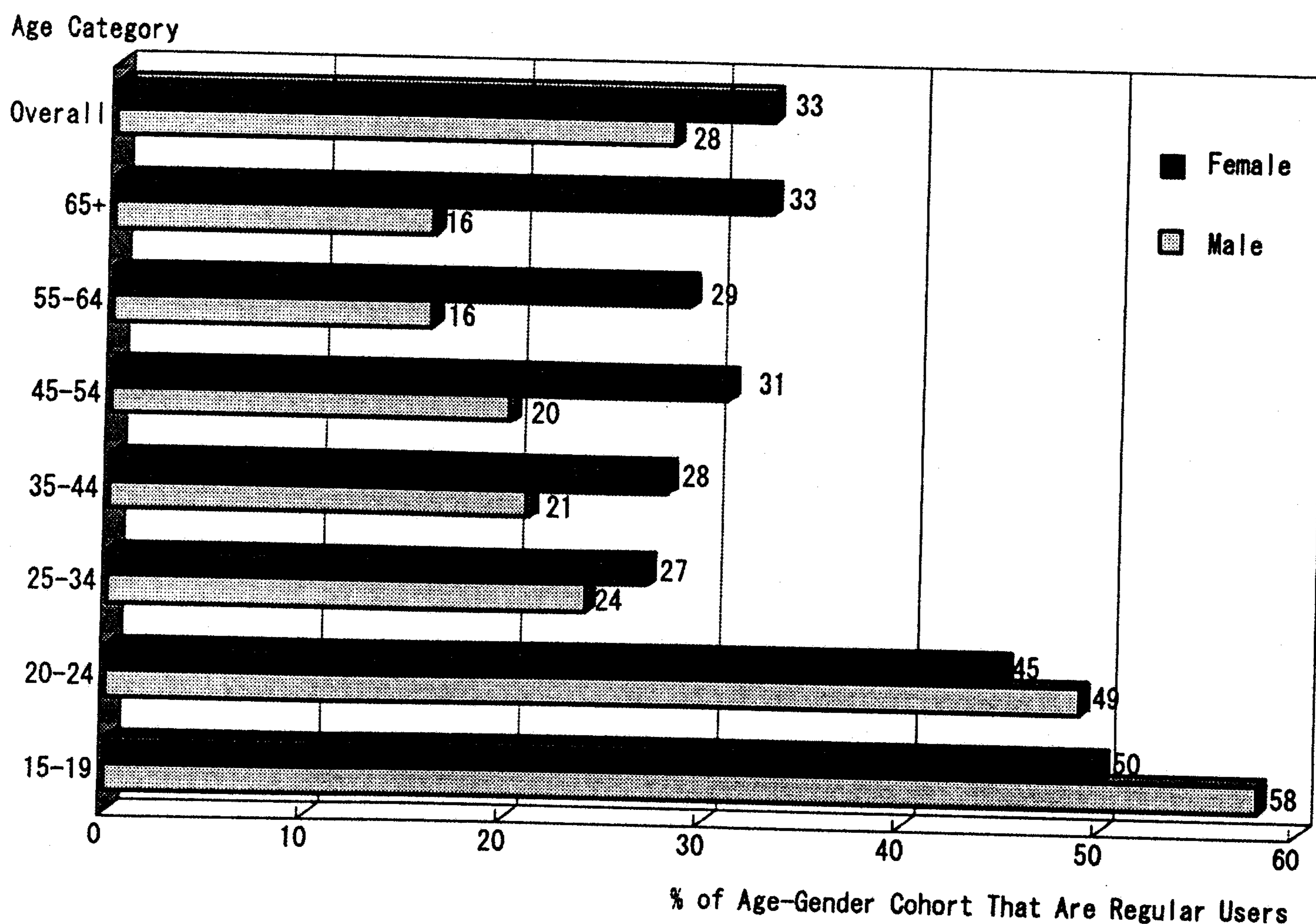


Figure 1 Transit Users in the City of Winnipeg

Source : Direction to the Future : The Guide to Better Transit for Winnipeg, July, 2000.

or cycle for various trips. Remaining 53% rarely use public transit except for the occasion that they have to use it because cars are not usable or under repair. Therefore, it is necessary to set up the strategy that can be used even by the purposes other than commuting and going to school to increase the number of people using public transit.

