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Teleworking : a New Perspective on Mobility

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Urban road transport externalities have become a severe problem in most industrialized countries during the past decade. The implementation of policy measures that effectively allow to reduce traffic flows on specific transport sections of the network during peak times, has become a necessity. Several Belgian and international transport economists (De Borger and Proost, 1997) (Verhoef, 1997) have put forward theoretical arguments favouring the implementation of road pricing as the solution for solving urban road transport externality problems. Unfortunately, the implementation of road pricing, is associated with a number of problems related to legitimacy, as well as administrative and target group implementation potential. These problems, however, can be reduced significantly if the implementation of road pricing is combined with other externality reducing policy tools. As telework implementation implies a partial or total substitution of the commuting trip, research that investigates the implementation potential of telework as an externality reducing policy tool should be viewed as a research priority.

The present research aims to develop a comprehensive conceptual framework for the adoption of telework to assess the "effectiveness" of telework in terms of reducing urban road transport externalities.

The used definition of telework allows an evaluation of the procedural as well as the potential effectiveness of telework as anti-congestion policy tool. For this research especially the effect on road externalities is important, hence following defition was constructed :
"Telework was defined as work from home, a satellite office or a telework centre for at least one day per workweek and without on-line communication being a necessity."
The used definition underlines that the implementation of telework does not result necessarily in the adoption of the practice on a full time basis.

A conceptual framework was constructed which would allow to assess the various components of the expected procedural effectiveness of telework as a policy tool to reduce road externalities. Procedural effectiveness consists of three main components: legitimacy, administrative implementation potential and target group implementation potential. In this research, the focus was on the target group implementation potential, with some attention also devoted to the legitimacy issue, by surveying the main stakeholders involved in implementing the practice (employees and employers). The lesser attention devoted to

government administrative implementation issues, resulted from the observation that little or no resources need to be directly allocated by public

agencies when implementing the practice. The role of government is viewed more as that of a catalyst or facilitator, rather than that of a conventional regulator. Given that telework primarily results in more choices, rather than less choices or more strongly constrained choices for all affected parties, it also appeared reasonable to restrict the legitimacy issue investigation to the parties directly involved in its implementation, i.e., the organizations and employees adopting the practice.

When the concept of teleworking gained substantial interest in the 1980s, a number of forecasts of the penetration level of teleworking were made. Today, those forecasts reveal the serious over-optimism of the 1980s. The gap between the expected adoption levels and the actual adoption levels calls for a careful analysis of the elements that influence the adoption behaviour of teleworking (Mokhtarian and Salomon, 1997). Although the choice to adopt telework may be an individual decision, it is made in a complex environment that influences that decision. Hence, a conceptual framework modeling the adoption of telework was developed. Teleworking is only offered as an option to the individual worker, if a minimum level of technological, institutional and organisational requirements is fulfilled or if potential constraints are eliminated. If this minimum level is respected then the individual worker will only consider teleworking if he/she is dissatisfied with one or more aspects of non-telework life or if a number of drivers exist. Hence, the ultimate choice to telework or not is potentially influenced by the presence of a number of drivers and constraints (Mokhtarian and Salomon, 1997).

- The environment

The main environmental elements are (a) de technological environment that needs to be in place before the implementation of telework is possible, (b) the institutional environment and (c) the managerial and organizational environment.

- The individual

The perceptions and attitudes of an individual and the characteristics of an individual are the two components of the individual aspect.

(1) Individual characteristics :

In the literature, the following features are generally accepted as characteristics that affect the individual decision to telework : personal costs that derive from teleworking, task suitability, the organizational/managerial support, the current household situation, the benefits one derives from the commuting trip, the ideology and travel related factors (commuting time, commuting distance, average commuting speed, stress, ...) (Mokhtarian and Salomon, 1994, 1996(a), 1996(b)).

(2) Perceptions and attitudes of an individual :

An individual's perceptions on teleworking influence the individual's decision to be part of a teleworking project. But a positive preconception about teleworking isn't enough. If a person has second thoughts about the teleworking program offered, there will be no participation. The attitude of an individual towards risk, control, discipline, independence, spare time and social contact will also influence the decision to telework.

