

# **Company Incentives and Individual Preferences Towards Sustainable Travel Alternatives**

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## **Preface**

I would like to take the opportunity to thank the persons that made the completion of this work possible. Firstly, my gratitude goes to Professor Folke Snickars who, despite his busy schedule, always has given me his personal engagement and the supervision needed. I also thank my assistant supervisor, Dr. Anders Karlström, who did not let me off the hook regarding the programming of the models, and who has shared his experience and expertise during all parts of the research. Dr. Mattias Höjer has played an essential role as my unofficial supervisor, sharing his competence and holding me on the right track. I would also like to thank Dr. Mats-Olov Hedblom, environmental director at Ericsson, to whom I owe my credits for launching the research project in Nacka Strand and for supporting me throughout the way. Furthermore, Dr. Göran Mälhammar and Louise Croneborg at Ericsson have played an essential role as the link between Ericsson and KTH, especially during the process of carrying out the survey. Dr. Leonid Engelson and Christer Persson at Inregia earn my appreciations for their thorough work with the design of the stated preference game. I should also mention Professor Lars-Göran Mattsson and my friends at the Unit for Transportation and Location Analysis, always supporting me in the right direction and making the research more enjoyable. In particular, Maria Börjesson, who proved to be an outstanding co-worker at the creation of the third paper. Finally, a big hug goes to my wife Annika for her emotional and intellectual support throughout the most demanding times during the production of this licentiate dissertation.

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## **Abstract**

Since the acceptance of changing travel habits is a matter of subjective preferences and individual values, the question of how to make individuals voluntarily choose new travel alternatives is not straightforward. In this study we focus on an office district called Nacka Strand outside Stockholm, where companies tried to implement new and more efficient alternatives to personal travel. The aim is to reduce both emissions and costs from personal travel, in parallel with an increased utility among the employees. The idea is that the employees shall be *encouraged*, not *enforced* to change travel patterns.

We start out from the research question of what factors affect individual preferences due to various incentives in the choice between present and new alternatives. From this perspective we derive secondary environmental and monetary gains possible to obtain. Examples of such incentives would be e.g. attractive IT-conveniences or monetary bonuses stimulating the use of the more efficient alternatives. To analytically analyse the impact from incentives on individual behaviour we use the toolbox of micro econometric modelling, in which the aim is to test the employees' criteria for changing behaviour, as dependent on certain explicit conditions. The models provide information of ways to reach environmental and economical goals without deteriorating the employees' working conditions.



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### List of papers

- (I) Robèrt, M. “A Framework Combining Backcasting with Econometric Modelling - Information technology and individual preferences of travel”.
- (II) Robèrt, M. “Employees’ Attitudes Towards Carpool and Ride-matching - A field study based on employees’ preferences in Stockholm“.
- (III) Robèrt, M. and Börjesson, M. “Company Incentives and Tools for Promoting Telecommuting”.



## 1. Background

Increasing pollution and emissions of greenhouse gases from the use of fossil fuels are making environmental goals more difficult to reach each year. The greenhouse effect caused by human emissions is now a general scientific fact and the consequences are unpredictable. No one knows the consequences of raising the temperature on earth, but still business as usual is most commonly applied. The average distance travelled per person each year almost doubled in Europe between 1970 and 1995 (Banister et al, 2000). Short-term economical profits are still prioritised before long-term environmental gains. In the light of this, private companies and their environmental responsibility is of crucial importance for a more sustainable transport system. Some proactive companies set good examples and show that mitigating the environmental impact does not always stand in contradiction to an increased profit within the company.

Arnfolk (2002) and Robèrt (2000) predict that the largest potential environmental impact caused by IT will be in the transport sector. Arnfolk (2002) focuses mainly on the potential of reducing travel emissions by substituting work-related physical travel to videoconferencing and telecommuting and addresses the need for profound strategies and company policies in order to substitute physical travel to virtual communication. He distinguishes two main kinds of possible environmental benefits caused by an increased use of IT in the transport sector:

- *Substitution* implies an electronic application partially or fully replacing a trip. Sending electrons demands less energy than sending atoms, e.g. electronic mails instead of posted letters or videoconferencing instead of face-to-face meetings.
- *Improved effectiveness* provided by IT, where the technology helps provide the same service with less transportation efforts, e.g. in the form of carpools or ride-matching, facilitated by IT.