There are two types of countermeasures to increase the use of public transit; immediate measures and indirect creating environment. The former is closely related to the municipal policy such as urban planning, traffic base investment, parking lot regulation and fare system. The urban extended space with low density and the biased road maintenance are negative conditions for the public transportation. The increase of parking lots in the downtown Winnipeg depresses the use of public transportation. As to the fare system of public transportation, the fare of bus has been raised in a ratio to exceed the driving and maintenance cost of car. Keeping away from bus does not stop unless this is not reviewed. On the other hand, the promotion of regional economy, especially the revitalization of the downtown, is really important as the measures of creating a revivable environment. It is because that the downtown is the main origin and destination for the movement using public transportation. Correspondence to the population change that the number of senior citizen increase while that of young person decreases is also important. After taking into consideration of these situations, the city of Winnipeg proposed an improvement plan that urban and economic development should be promoted to increase the potential users for public transportation. The emphatically investing in the places such as the downtown, shopping centers, universities, and big firms where more transportation demand was anticipated to occur was included in this plan, too.

3. Public Transportation of Metropolitan Area and its Future - the Case of Greater Toronto Area -

In Toronto, the largest metropolis in Canada, and its neighboring area, which are called Greater Toronto Area (GTA), GO Transit (Greater Toronto Transit Authority) and TTC (Toronto Transit Commission) supply public transportation services. GO Transit is the traffic business body established in 1967 for the first time in the country, and covers a wide area of plural municipalities. There is no wide area traffic business body comparable with this in Ontario. The service reaches 100 km in the radius from the downtown of Toronto, and 3.5 million passengers are annually transported on the railroad and bus networks that spread around GTA. TTC was the traffic business body established in 1920 and called Toronto Transportation Commission at first, and then became the present name in 1954. It has the development history that some railroad companies around Toronto have merged and been purchased. The annual number of passengers

transported by three main subways, streetcars, and buses is about 380 millions.

Two traffic business bodies supplying the intra-urban and inter-urban transport services respectively extend their networks taking into consideration of the convenience of transfer connection. The largest transfer of passengers occurs at Union Station that is located south of the downtown of Toronto, and 96% of the passengers of GO Transit go in and out of the station. In addition, Scarborough Center, York Mills, Kipling and Finch, which are all in the suburbs of Toronto, are the main connecting points. These are the terminals of subway, and the bus networks of GO Transit extend from there. The total extension of the subway of which first route was opened in 1954 is 61.9km, and the route of rapid transit, a new transportation system, is added to this. The largest number of passengers getting on and off a day is recorded at the station of Bloor north of the downtown, and it counts 182,000.

Even in Toronto that has a long history of public transportation and supplies transportation service with the wide area business organization, people begin to stay out of the public transportation. On this account, the city of Toronto compiled the official plan in 2000 to build the transportation system that did not depend on cars any more. The basic direction was already recognized in the city of Toronto before administrative merger and the Toronto metropolitan area. After the merger, a new plan was reconfirmed in the expanded Toronto area. The basic principles of this plan are as follow.

First, the land use and urban design that can lessen the frequency of movement and make distance short are desire. Second, the public transportation services competitive with car traffics should be supplied. Third, the efficient transportation system coping with a severe economic competition should be established. The road maintenance to increase the movement of walking and bicycle is the fourth, and the restraint of possession and usage of car is the fifth. From the sixth to eighth principle are the environmental protection, the reduction of discharge of air pollutant material from car, the fairness of transportation service by taxation and subsidy. As indicated by these principles, the main purpose is to reconsider urban transportation from the viewpoint of urban structure and environment problem rather than to increase the use rate of public transportation. It is hoped that the public transportation such as subway sand buses are used more as a result of this policy.