The use of empirical applications allowed to assess the organizational parameters relevant for organizations located in Brussels. Human resources (HR) managers of 230 companies in Brussels were approached to fill in a questionnaire regarding teleworking. Of those companies, 83 completed and returned the questionnaire. At present 19 of the 83 firms

already implement teleworking; they all expressed the desire to implement teleworking on a larger scale in the future. Twenty other firms suggested they would start implementing teleworking in the near future. The questionnaire aimed to identify barriers and drivers related to the technological, institutional and organizational context of teleworking. The questionnaire reflects insights gained from a mix of individual choice models developed by various researchers such as Bernardino et al. (1993), Mahmassani et al. (1993) and Mokhtarian and Salomon (1994).

At present the adoption of telework programs in an organization is mainly determined by the following parameters according to the conducted analyses: (1) awareness of the "telework" concept, (2) the presence of a coordination and control mechanism which is output oriented, (3) experience with flexible work hours, (4) activities in a knowledge based sector, (5)the importance of non-routine decision making and (6) a high percentage of highly skilled workers.

The empirical work led to the conclusion that organizations not yet adopting the practice have the same perceptions on telework benefits but a much more negative view on telework "costs", as compared to organizations that have already adopted the practice.

The survey among HR managers also allowed to evaluatie 3 proposed policy tools to enhance the adoption of telework. The HR managers believed that the awarding of financial incentives to organizations implementing telework, will enhance the penetration level of telework However, these HR managers als believed that the most effective way to achieve a higher telework adoption rate appears to be through the diffusion of "best practices". This conclusion is in line with the research finding that organizations and individuals without any telework experience tend to have an overly pessimistic view of the disadvantages of this practice.

A total of 261 employees from 16 different organisations in Brussels filled in a second questionnaire that aimed to identify the implementation barriers and drivers at the level of the individual as well as the impact of telework implementation on commuting travel. The used sample consisted of 131 men and 130 women of which the age ranged between 21 and 62. More specifically, the survey was completed by 42 people in their twenties, 94 people in their thirties, 93 people in their forties, 29 people in their fifties and one person in his/her sixties. Of the 261 employees in the sample, 55 individuals were already teleworking today, while an additional 110 individuals said to be able and willing to telework on a regular basis, an extra 23 individuals said to be able and willing to occasionally telework and 73 conventional employees. This questionnaire also reflects insights gained from a mix of individual choice models developed by various researchers.

The empirical assessments revealed that the adoption of teleworking by an individual is less likely if the job requires (1) face-to-face contact with colleagues, (2) the availability of a fax (especially required for secretarial functions), (3) coordination and control based on direct supervision, or if the individual (4) is unaware of the teleworking concept, (5) has not given any thought to whether or not his/her job is suited for teleworking, (6) he/she has a clerical occupation, (7) the individual believes the commuting trip allows him/her to separate his/her

professional life from his/her family life, (8) the individual believes the atmosphere in the office is an important motivational element, (9) the individual believes it is important to make a distinction between family and professional life and if direct contact with (10) the direct superior and (11) other persons is important. The adoption of teleworking by an individual is, however, stimulated if the employee (1) has a location independent job, (2) has experience with taking work home, (3) has flexible work hours, (4) requires an internet connection or (5) requires the availability of a modem in order to perform his/her job, (6) is a manager, (7) is controlled and coordinated based on his/her degree, (8) is mainly involved in non routine decision making, (9) has a long commuting distance, (10) has a long commuting trip time in the evening and (11) in the morning, (12) uses a company car, (13) uses the car during work hours, (14) is a man, (15) has office space at home, (16) has a high education level, (17) has a high income level, (18) benefits from a positive attitude of the employer and (19) benefits from a positive attitude of the direct supervisor towards the adoption of teleworking, (20) has a stressful commuting trip, (21) perceives the commuting trip as having a negative influence on society and (22) finds it important to work without interruptions of colleagues.

The comparison of the perception of potential regular teleworkers and non-teleworkers lead to the conclusion that both groups recognize the same advantages of telework but the second group attributes more disadvantages to the practice.