So far, however, a reduction of only 0.3% of annual travelling is obtained by use of traffic telematics. This is a rather modest figure in comparison to the 3% annual increase in total travel demand (Rapp and Skåmedal, 1996). It is quite evident that IT is not environmentally benign and will not solve the environmental problems by itself. However, if used strategically, it might increase the attractiveness and acceptance of new, innovative transport alternatives. In that sense it could probably serve as a useful tool in the process towards sustainability. In several countries, e.g. the Netherlands, the UK and the US, companies have implemented effective policies in order to stimulate more efficient personal travel (Rye, 1999). The concept of travel plan (TP) is referred to as an efficient measure to reduce employee private car commute within companies. It is defined as “a package of measures developed by an employer designed to encourage their employees, visitors or customers to switch from driving alone to encouraging the use of more efficient and environmentally friendly forms of transport” (Newson, 1997).

In many scenarios concerning the role of IT in sustainable development (e.g. Höjer, 2000), great importance is put on the user of the services if the scenarios shall be realized. Fundamental to the current study, is to start out from the key players in the context, the potential users of these travel alternatives. In the sequel, we focus on in what conditions the Ericsson employees, working in an office area outside Stockholm

called Nacka Strand, are willing to use new and more resource efficient travel-plan alternatives. Examples of IT-related travel-plan alternatives are videoconferencing, telecommuting and carpools.

## 2. The aim and the structure of the study

In this study we focus on the development and the potential adoption of some IT-related transport services in an office area called Nacka Strand, outside Stockholm. The research project has been a co-operation between the Royal Institute of Technology and a branch of the telecom company Ericsson, located in the area. The purpose among the companies in the business district is to achieve reduced costs and emissions from personal travel, while at the same time improve the employees' working conditions. Several results from this study indicate that there is room for economical investments in order to improve the competitiveness of the new alternatives, and that certain improvements would have a significant impact on the employees' acceptance of changing travel habits. For instance, a majority of the staff at Ericsson state they would choose the economically and environmentally more efficient carpool instead of taxi *if* the improvements tested in this study were implemented in reality. Also a ride-matching system and a flexible office arrangement seem to be accepted among the employees on condition of some specific criteria tested.

The study consists of three separate papers, where the structure follows an order of general to specific, see figure 1 below. All papers have been submitted to scientific journals by the end of 2003. To date, paper 1 has been presented at the NorFA-workshop in Haugesund (September, 2002) and is recently submitted to Journal of Cleaner Production. Paper 2 has been presented at seminars at KTH and at an IT/sustainability-workshop in Stockholm (October, 2003). Paper 3 has been presented at the European Transport Conference in Strasburg (October, 2003).