In order to follow this policy, the city of Toronto proposed four fundamental rules to realize the plan. They are all concerned with the relationship between land use and transportation, and suggest that the improvement of transportation is not realized without the modification of urban structure. The first rule is the adoption of zoning to raise the density of land use near the nodal points of public transportation, and the change of urban structure to increase the movement of

walking and bicycle. The second is to reinforce the regional extension of public transportation system, the connection between GO Transit and TTC, and the supply of intermediate transportation service (riding together taxi) in the insufficiency area of TTC service. The third is to give priority to the public transportation and HOV (High Occupaied Vehicle) in an existing road and the low pollution cars in parking lots. The extension of bikeway is included in this, too. For the fourth more, it is hoped that the financial base and governance is raised by the introduction of new tax levy and strengthened the rule to improve public transportation. In short, it is emphasized to give priority to public and make the high dense city suitable for the public transportation. The city cannot continue to exist in the future if we do not make much of social total profit from the aspects of environmental problems, resource restriction, etc.

IV. Development of Telecommunication and Change of Urban Regional Structure

1. Production and Use of Telecommunication in Advanced Country

The informatization of the contemporary society has rapidly advanced with the development of telecommunication technology (ICT: Information and Communication Technology). Canada is said to be at the higher level in this field and is in existence to acknowledge the superiority in advanced nations. There is an environmental condition that the land is vast and natural condition is very severe, and it is not easy to maintain both the society and economy without depending on telecommunication technology. Enterprises and research laboratories always try to develop such a technology, and the government and business world in Canada share the idea that the information and communication industry should be developed internationally by overcoming the narrowness of domestic market.

Then, what one is the current state of the information and communication industry in Canada? The information and communication industry in the advanced country comes to be understood based on the industrial standard that OECD newly brought together in 1998, and Canada also is following this. Moreover, Canada came to adopt North America industrial classification system (NAICS: North American Industrial Classification System) newly in place of a current industrial nomenclature since 1997. Recently, the section of the computer service and telecommunication that developed rapidly came to be understood appropriately by this industrial nomenclature. These two sections are manufacturing and its related service industry producing the equipments that receive, send, and display information and data in the electron, that is, the center of telecommunication technological section.

According to the investigation of Canadian Statistics Bureau in 2000, the gross products of the ICT section are 57.5 billion dollars, and this corresponds to 6.3% of the amount of gross domestic

product (Figure 2). The production increase rate in this section from 1997 to 2000 is 68.7%, and this is about 5 times the increase rate in the overall industry. This industry employed 469,000 people in 1999, and the number of employees has increased by 32.5% comparing with 1994. It can be said that the expansion is three times or more because the increase rate of the overall industry is 9.9%. Exports in the international trade of this industry in 2000 were 42.4 billion dollars and imports were 63.8 billion dollars. The ratio that occupied to the whole was 16.5% in exports, and 9.6% in imports respectively. Because there was a deficit in the production, the entire trade balance was consequently negative though the trade balance of service was positive. As in the international trade, service exceeded production, and the ratio was about 3:2 in the scale of profit.

The feature of ICT section in Canada is a lot of investments in the research and development, and their total investment amount, 26.9 billion dollars, from 1994 to 2000 corresponds to 42.9% of the amount of investment of all the private companies for the same period. As for a recent tendency, the growth rate in the manufacturing section exceeds that of the service agency though it is almost in halves when the research and development spending is divided into the