This research also evaluated the potential effectiveness of telework implementation as an anti-congestion policy tool. The demand for mobility is still rising in Brussels and Belgium. Hence, increasing the necessity to protect of the atmosphere. A reduction of the external effects that result from an increased demand for mobility can no longer be achieved through an increase in the physical infrastructure, since insufficient financial resources and/or space characterize most highly congested urban areas. As a result, governments are increasingly willing to adopt new policy instruments to reduce traffic congestion. A wide range of policies to reduce traffic congestion has been adopted in various countries. However all these policies have limitations. For instance, the idea of self regulation and traffic calming measures offer no solution for the increase in demand for mobility from an economic, social, political and ecological point of view. Here, no differentiation for duration or importance of the trip is made among the considered trips. An improved network performance through technological applications will not solve the problem either since each of the existing systems (computer-linked traffic lights, direct vehicle-to-vehicle communications, the provision of up-to-date information, ...) has its limitations (Jones, 1993). Therefore, *road pricing* has often been proposed by transport economists as a response to congested roads (De Borger en Proost, 1997). The principles of road pricing build upon Pigouvian tax principles. The road user should bear the real costs of the road transport externalities he/she causes. Such an optimal incentive structure should encourage the road user to change his/her behaviour in all relevant aspects (for instance : number of moves, length of trips, the used technologies, time of transfer, ...) (Verhoef, 1997). Road pricing is undoubtedly an effective policy measure, the problem is, however, that

(1) a substantial impact sometimes only occurs when a combination of policies is pursued;

(2) such policy is mostly only accepted by the public when it is linked to a program of expanded public transit, higher quality transit and income compensation measures.

Unfortunately, the simultaneous pursuit of various anti-congestion policies requires substantial resources which government agencies often cannot afford to spend. In addition, most of these policies may take several years before they result in a reduction of congestion. Therefore, we suggest supplementing road pricing with a complementary policy namely teleworking.

As the research focuses on the effects of telework on road externalities, the main goal is to obtain insights into these effects. Hence, the main focus is on road externalities resulting from private transport (road congestion, noise pollution, road accidents and air pollution) due to the fact that the main influence of telework lies in this field. Telecommunication influences a wide spectrum of human behavior, which complicates the prediction of the impact of telecommunication on mobility patterns. Furthermore predictions build upon experiences from the past. However, there is a lack of relevant data about the telework implementation in the past. Hence, additional assumptions are used, however, these assumptions undermine the validity of the predictions. The application of the model of Mokhtarian (1998) in order to assess the impact of telework implementation on the number of commuting trips to/from Brussels, revealed that telework implementation can significantly reduce the number of commuting trips, even when recognizing that it may also generate some new traffic. The net impact of telework implementation leads to significant monetary savings in external costs related to road congestion, air pollution, noise pollution and road accidents, namely between 8,6 billion BEF and 18,7 billion BEF.

In addition, the following three outcomes, resulting from the present study, may be especially useful to the stakeholders involved.

1. The research has revealed that government agencies have a high percentage of employees with a job suited for telework. Furthermore, the research conducted has shown that the most optimal way to enhance telework implementation is through the diffusion of information on “best practices”. This specific policy measure appears to be associated with both a high potential effectiveness and procedural effectiveness.
2. The research conducted also suggests that current and (potential) regular teleworkers have a positive perception of the influence of telework on procedural justice (the perception of the fairness of the distribution of work rewards relative to the actual work performed) and job satisfaction, whereas non-teleworkers tend to have a negative view of the practice’s impact on these parameters (in case they would themselves adopt the practice). This research finding is important, as it suggests that HR-managers do not need to be overly concerned about the impact of telework on procedural justice and job satisfaction when dealing with bottom-up requests to adopt the practice: the employees’ own perception of the likely impact of telework implementation on procedural justice and job satisfaction, acts as a “natural selection” force. Only the employees with a positive perception are likely to volunteer or to ask for telework implementation projects. This

research project's main managerial implication is that HR-managers can use telework as a human resources management tool to satisfy the needs of highly skilled employees.

