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Impact of telework and flexitime on reducing future urban travel demand: the case of Montreal and Quebec (Canada), 1996-2016

Y. Bussière[1] & P. Lewis[2]
[1] *INRS-UCS (Urbanization-Culture-Society), University of Quebec, Canada*
[2] *Urban Planning Institute, University of Montreal, Canada,*

Abstract

A research completed in 1999 for the Quebec Department of Transportation on the impact of telework (telecommuting and autonomous telework) and flexitime on future travel demand in the urban areas of Montreal and Quebec concludes that on the long term we can expect that the combination of these three forms of work could induce a reduction in the range of 6% of morning peak work trips.

1 Introduction

This paper presents the results of a research completed for the Quebec Department of Transportation in 1999, by a team from three universities (University of Quebec, University of Montreal and Laval University) to measure the impact of telework (telecommuting and autonomous telework) and flexitime (flexible hours and compressed work schedule) on reducing future travel demand in the urban areas of Montreal (population of 3.7 million) and Quebec (0.7 million).

2 Methodology

The study consisted of surveys and modelling for both cities, proceeded by an extensive review of the literature. The (near) absence of literature on the Canadian scene made these surveys essential. On flexitime and telecommuting, the surveys consisted in 3 parts: a pre-survey by telephone to give a preliminary

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evaluation of the phenomenon, a face-to-face survey of selected enterprises and organisations which offered some form of flexibility, and a survey of workers in these enterprises to get a profile of mobility patterns of employees using some form of flexibility. A separate survey was also done on a sample of autonomous workers (Figure 1).

Figure 1: Summary of surveys in Montreal and Quebec

Impact on long term transportation demand (1996-2011-2016) from surveys in Montreal and Quebec:

- Flexible hours
- Flexible week (compressed work schedule)
- Telecommuting

- **Enterprises**: telephone and person to person interviews of directors of personnel from a sample (Quebec: 55; Montreal: 76)
- **Workers**: From a sub-sample of the previous enterprises, a sample of workers (Montreal: 20; Quebec: 23) with a self-administrated questionnaire (Montreal: 98; Quebec: 101).
- **Autonomous workers**: From a large sample autonomous teleworkers (workers who used telecommunications technologies to complete their work)
  - Self-administered questionnaires: 97 workers
  - Detailed interviews on a sub-sample of the workers: 15 workers

These surveys permitted us to draw profiles of various types of flexibility offered by the enterprises in various sectors of activity and a profile of mobility patterns of the workers (salaried and autonomous). From this data we were able to model future travel demand, as described below.

3 Results

3.1 Flexitime and telecommuting

The review of the literature shows that the proportion of telecommuters in industrialised countries is still less than predicted (Claisse and Rowe, 1995), between 10 and 15% of the work force, even if we add various types of telecommuting and autonomous workers. The proportion is lower than some expected, partly because of the resistance shown by employers (Mokhtarian, 1998). For flexible hours, the proportion of workers affected is much larger – around 20% to 25% of the work force in Canada and USA - , even if most of those working regular hours still start work between 6:30 and 9:30 AM.

In Montreal and Quebec, according to our analysis, the level of telework was lower, in proportion to the global labour force, with around 7% in 1999 (2% for the salaried workers and an additional 5% for autonomous workers). The reorganization of the work schedule (flexitime) is much more frequent with about 20% of the labour force on flexible schedules, but most of them still arrive at work morning during peak hours. Compressed work weeks (for instance a 5 days work in 4 days) account for less than 5% of the work force.

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For a better understanding of the level of flexible work in the enterprises of our sample, Table 1 presents basic data on the actual implementation of different forms of flexible work arrangements of various sectors of economic activity surveyed. This data has been disaggregated into 3 forms of flexibility:

- the proportion of enterprises which offer flexibility (FLEX1);
- the proportion of employees to whom it is offered (FLEX2);
- the proportion of employees who accept flexibility (FLEX3).

The total impact (FLEXT) is the proportion of employees who are touched by some form of flexibility (which is the filtering result of multiplying the ratios of the 3 forms of flexibility). A close examination of Table 1 leads to four conclusions:

(1) It is flexible hours which are the most offered by enterprises in the Montreal and Quebec regions: 88% of the enterprises offer flexible hours, the proportion being lower for the compressed week (70%) and still lower of the telecommuting (56%).
(2) The proportion of employees who have access to flexitime is lower, more so for compressed week and telecommuting: 75% of the employees have access to flexible hours, 39% to flexible week and, finally, 25% to telecommuting.
(3) It is the employees to whom telecommuting is offered who, the most, accept this possibility (68%), comparatively to 60% for variable hours and only 18% for the compressed week. The low rate of acceptance of compressed week reflects its relative unpopularity, probably due to the loss of revenue that it generally induces. However, telecommuting and variable hours are more popular.
(4) The variable hour affects sensibly a higher proportion of workers (between 35% and 40%) than the compressed week (3% to 5%) or even telecommuting (5% to 10%), a more recent phenomena.