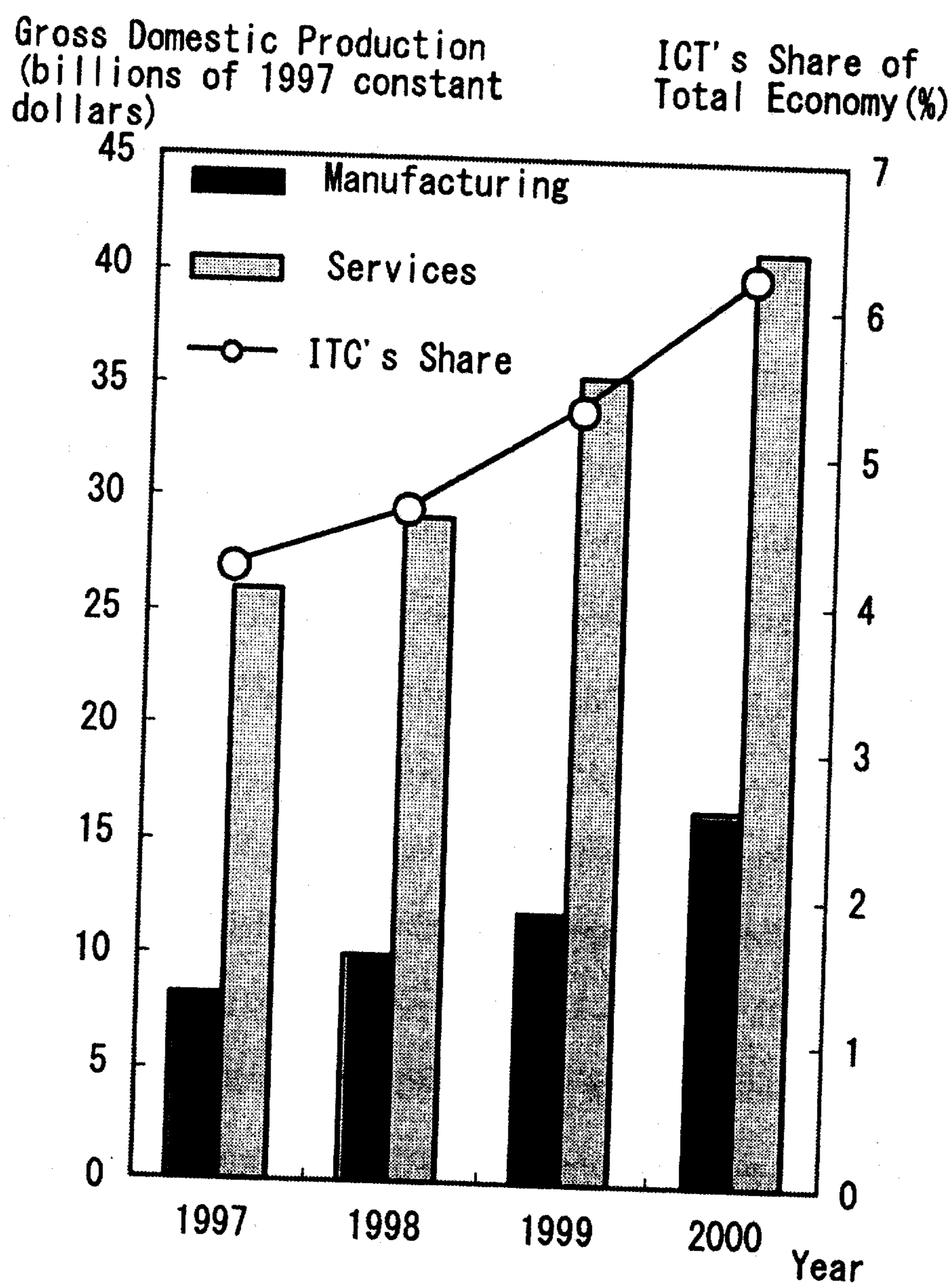


Figure 2 GDP of ICT and its Share of Total Economy

Source : Statistics Canada, Catalogue No. 56-506-XIE, Information and Communication in Canada, 2001.

manufacturing section and the service agency. It is one of the reasons why the research and development spending of the ICT section is numerous that there is a cordial promotion policy of the government. When the indices of the research and development spending (this is called B - index in 1999) in the effect of the tax system are compared internationally, it is apparent that Canada (0.70) is in the situation very given smaller than United States (0.88), Japan (1.01), and Germany (1.05), etc. Therefore, wireless enterprise companies in the eminent world such as Nokia in Finland, Ericsson in Sweden, and Alcatel in France are placing the bases of the research and development in Canada.

In the service sector of ICT section, that is, software development, Canada's high technological level is especially famous in the world. It is said that 60% of the digital technique used by "Titanic" and "Jurassic Park" etc. of Hollywood film is the special effect software developed in Canada. Three large game manufacturers (Sony, Nintendo, and Sega) in Japan use the animation software made in Canada to produce their own characters. The software used internationally like this is invented based on the accumulation of excellent engineers. The environmental condition given for the development of the software of the ICT section such as contents creator training power and educational-industrial complex program of high level, for example, Sheridan university in Toronto, is a background in which such a result is invented.