3. The research also provides an important policy implication for policy makers in the field of transportation. At present, road pricing is often put forward by transport economists as the alleged most efficient policy measure to close the gap between the demand for mobility and the supply of infrastructure. In principle, road pricing can likely contribute to solving congestion problems. However, the implementation of textbook road pricing would require continuous monitoring of the traffic conditions on each particular point of the network, taking into account the features of each vehicle as well as that of the road to determine the tax to be levied, which should be equal to the marginal costs generated by each particular car, associated with a marginal change in traffic. These requirements, which are virtually impossible to satisfy in practice, undermine the real effectiveness of this policy tool when implemented in real-life situations: given that both the taxation level and the way the tax would be levied in practice will likely diverge substantially from textbook suggestions, major barriers can be expected in areas such as perceived legitimacy, target group implementation potential (including the problem of unintended policy effects) and administrative implementation potential. In practice, a "second best" policy that entails the introduction of a uniform tax per vehicle-kilometer (perhaps differentiated according to the time traveled) is the most likely approach. A uniform tax implies that every road user is charged the same amount of tax regardless of the external costs really caused. Here, is it doubtful that the affected parties will accept this shift of burden for the sake of overall economic impact. Even when leaving aside this lack of efficiency at the micro-level, the distributive effects of this policy tool are likely to lead to substantial resistance, especially by those categories of road users whose real living standards may be greatly affected by road taxes and who do not have access to acceptable alternatives such as high quality public transport for their commuting trip. Interestingly, these negative features of road pricing could be minimized by offering an alternative to avoid this tax, namely telework and at the same time road pricing would minimize unintended negative effects of telework, through curbing the possible travel generating effects of telework.

In addition to the above policy and managerial implications of telework implementation, this research also allowed to identify five challenges that the future research agenda on telework should address :

1. The successful implementation of telework usually results from a clear organizational strategy aimed either at reducing costs or at enhancing employee satisfaction. In this context, management tools that aim to strengthen the organization's competitive cost position, such as outsourcing, office automation and business process re-engineering have stimulated telework implementation. At present, imbalances between the demand and supply of particular skills, lead employers to search for new and creative ways to attract qualified applicants and retain highly skilled employees. Teleworking has already been used effectively by some organizations to attract and retain employees, and its importance is likely to grow in the near future. Consequently, the gathering of reliable statistical data about the penetration level and potential of the different types of telework

is essential. The best way to obtain this type of data is through the adding of standard questions to the population census and labour surveys.

2. Although the choice to adopt telework may ultimately be an individual's decision, it is often made in a complex environment that influences this individual's decision. Hence, the research approach adopted in individual choice models (Mahmassani et al., 1993) (Bernardino et al., 1992) (Mokhtarian en Salomon, 1994) (Mokhtarian en Salomon, 1996a) (Mokhtarian en Salomon, 1996b) (Mokhtarian en Salomon, 1997) was combined in the present study with environmental parameters taking into account by other researchers (Kugelmass, 1995) (Nilles, 1998) (Limburg, 1998) (Huws, 1993) and applied to the Brussels context. The objective of future research should be to extend the main research results valid for Brussels to the other very large Belgian cities. This should allow the construction of an "urban telework prediction model" applicable to all main urban areas in Belgium.
3. A quantitative analysis of the costs and benefits of telework implementation is not an easy task due to the fact that many effects resulting from telework implementation are intrinsically qualitative in nature. The present study has also focused primarily on such quantitative effects, although the existence of many qualitative impacts was recognized throughout the analysis. Hence, the development of an evaluation method which would allow to take into account quantitative as well qualitative effects would be very useful.
4. Three types of interactions can be identified among employees, namely purely professional interactions, socio-technical interactions among employees with common duties and purely social interactions among workers who do not have common duties (Salomon and Salomon, 1984). In this context, a frequently cited disadvantage of telework implementation is the constraint placed by this practice on social and professional interactions. Although the present study did not identify such effects, the in-depth analysis of the influence of telework implementation on intra- and inter-organizational communication is clearly a research priority.
5. The ideal evaluation methodology to assess the impact of a telework program on travel, energy use and air quality, would include travel diary surveys before and after the start of the program in order to assess any changes resulting from it (Mokhtarian et al., 1995). Multiple "after-surveys" would be even more appropriate since they would allow to assess how these changes evolve over time (Hamer et al., 1991) (Mokhtarian et al., 1995). Hence, future research on telework implementation in Belgium and more specifically Brussels should follow this methodological design. Such a design was not adopted in this research due to a lack of administrative and monetary resources. In the future, however, such a research design should not only be adopted for telework research in Brussels but also in other Belgian cities. This would allow to assess whether the research findings for Brussels are also valid for other Belgian cities. It would also lead to a serious empirical foundation of observations on the present overall impact of teleworking implementation in Belgium.