An analysis by sectors of economic activity adds more nuances to these results as Table 1 shows. By sectors of activity the profiles of the regions of Montreal and Quebec are quite similar, even though we noted two main dissimilarities:

(1) The impact of flexible hours is more important in Montreal (48%) than in Quebec (36%), mainly because more employees accept it in Montreal.
(2) The level of telecommuting is more important in Montreal than in Quebec, where it is very low for most sectors, except for the education sector.

Table 1: Level (1) of flexitime in the enterprises of the survey, for various sectors of activity, Montreal and Quebec, 1999(*)

Sector of activity (***)	Nb. (**)	Type of program											
		Flexible hours (2)				Flexible week (3)				Telecommuting (4)			
		FLEX1	FLEX2	FLEX3	FLEXT	FLEX1	FLEX2	FLEX3	FLEXT	FLEX1	FLEX2	FLEX3	FLEXT
Communications and other public services	4	50%	79%	81%	32%	75%	27%	85%	17%	50%	2%	0%	1%
Financial services and insurance	6	100	99	61	60	100	94	2	2	67	9	100	6
Manufacturing sector	4	50	50	100	25	25	2	0	0	100	41	37	15
Hotels/restaurants/others	13	100	97	53	51	62	74	5	2	77	52	60	24
Education services	2	100	95	20	19	0	0	0	0	50	74	61	23
Government services	12	100	64	84	54	92	57	23	12	17	N/D	N/D	N/D
Transportation and storage	1	100	6	67	4	100	16	100	16	0	0	0	0
Others	1	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	100	N/D	N/D	N/D
Total	43	88	75	60	40	70	39	18	5	56	25	68	10

Source: Survey on enterprises. (*) The survey over-sampled enterprises offering flexibility. An overall estimation of the economy of Montreal and Quebec would give 2% of salaried workers with flexible hours, 15% with flexible week and 2% for telecommuting. (**) Number of enterprises in the survey. (***) FLEX1: Enterprises who offer it; FLEX2: Employees to whom it is offered; FLEX 3: Employees who accept it; FLEXT: Employees touched by flexitime.

Notes: (1) Due to the small size of the samples, these tables intend primarily to give a global idea of the phenomenon. (2) Flexible hours: Of the 43 enterprises contacted, 38 answered positively, 3 negatively and 2 had no availability. The flexible hours seem to be a very common practice, in all sectors of activity. (3) Flexible week: Of the 43 enterprises contacted, 30 answered positively, 11 negatively and 2 had no availability. (4) Telecommuting: Of the 43 enterprises contacted, 24 answered positively, and 10 negatively.

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To sum up, the enterprises are very open to flexible hours and such measures are widely spread in most sectors of economic activity and very popular among employees. The flexible week is more recent, less developed, and less popular among employees. Telecommuting is less developed; it is still a new phenomenon in front of which the enterprises are often hesitant but generally favourable to its implementation (Mokhtarian, 1998). However it is very popular among employees who often use it when it is offered.

3.2 Autonomous work

Autonomous work is much more widespread and we can expect it to continue growing. According to census data it represented, in 1991, 8.9% of the total work force in Quebec and 8.4% in Montreal (Roy, 1997). Our survey showed us, furthermore, that the level of education of the autonomous workers is rather high with (Montreal and Quebec combined) 18.5% with college education and 66% with some form of University degree (from Bachelor to Ph.D.). The number of autonomous workers grew rapidly during the 80s, when the labour market was difficult to enter; this is confirmed by our survey: 37% (28.3% in Montreal and 51.5% in Quebec) of respondents became autonomous workers because they had not been able to find a job. The other main reasons were: "I wanted to be my own boss" (26%) and "I wanted more autonomy" (22%). Table 2 illustrates the modal choice of the autonomous workers. We can see that they are mainly auto-drivers (78.3%), but that transit is still important (23%), mainly in Montreal (32%), where transit supply is much higher than in Quebec, because of the presence of an efficient metro system in the central area.