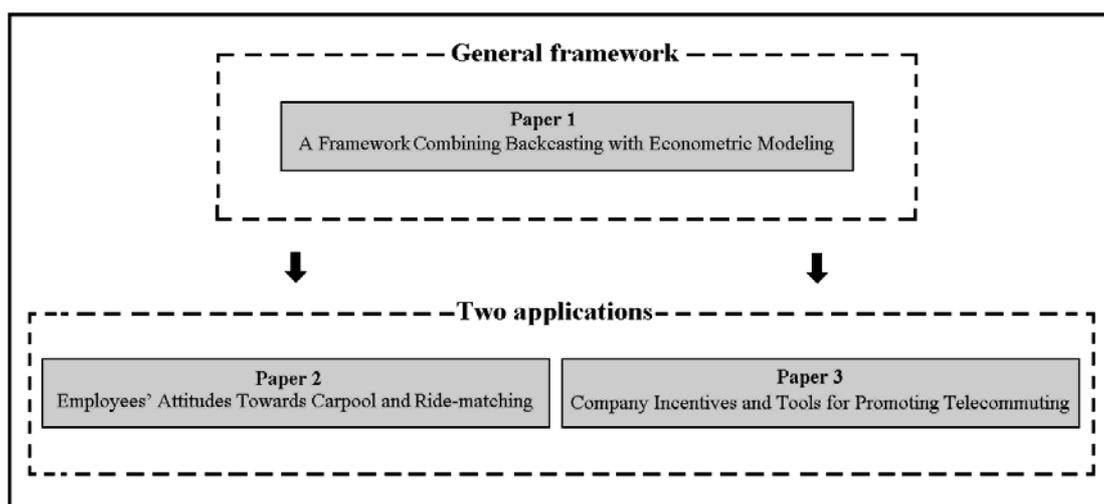


Figure 1: *Structural scheme of the study. The general context and outline of the study is presented in paper 1. Papers 2 and 3 present two empirical case studies where the methodology discussed in paper 1 is applied in practice.*

The first paper gives a description of the research project in Nacka Strand at large, together with a problem formulation of the analysis. This paper puts the latter two papers in a context of sustainable development. It also paves the way for how the results and findings from the two latter empirical papers can be used from a company policy perspective, setting future goals for sustainable development.

In the first paper we present the general idea of *backcasting*, an analytical framework generally applied when planning in complex systems (see Robinson, 1982, Dreborg, 1996, Höjer and Mattsson, 2000). We point at econometric modelling as a useful tool in the backcasting framework when incorporating uncertainties related to future individual behaviour. Backcasting is particularly useful in a system consisting of several independent components, when the aim is to reach a successful predetermined goal. The initial step is to sketch the desired long-term goal and then, with regard to the present conditions, derive feasible paths between the desired and the present situations. The main advantage is that it allows the planner to focus on the different components of the system in separate and without losing the general context. To optimise the conditions for one component could facilitate the development of also other components (synergy effects). In the research of Nacka Strand, the most difficult component to forecast is the employees' future behaviour if having access to new hypothetical alternatives.

Also, some elementary methodology from the field of econometric discrete choice theory is presented in the paper. By using econometric modelling we treat the individuals as rational "utility maximizers", always choosing the alternative that seems to be the most desirable from an objective point of view. A desired long-term goal in Nacka Strand would for instance be an acceptable use rate of the alternative services, in order to make implementation of renewable fuel technologies economically feasible. This would be a win-win situation where both environmental and economical gains are achieved. Of course, in order for this to be realized, also other components than individual choice conditions must be considered (e.g. company policies, practical feasibility, technological developments, etc.). Nevertheless, knowledge of the individuals' criteria for changing behaviour might open doors for new company policies and other components consistent with the long-term goal.

The second paper is an empirical study of two specific travel-plan alternatives, having the potential to reduce emissions and costs from personal travel at work: carpool and ride-matching. The results point at a reasonable acceptance among the employees working in Nacka Strand to accept:

- a) *Carpooling* instead of taxi for local business trips;
- b) *Ride-matching* for local business trips and for work commute.

The findings indicate that the company has a potential to influence their employees' travel behaviour towards these more economically and environmentally efficient alternatives - if using the right instruments and incentives. For instance, in spite of the fact that only 3% of the respondents claimed they used carpool at the latest local business trip, a majority (62%) state they would choose carpool in favour of taxi, on condition of the attributes presented in the survey.

As discussed in paper 1, some travel related alternatives might give negligible economical or environmental benefits according to present conditions, but might work as platforms for future developments of e.g. fuel cells and other environmentally benign technologies. However, if this would be realized in practice, the new alternatives must first reach an acceptable use rate in order to make them economically feasible. To find the employees' conditions for choosing e.g. carpool instead of taxi is therefore an essential first step in the discussion of practical paths

towards a long-term sustainable goal. This reasoning applies if there exists a profound strategy of the development of the alternatives tested. This logic applies even to the ride-matching system tested in this study. It has the potential to reduce both travel costs and emissions during work commuting and local business trips. In this study we test the first essential component of such a system –the drivers’ acceptance of picking up passengers in their cars. Since quite a good half of the drivers (51%) claim they are willing to pick up passengers on condition of the certain criteria tested in the survey, subsequent steps towards an implementation of an effective ride-matching system would be creation of new company policies and launch of a ride-matching system that best corresponds to the requirements stated by the drivers in this study.