2. Accumulation Region of Information and Communication Industry

The information and communication industry in Canada centers on Toronto, Montreal, and Vancouver respectively and the activity is done. Especially the greatest accumulation ground is Toronto and its vicinity, Greater Toronto Area (GTA), and has the enterprise of 3,100 companies or more there. The number of employees is 155,000, and telecommunication service accounts for 29% of the total employees, computer related 24%, and ICT service 19%. GTA is the eminent accumulation place of image and multimedia industry and movie and television program production industry in North America. Film industry is the fourth place and television industry is the third place respectively in the scale. The feature of this region is that there are a lot of enterprises with a high technology in the processing of animation technology and computer graphics. Nortel network, one of the representative companies in Canada, sets up its headquarter in Brampton, the suburb of Toronto. The antecedent of this enterprise was Northern Telecom of the telephone telecommunications equipment manufacturing. After a spinout, this new company started to handle the high-value-added service of high-speed Internet.

The headquarter of Serestica that employs 38,000 employees all over the world is in Toronto, too. This enterprise purchased the manufacturing section of IBM Toronto, and after that

developed to purchase the production base of the international manufacturers distributed in the United States, Europe, and South America. This company has expanded the EMS (Electronics Manufacturing Service) business rapidly. 724 solution company of which headquarter is in Toronto is the leader of wireless software for financial institution. Many of powerful financial institutions in North America make the software of this company bases and are developing the wireless banking service. The technology of this company that enables the electronics banking service and the electronic commerce dealings corresponding to all the Internet devices interests the world financial institutions concerned and the enterprises related to electronic commerce. Besides these powerful enterprises, there are enterprises with the advanced technique in three dimensional image productions such as Alias 3D Company and IMAX company.

In Quebec, there exist communication industries such as telephones and CATV and enterprises that research, manufacture, and develop software in optical communication field. The number is about 4,000 in all, and three quarters of those are in Montreal. Of them, the enterprises that develop software target a wide range of field such as the multimedia for game and education, GIS (Geographical Information System), and the Internet related business. Most of them have developed the products for selling in the American market at first in consideration of the narrowness of domestic market, and have high competitive edge. The government of Quebec makes efforts to the development of information and communication industry, and takes a preferential tax treatment for them. Moreover, the enterprise that develops software in the multimedia city that lies to the redevelopment region in Montreal's old urban area can receive the tax credit of labor cost.

The third base of the information and communication industry is in Vancouver and its neighboring area (Victoria and Okanagan). The feature of this region is the diversification of businesses. Communication, wireless, network related business, graphic, multimedia, Internet, information control system and network design are included in them. This region also carries out the function as the hub of east and west data communication from a geographic condition of belonging to the Pacific Rim. It is close to Seattle and has a deep relationship with Silicon Valley, so it is called Silicon Valley the north. Vancouver is the third largest filmmaking base in North America succeeded to Los Angeles and New York, and multimedia industry is very active, too. To develop the information and communication industry, the provincial government has various promotion programs for research and development. A corporate financing by the Canada development bank and the talent promotion programs such as scholarship offer and new graduate employment preferential treatment are prepared.

3. Internet Usage by Province and City

Canada is at an advanced position in information and communication industry, and runs at the head on the use side of the telecommunication means including the Internet. According to the survey conducted by Ministry of Public Management, Home Affairs, Posts and Telecommunications in Japan, the rate of the diffusion of the Internet is the 10th place (53.3%) following Norway (54.4%) and Australia (54.4%) and exceeds Singapore (50.3%) and Japan (44.0%). However, it is not equal to Sweden (64.7%) of the top and the United States in the fourth. The advanced level in Canada in this respect appears in the progress level of an electronic government, and Singapore and the United States are suppressed by Canada, the 1st place, in the international comparison in 2002 (based on the survey of "Electronic government progress level investigation" by Acsentua Co.). By the way, Japan is the 17th place in this investigation in 23 countries.