We can also note that autonomous workers travel generally outside peak hours. As is shown in Table 3, more than 40% travel during peak hours only once or twice a week and around 30%, never during peak hours. We can therefore expect a certain impact of autonomous workers on trip reducing during peak hours.

4 Method of forecasting

The question asked was to what extent will the observed proportions change in the future and what could be its impact on morning peak hours travel demand by mode for Montreal and Quebec metropolitan areas.

4.1 Forecasting of the impact of flexitime and telecommuting

For flexible hours and telecommuting, from the data collected in the surveys and the review of the literature, and travel data from O-D surveys, we constructed a model to simulate the actual impact on reducing travel demand, and we elaborated various scenarios to measure its probable impact on future demand in the morning peak hour.

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Table 2: Distribution of autonomous workers in function of the choice of mode for travelling, Montreal and Quebec, 1999 (%)

	Montreal	Quebec	Total
Auto-driver (alone)	68.3%	96.9%	78.3%
Auto-driver (with passenger)	1.7	0.0	1.1
Auto-passenger	1.7	0.0	1.1
Public transport	31.7	6.3	22.8
Walking	10.0	6.3	8.7
Other	8.3	0.0	5.4

N = 92 Source: Survey on autonomous workers.
Note: more than one mode could be given for trips.

Table 3: Distribution of autonomous workers in function of their trips during peak hours, Montreal and Quebec, 1999 (%).

	AM			PM		
	Montreal	Quebec	Total	Montreal	Quebec	Total
5 times a week	14.0%	15.6%	14.6%	14.0%	18.8%	15.7%
3 or 4 times a week	14.0	9.4	12.4	14.0	3.1	10.1
1 or 2 times a week	43.9	46.9	44.9	36.8	43.8	39.3
Never	29.8	25.0	28.1	33.3	28.1	31.5

N = 89 Source: Survey on autonomous workers.

The data used were the following:

(1) Distribution of employment by industry and by zone in both cities in 1995 (from 1996 census data), for poles of attraction.
(2) Pre-survey on enterprises (141 enterprises: 87 in Montreal and 54 in Quebec).to measure to presence of flexitime.
(3) Survey in enterprises (total of 42 in Montreal and Quebec).
(4) Survey on workers on a sub-sample of the previous enterprises (98 workers in Montreal; 101 in Quebec).
(5) O-D surveys of Montreal (1993) and Quebec (1996).

The model incorporated four main dimensions:

(1) Employment and flexibility. Estimation of the attraction of workers touched by flexibility (variable hours and telecommuting) by sector of activity and zone with employment data of 1995. As discussed above,

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flexibility was disaggregated in the 3 dimensions of flexibility, where total flexibility is equal to: FLEXT = FLEX1 x FLEX2 x FLEX3; the enterprises of the pre-survey were selected in various sectors of activity in areas susceptible to offer flexibility. This permitted to elaborate a sample of enterprises for direct interviews. This pre-survey was used for a first calibration of FLEX1, which was complemented with a Delphi method consisting of a cross-examination of the coherence of the rates observed with the review of the literature. Since the sample was small, and since the sector of activity appeared determinant in the presence of some form of flexibility, we supposed that the level of penetration by sector was the same in both cities as well as by zone. The impact by zone would therefore be a direct function of the type of activities by zone. The next step consisted in the estimation of the number of "flexible" jobs which would induce a diminution of trips during the morning peak hour (6h to 9h AM in Montreal and 7h to 9h AM in Quebec). The ratios used for these calculations were drawn form the surveys of enterprises. These ratios were then applied to travel trips by mode (auto-driver, auto-passenger, transit, other) and by O-D pairs.

(2) Variation of flexibility according to various scenarios. We supposed that one flexible employment corresponds to a diminution to one travel trip during the morning peak period.

(3) Variation of trips. For each scenario we translated the variation of trips of dimension (2) to the matrix of O-D trips for work, morning peak, by O-D pairs, by mode and by zone. This permitted to generate rates of variation of travel demand.

(4) Calculation of the total impact of the various effects.

4.2 Various scenarios

For each type of work mode, disaggregated in FLEX1, FLEX2 and FLEX3, various scenarios were constructed: a reference scenario (1996-99); a low-growth scenario, and a high-growth scenario, supposing substantial growth of flexibility. Let us briefly present the results of the impact of various forms of flexibility for the reference scenario (1996-99) and the strong scenario at the horizon 2016.