The third paper of the study addresses telecommuting from a somewhat different angle: What would a company gain from promoting telecommuting to the employees? As for the services analysed in paper 2, even telecommuting has a potential role in the discussion of more sustainable travel patterns at work since it might reduce the need for daily commuting and travel during traffic peak hours. However, if telecommuting shall be more widespread and thus serve as a traffic mitigating measure in the future, companies must have clear motives for promoting this work form to their employees. In this study we test the employees’ acceptance of “flexible office rooms” where several employees share the same workplaces but on different occasions (since part of the staff is always telecommuting). This implies possible office area reductions for the company, and consequently, potential savings of rental costs.

To empirically test the employees’ acceptance of giving up their present workplaces for flexible office rooms, we again use econometric modelling. The models are specified so that we predict the probability for accepting the flexible office as dependent on a monetary compensation from the company. The results point at a significant willingness to accept the flexible office room if receiving a monetary compensation for the inconvenience. To extend the analysis, a more flexible discrete choice model is developed (a mixed logit model), and compared with a multinomial logit model.

Also the findings from this study have the potential to fit into the backcasting framework presented in paper 1. The long-term goal would here consist of a combination of telecommuting and flexible offices where both reduced rental costs and decreased emissions from work commuting are obtained (a win-win situation for the company and the employees). By using econometric modelling we have predicted the company’s and the employees’ most profitable level of compensation for accepting the flexible office. If introducing a compensation rate of 500 SEK (50 USD) per month, about 40% of the employees would accept the flexible office. With insight in that, the company can strategically plan for other criteria essential to make this consistent with the long-term goal. One example would be introduction of more distinct incentives and policies, stimulating telecommuting at the company so that introduction of flexible offices will be feasible in practice. To find the employees’ conditions for adopting more telecommuting than at present, the study also includes a separate analysis of the employees’ perceived preferences as regards this work form.

### 3. Behavioural models used in the research

#### 3.1 Utility functions in discrete choice models

Since the aim from a company policy perspective is to find ways to influence an employee's behaviour (e.g. choose a new more energy effective travel-plan alternative), it is necessary to find on what conditions the person is willing to do this. Let us take the example where we want to investigate the potential to substitute taxi with the more cost- and environmentally efficient carpool at local business trips. The two alternatives are connected to some more or less attractive attributes (e.g. travel times, travel prices, certain conveniences), which we assume give a certain pleasure or in microeconomic terms, *utility*. In our econometric models the utility is used to form the *utility function* in order to estimate the choice probability between the alternatives. The general modelling procedure is pictured in figure 2 below, using the example of estimating the choice probability between the two alternatives carpool and taxi. In order to derive the choice probability between carpool and taxi, we use the adherent attributes to the two services (e.g. travel time, travel cost, booking system, etc.). The choice probabilities can ultimately be of use to derive likely market shares over the total population, as dependent on the individuals' perception of the adherent attributes (see Louviere et al, 2000, Thomas, 1997, Greene, 2000).

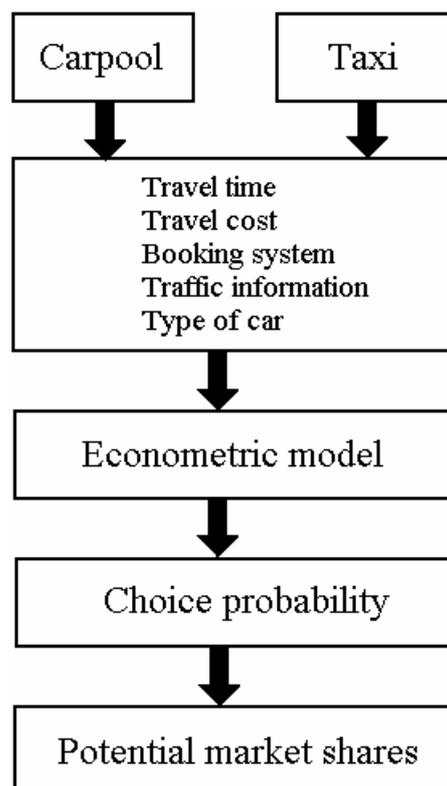


Figure 2: A graphic representation of the modelling procedure when deriving the choice probabilities and the market shares between two alternatives.