When the Internet diffusion of Canada that exists comparatively in high rank in advanced nations is examined closely, it is apparent that there is a regional difference by province and city. According to the investigation of Canadian Statistics Bureau (2000), the rate of use of the Internet is 52.8% on the national average, 55.0% in urban region, and 44.9% in rural region. The difference between urban and rural is more than 5%. When examining it by province, it is clear that British Columbia (61.2%) and Alberta (60.3%) are prominent, and Ontario (54.7%) follows them. Although the rate of use in the urban region of Nova Scotia is 57.2%, the rural region is 45.7%. On the contrary, it is Newfoundland (43.5%), New Brunswick (44.5%), Quebec (45.6%) and Manitoba (46.0%) that the rate of use is low. The rate of use in the rural region of these provinces is confined to 30% level.

From the comparison by city, it is clear that the spread of the Internet advances more in the west of the country (Table 2). When seeing based on the statistics of Census Metropolitan Area (CMA), the rate of use of the Internet is more than 60% in Calgary (67.4%), Saskatchewan (64.0%), Victoria (63.5%), and Vancouver (63.2%). It is only Halifax (65.4%), Ottawa-Hull (62.7%) elsewhere that exceed this standard (62.7%). Toronto, Montreal and Hamilton are 50% levels, and Quebec City is confined to 40% levels. In this way, the rate of use of the Internet shows the tendency that the western region of the country is higher than the eastern region. However, it is noticeable that even in the western region Winnipeg (49.4%) is low, and Halifax (65.4%) in the eastern region shows high rate respectively.

It is common to every province that the rate of use of the Internet in urban area is higher than that in rural area. One of the reasons of this tendency is that the use of the Internet is related to people's life styles. E-mail is the most popular use of the Internet, and 83.6% of all the people in the country use it. Commodity and service information (74.3%), news reading (54.7%), health

Table 2 Percentage of the population aged 15 and over using technology in the past 12 months, Canada and selected census metropolitan areas, 2000

	Total population	Internet	Internet connection at home	E-mail	Computer
	(000s)	%			
Canada	24,566	52.8	42.2	46.7	66.3
St. Johns	141	59.7	43.6	52.2	69.0
Halifax	288	65.4	51.2	59.9	74.3
Saint John	102	54.7	40.0	45.5	64.5
Ouebec	540	46.8	37.3	40.3	60.3
Montreal	2,767	51.0	39.3	44.0	65.7
Ottawa-Hull	866	62.7	52.7	58.6	74.7
Toronto	3,832	55.8	48.7	50.7	67.0
Hamilton	556	55.5	50.6	47.2	69.5
Winnipeg	534	49.4	35.3	43.2	62.3
Regina	143	58.9	40.3	51.6	72.5
Saskatoon	187	64.0	49.8	59.0	77.2
Calgary	752	67.4	55.0	63.6	76.8
Edmonton	753	59.9	48.8	53.2	71.5
Vancouver	1,662	63.2	53.7	58.6	73.4
Victoria	289	63.5	48.0	58.2	70.7

Source : Statistics Canada. General Social Survey, Cycle 14.

information (45.9%), and chat (30.0%) are other main purposes of the use of the Internet. The Internet is suitable for urban dwellers with much stimulation as the access means to E-mail, business information, and news, and has spread promptly. The rate of use of the Internet for the purpose of financial and commodity trade is still in 20% levels. In this field, British Columbia and Alberta lead other provinces, and Ontario and Nova Scotia follow these two. It never seems by chance that the Internet spread early in two provinces of the western region attracting much attention as a new economic development area succeeded to the heartland.

Canadian Statistics Bureau investigated and analyzed the use of the Internet paying attention to the difference of sex, age, academic background, income class, and language. According to the result, it is apparent that the rate of use by men is higher than that of women. The exception is only a point that women exceeds men by income hierarchy 50,000~80,000 dollars. The rate of use decreases inversely proportional to the age of men and women. In addition, the rate of use increases in proportion to the degree of academic background and income class. By language, the result shows that the rate of use is high in English, French and other languages in this order. Thus, it is necessary that attention should be paid not only to the regionality of province and city

but also to the personal attributes of user to clarify the use of the Internet.