For various forms of flexibility, the hypothesis we the following:

- Autonomous workers would increase by 100% over a period of 20 years.
- Flexible hours (FLEXT) would increase by 25%. This reflects an increase of 10% of FLEX 1, 10% of FLEX 2 and 10% of FLEX 3, with a constraint of a maximum of 100%.
- Telecommuting would increase by 62% in Montreal and 66% in Quebec, and reach respectively 3.3% and 3.6% of salaried workers (from 2.1% in

Montreal and 2.2 in Quebec in 1996) with more telecommuting in the centre than in the outer suburbs (i.e., 3.1% compared to 1.8% in Montreal). This represents an increase of 100% in FLEX1, 10% in FLEX2 and 10% in FLEX3, with a constraint that FLEX1, 2 or 3 cannot surpass 80%.

Table 4 summarizes the impact of the various scenarios. These results will vary by mode and destination. The diminutions of trips will be slightly higher for auto-driver than for public transport and for destinations to the centre of the city. Globally, over the long term (defined here as 20 years) the diminution in morning peak work trips would be, respectively in Montreal and Quebec, of 2.9% and 2.8% for autonomous workers, 1.1% and 0.6% for flexible hours and 2.3% and 2.5% for telecommuting. Over the period studied, this gives a total impact of 6.3% in Montreal and 5.9% in Quebec. Among the measures, flexible hours will have the least effect.

Table 4: Impacts of different forms of flexible work arrangements on AM peak hour travel demand for work, Montreal and Quebec, 1996-99 and 2016, and annual growth rate 1996-2016 (%)

	Montreal		Quebec	
	1996-99	2016	1996-99	2016
Autonomous work	-2.9%	-2.9%	-2.8%	-2.8%
Flexible hours	-3.0	-1.1	-1.7	-0.6
Telecommuting	-0.4	-2.3	-0.4	-2.5

Finally, Table 5 (below) gives detailed projections by mode for flexible hours and telecommuting in Montreal and Quebec, and translates in annual rates the long term global impact on a 16 years period (1996-2011) or a 20 years period (1996-2021).

5 Conclusions

The impact of telework and flexitime on future travel demand will depend on their development in various economic sectors, but also on the reaction of workers to the possibilities. In the past, the progression of autonomous work and flexible hours had a significant impact on the reduction of peak travel demand (and the spreading out of peak hours), and much less so, telecommuting which is still a new phenomenon. However, telecommuting is perceived positively as a technological solution for the future, by employers and employees, as well as transportation networks' managers. If full-time telecommuting was to develop as many have predicted, it could induce a certain diminution of travel demand.

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Table 5: Impact of telework and flexible hours on AM peak work trips, Montreal and Quebec, 1996-2011-2016 (strong scenario)

	Montreal		Quebec	
Total variation on the long term				
	Flexible hrs	Telecom.	Flexible hrs	Telecom.
Auto-driver	-1.14%	-2.29%	-0.62%	-2.58%
Auto passenger	-1.13	-2.28	-0.59	-2.44
Public transport	-1.07	-2.21	-0.55	-2.19
Other modes	-1.16	-2.34	-0.59	-2.40
All modes	-1.12	-2.27	-0.61	-2.52
Total variation: annual growth rates over 16 years (1996-2011)				
	Flexible hrs	Telecom.	Flexible hrs	Telecom.
Auto-driver	-0.072%	-0.145%	-0.04%	-0.16%
Auto passenger	-0.071	-0.144	-0.04	-0.15
Public transport	-0.067	-0.140	-0.03	-0.14
Other modes	-0.073	-0.148	-0.04	-0.15
All modes	-0.071	-0.144	-0.04	-0.16
Total variation: annual growth rates over 21 years (1996-2016)				
	Flexible hrs	Telecom.	Flexible hrs	Telecom.
Auto-driver	-0.055%	-0.110%	-0.03%	-0.12%
Auto passenger	-0.054	-0.110	-0.03	-0.12
Public transport	-0.051	-0.107	-0.03	-0.11
Other modes	-0.056	-0.113	-0.03	-0.12
All modes	-0.054	-0.109	-0.03	-0.12

In the future we can expect autonomous work to continue its expansion as well as telecommuting, but much less so for flexible hours. Compressed week schedule does not seem to be expanding much in the future and the reduction of travel demand that it would induce is mostly concentrated on Fridays, and would have little impact on traffic congestion the other days of the week. On the long term we can expect that the combination of autonomous workers, flexible hours and telecommuting could induce a reduction in the range of 6% of morning work peak travel trips, which is significant in the context of scarce resources for new infrastructures.

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