In micro econometric modelling the utility function is assumed to be *ordinal*, as opposed to *cardinal* (Ben-Akiva and Lerman, 1985). This means that we only regard the relative order of the utility for different alternatives, giving us preference rankings between the alternatives at the micro level.

In econometrics, binary choice models are used to predict the probability that travel mode  $a$  is preferred to travel mode  $b$  (Ben-Akiva and Lerman, 1985). As discussed, each of the two choices  $a$  and  $b$  could be connected to some known attributes, giving the utilities  $U_a$  and  $U_b$ . The probability for choosing mode  $a$  instead of mode  $b$  is then the probability that  $U_a$  is greater than  $U_b$ :

$$P_a = P(U_a > U_b) \quad (1)$$

The utility for individual  $n$  to choose alternative  $i$ , having  $K$  attributes, can be expressed in an additive linear function of the different attributes  $x_{ki}$  and the weights  $\beta_{ki}$ :

$$U_i = \alpha_i + \beta_{1i} x_{1i} + \beta_{2i} x_{2i} + \dots + \beta_{Ki} x_{Ki} + \varepsilon_i, \quad i = a, b \quad (2)$$

The variables  $x_{ki}$  represent quantifiable attributes, such as time consumption, cost, or different comfort aspects associated with each alternative. The core of discrete choice analysis is to estimate the preference parameters,  $\beta_{ki}$ . By collecting data from peoples' choices between the different feasible alternatives, the parameters  $\beta_{ki}$  can be estimated in the models. The parameters  $\beta_{ki}$  mirror the respondents' perceived importance of each specific attribute (i.e. the  $\beta_{ki}$ -parameters weight the influence of each attribute on the choice probability). The term  $\alpha_i$  stands for the "alternative specific constant", also termed the "intercept parameter". This constant compensates the utility function for hidden attributes, not included in the model. The term  $\varepsilon_i$  in equation (2) is called the *random* component or the disturbance. This term represents attributes that cannot be measured explicitly, e.g. measurement uncertainties and model misspecifications. The assumption of the density distribution of these disturbances is what determines the type of choice model.

The utility function  $U_i$  can be treated from the theory that the decision maker acts rationally and that the preferences are *consistent* and *transitive*. A consistent preference means that if a decision is made once it will be made again if the person has the opportunity to choose again. Transitivity implies that if a person stands in front of three possible alternatives and the first is preferred to the second and the second is preferred to the third, then the first alternative is also preferred to the third.

Since utility is a subjective measure, the modeller must consider the uncertainties of not capturing the individual's *true* utility function in the models. If we assume that the utility function could be partitioned into one observable part  $V_i$  and one error term  $\varepsilon_i$ , we could treat the former with greater confidence and the latter with special precaution.

Equation (2) could now be expressed in vector form as:

$$U_i(\mathbf{\beta}_i) = \alpha_i + \mathbf{\beta}_i \mathbf{X}_i + \varepsilon_i = V_i(\mathbf{\beta}_i) + \varepsilon_i \quad (3)$$

Here,  $\mathbf{\beta}_i = (\beta_{1i}, \beta_{2i}, \dots, \beta_{Ki})$  is the preference-parameter vector, and  $\mathbf{X}_i = (x_{1i}, x_{2i}, \dots, x_{Ki})$  is the attribute-vector, containing the different attributes affecting the choice

between the alternatives.  $V_i(\beta_i)$  is called the *systematic* component of the utility (i.e. the part of the utility that is known to the modeller).