4. Substitution and Reinforcement Relationship between Information and Communication and Transportation

The diffusion of information and communication means represented by the Internet causes to change the behavior of people in many fields such as society, economy and daily life. A substantial change is especially expected to occur in the existing way of moving, that is, transportation system. If information and communication take over the movements of commuting, shopping and traffic for business, it is not only the volume of transportation but also the arrangement and figure of activities that will change. But, it is a partial interpretation that information and communication are replacing means of transportation. The fact is that information and communication act considerably as the role of compliment and reinforcement of transportation. For example, if information is collected easily from wider area than before, the possibility of activity will increase and the volume of transportation will augment.

Then, what is the relationship between the diffusion of information and communication means and the change of transportation in Canada? According to the interview survey conducted by Royal Bank in 2001, 77% of responders (742 people) feel that homework using telecommunication raise the degree of satisfaction. There are many affirmative opinions that peoples can have much time with their families (72%) and have enough time to care children (58%). More than 70% of persons doing SOHO (Small Office Home Office) at home (308) really use the Internet and answer that the Internet contributes to increase the efficiency of their work. Person saying that business does not meet ends without the Internet accounts for 47% of all. The main purpose of using the Internet is to access to information (37%) and to send and receive E-mail (30%). 12% of respondents are dissatisfied with the reliability of the Internet service. Although many people (87%) actually use the Internet, the number of people who use the Internet for financial trade (44%) and commercial trade (37%) is still limited.

77% of people who use the Internet at home feel that Internet-banking and Internet-shopping are very easy to deal with, and 65% of all have a view that the Internet is very interesting. Furthermore, more than half of people (56%) changed their behavior of going to bank after the introduction of the Internet-banking. On the other hand, 41% is the people who do not feel substantial influence from the Internet. The result of the comparison between the financial trade with the Internet and usual trade is that the former gets 8.1 points and the latter 6.7 points (Figure 3). In the case of commercial trade, the Internet-shopping, the score of using the Internet is 7.0 points, and the score of going to stores is 7.3 points.