### 3.2 Density functions and the logit model

Before the probability for choosing alternative a can be derived from equation (1) above, some assumptions of the distribution of the error term  $\varepsilon_i$  have to be made. The distribution  $f(\varepsilon_i)$  is called the *density function*. The probability that mode a is chosen can then be derived by integrating the density function over some specific interval. It is here obvious that the probability of choosing mode a increases as the difference between the systematic utilities increases (i.e. the probability for choosing alternative a is larger when the utility  $V_a$  is greater than  $V_b$ ).

When the difference between the systematic utilities reaches far negative values, the probability will approach values close to zero and high positive values must imply probabilities close to one. Also, since it represents an appropriate distribution of random disturbances the function should preferably be without kinks or discontinuities.

One assumption would be to assume that the error term in equation (2) is the sum of a large number of independent components. The distribution  $f(\varepsilon_i)$  then have a normal distribution over the interval and the corresponding choice model is called the *probit model*. Normal distributions are what normally occur when a large number of independent samples are randomly selected. Consequently, this makes the probit model intuitively attractive and comprehensible.

A density distribution that has a similar shape to the normal distribution is the *Gumbel-distribution*. If we assume that  $\varepsilon_i$  is Gumbel-distributed, we instead arrive at the *logit model*, which is far easier to treat analytically (equation 5 below). In our application binary logit models are used in situations where we want to test the potential for a new transport alternative as a substitute for one of the older ones, e.g. carpool versus taxi or drive alone versus ride-matching. In the case where the decision maker has more than two feasible alternatives, we could generalize the above reasoning to yield a choice set, denoted  $C = \{1... J\}$ . The choice set contains a number of different alternatives. The notation for making choice i from the choice set C of J alternatives is then stated as:

$$\begin{aligned} P_i &= P(U_i > U_j, \forall i, j \in C, j \neq i) \\ &= P(V_i + \varepsilon_i > V_j + \varepsilon_j, \forall i, j \in C, j \neq i) \end{aligned} \quad (4)$$

If assuming the error term being identically independently Gumbel distributed (IID), the probability for choosing alternative i is given by the multinomial logit model (MNL) as:

$$P_i(\beta) = e^{V_i(\beta_i)} / (\sum_{j \in C} e^{V_j(\beta_j)}) \quad , \beta = (\beta_1, \dots, \beta_J) \quad (5)$$

Equation (5) reduces to the binary logit model if  $J = 2$ . Also it defines a proper probability mass since

$$0 \leq P_i(\mathbf{B}) \leq 1 \text{ and } \sum_{i \in C} P_i(\mathbf{B}) = 1 \quad (6)$$

We applied maximum likelihood methods for estimating the parameters of the logit models presented in this study. All models were individually programmed in the programming language Ox. The programming code of the mixed logit model is presented in the appendix of the third paper.

### 3.3 Taste variations and the mixed logit model

One property of the multinomial logit model is the assumption that the preference parameters are fixed over the population. This assumption implies that the valuation of attributes is aggregated to one average preference vector  $\mathbf{B}$ , representing all individuals' tastes (i.e. individual tastes within the population are assumed not to vary so we estimate the same  $\mathbf{B}$  for all individuals). This restriction is eliminated in the mixed logit model (MXL), where we instead allow the preference vector  $\mathbf{B}$  to vary over the population with the normally distributed density function  $f(\mathbf{B} | \boldsymbol{\theta})$ . Here  $\boldsymbol{\theta} = (\mathbf{B}_{\text{mean}}, \mathbf{B}_{\text{sd}})$  represents the mean value ( $\mathbf{B}_{\text{mean}}$ ) and the standard deviation ( $\mathbf{B}_{\text{sd}}$ ). The aim is then to estimate the parameters of  $\boldsymbol{\theta}$ . Figure 3 below pictures the density function of  $\mathbf{B}$  in one dimension.

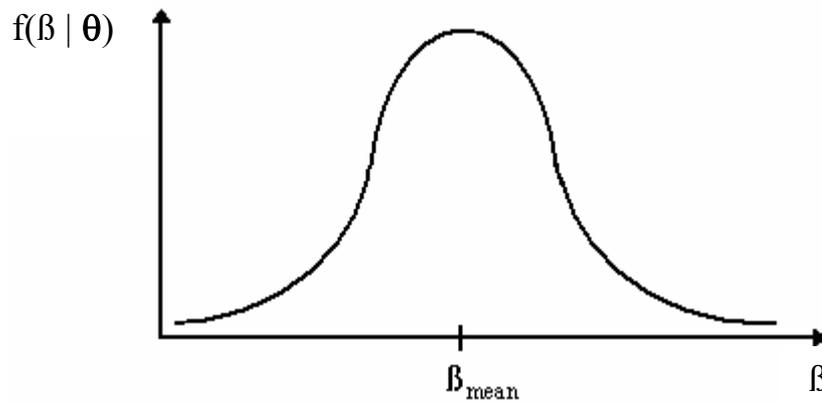


Figure 3: *The density function of  $\mathbf{B}$  in one dimension.*

The utility function in equation (2) is then provided with an extra term, incorporating the effects of the standard deviation over the population of  $n$  individuals:

$$U_i(\mathbf{B}_i) = \alpha_i + (\mathbf{B}_{i,\text{mean}} + \mu \mathbf{B}_{i,\text{sd}}) \mathbf{X}_i + \varepsilon_i \quad , \mathbf{B}_i = (\mathbf{B}_{i,\text{mean}} + \mu \mathbf{B}_{i,\text{sd}}) \quad (7)$$

Where  $\mu$  is  $N(0,1)$  distributed and  $\varepsilon_{ni}$  is Gumbel distributed with zero mean.

The choice-probability given by equation (5) must then incorporate the density function  $f(\mathbf{B} | \boldsymbol{\theta})$ , to handle the distribution of the choice vector. The mixed logit formula for a population of  $n$  individuals is the choice probability in equation (5), integrated over all possible values of  $\mathbf{B}$ , over the density function  $f(\mathbf{B} | \boldsymbol{\theta})$ :

$$L(\boldsymbol{\theta})_i = \int P_i(\mathbf{B}) f(\mathbf{B} | \boldsymbol{\theta}) d\mathbf{B} \quad (8)$$

The parameters  $\boldsymbol{\theta}$  cannot be estimated directly through a log-likelihood procedure as with standard multinomial logit models but must instead be estimated by numerical simulation. A mixed logit model is found in the third paper of this study, where we have built a mixed logit model in order to derive employees' valuations of a flexible office, compatible with telecommuting.

The more complex model specification of the mixed logit model also implies certain drawbacks. First it demands a higher quality of data, which limits the applicability of this model to larger samples of data and more thoroughly constructed survey methods. We experienced these problems when estimating the models in paper 2. Here, as opposed to the multinomial logit model, the mixed logit model failed to converge to stable values in the estimates and was therefore excluded from the analysis. A second drawback with the mixed logit model is that it is still not generally utilized, which makes the results less comparable and interpretable by other researchers acquainted with the traditional multinomial logit model.

## 4. Model limitations

There are several aspects that are hard or impossible to incorporate in the behavioural models used in this study. In this section we summarize some of these aspects.

### *Altruistic values*

One aspect that is hard to capture in the behavioural models discussed above, but which might have certain relevance in the employees' willingness to adopt more sustainable transport alternatives, is the impact of *altruistic* values. One of the motives of this study is to find tools for promoting sustainable development. To that end, it would have been interesting to test the potential utilities of actions that are perceived as supportive of the common good. It is not certain that those are solely "ethical" and separate from the individual's perception of "selfish" utility. Humans have behavioural patterns that are inherent in our mental and social constitution. This means that it cannot be excluded that choices of transport that are perceived as positive with regard to, for instance, the green house effect, may carry weight also as a utility factor to the individual.

### *Group dynamics and group pressure*

Another aspect, related to the matter of altruistic values, is the impact from group dynamics and group pressure. It tells us that if an individual believes that a certain choice or behaviour for the common good will be followed by others, it is perceived as more attractive since the chances of contributing to success is then increasing. If such aspects can be measured as having relatively high weight amongst the attributes that are applied in the traditional models, it may open up for attractive ways of influencing societal planning into win-win solutions. However, the impact from group dynamics or group pressure in the case of hypothetical alternatives in Nacka Strand is not straightforward to include in a utility function. To test the impact from group dynamics, the stated preference data used in this study is not fully sufficient.