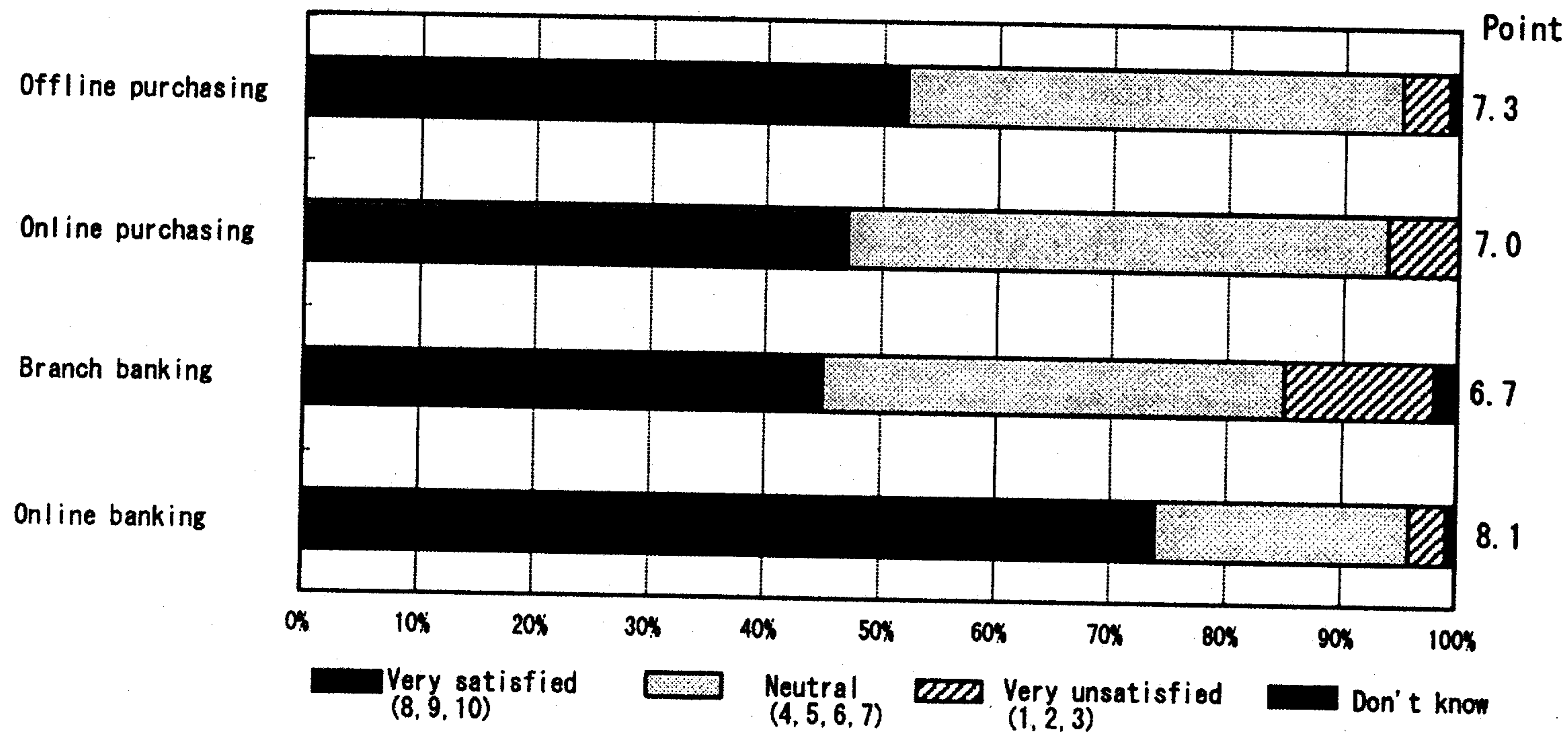


Figure 3 Online vs. Offline Satisfaction

Source : Canadian Families and the Internet, RBC Financial Group, 2001.

The findings of the research survey by Royal Bank generally show that there are many people who are positive for the Internet. In addition, it is also clear from these findings that the information communication contributes to reduce ordinal movement. However, as it is indicated that the Internet-shopping is less estimated than ordinal shopping, people do not always agree with the life style through electronic means. It should be noted that 14% of responders hope life style without the Internet.

If we return to the argument about the relationship between information communication and transportation, it can't be denied that the saving of time by the Internet makes potential behavior and movement to occur. The frequency of going to bank and store may decrease, but other actions such as going for leisure and recreation may increase instead. In other case, there is a possibility that the decrease of commuting because of the increase of home working may make it possible for anyone to use vacant road. Commuting and shopping are sometimes carried out accompanying with other movement than original purpose. It is not rare that acquaintance in working place and community and leisure are performed on the way to commuting and shopping. There is a chat function in the Internet, but it is not conceivable that the chatting takes over the dialogue by direct interaction.

V. Concluding Remarks

Transportation and communication systems are the basic infrastructures sustaining not only industries but also socio-cultural activities in a city. As to transportation, one of the most important tasks to be solved in the near future is to change the present transportation system

into a reasonable one from an environmental point of view. Canada is a country blessed much with resources such as oil and natural gas, but the saving energy contributes to the realization of society reducing the load on the environment not only nationally but also internationally. As repeatedly mentioned, the transportation system can't be separated from the urban regional structure. So, it is important to pay attention to the urban regional structure considering the reasonable transportation system.

In Canada, telecommunication has diffused earlier than other developed countries. Information and communication industry has developed as a representative industry of this country, too. This industry will lead the economic development of the country and stimulate the information society oriented to efficient communication among firms and people. A variety of development of information and software will contribute to widen the multiplicity of culture and art in Canada that maintains multiculturalism as a national policy. Sophisticated communication tools and multicultural works produced in Canada surely make peoples happy in the world.

This century is the period that a new model is needed to sustain the environmentally fragile and complicated society. New paradigm adjusted for new age will demand us to change the present life style including behavior and communication in the city. In order to fit this new paradigm, we have to alter the spatial pattern of urban area through a new transportation and communication system. Gradual change toward this direction has already been seen in several metropolises in this country. Canada had ever a role of connecting developed countries and developing countries in the world system, and in the future, will contribute to the international progress in the field of transportation and communication by supplying technology and software based on an environmentally sustainable society.

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