### *Individual utility and long-term sustainability*

Fundamental in this research is to test the employees' willingness to adopt more economically and environmentally efficient transport alternatives at work. As presented in equation (1), the criterion for doing so is dependent on the individual's perceived utility from using the different alternatives. However, the individual's utility function does not, in general, incorporate the long-term sustainability perspective, even though this would contribute to a preserved or increased utility in a longer time frame. In the choice between two alternatives, the consumer most likely primarily considers the immediate utility received when making the choice, rather than the long-term effects. This is also evident if considering that the attributes included when modelling the employees' choice probability in Nacka Strand consist solely of concrete travel advantages or disadvantages such as price, time, and travel conveniences (e.g. IT-services). This problem of including the long-term perspective is one of the motives for using the backcasting framework presented in paper 1.

### *Data acquisition and the stated preference technique*

There are two main survey techniques used for micro econometric modelling. The first is revealed preference (RP), where data is collected from the respondents' actual choices in daily life. The second is called stated preference (SP), where the respondents are confronted with hypothetical choice situations, constructed by the modeler. Since we in this research test the acceptance of alternatives not necessarily

familiar to the respondents, we are to a large extent constrained to the latter method, where we construct hypothetical choices of travel alternatives (old vs. new alternative). As a consequence, this entails certain drawbacks since we could never be confident that the respondents answer in perfect accordance with what they would have chosen in reality.

In general, there are reasons to believe that the respondents might:

- Neglect family constraints or other hidden factors, preventing them from choosing certain alternatives in reality;
- Answer as they think they *should*, instead of what they really *would* (e.g. according to company policies). Or answer what they *hope* they would choose in reality as a “good citizen”. This is generally termed the warm glow-effect;
- Suffer from fatigue effects, resulting in reduced precision of our modelled data;
- Adopt the answers to the levels given in the stated preference game, i.e. the respondents would have answered approximately the same even if we had constructed other levels. This effect is generally termed “the anchoring effect”;
- Care for other attributes, not included in the stated preference question, but which might be even more relevant to the choice if confronted in reality;
- Give policy-oriented answers, from the intention to influence policies and decisions concerning the alternatives tested in the survey (e.g. reduce costs);
- Be influenced from past experience, resulting in biased attitudes and unrepresentative response to the questions. This could be seen as a recall and context dependent effect;
- Belong to a certain segment, which is not representative for the population at large. There is also a risk that people least motivated using the alternatives tested in the survey might fall off.

Figure 4 below pictures the complex web of included components in the individual choice process. The decision process is dependent on the individual’s prior knowledge, attitudes and experience resulting in a more or less coloured view of the stated preference questions. This potential bias must be regarded in order to avoid over interpretations of the responses.

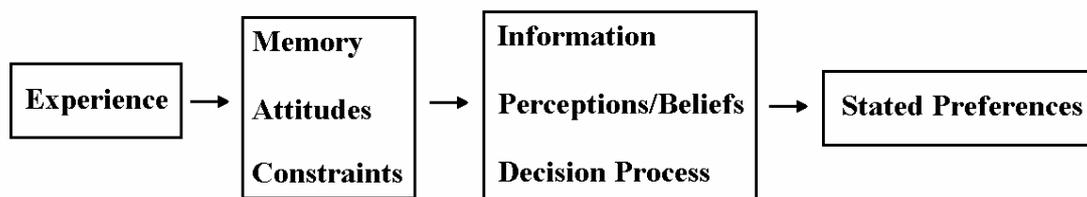


Figure 4: A representation of the individual choice process when confronted with stated preference questions. The respondents might be biased from a large set of hidden factors. The figure is adapted from Mc Fadden (2000).

## 5. Summary of results and conclusion

IT has a great potential to save resources, and has therefore a place in the discussion about sustainable development. Experience from the early days of IT shows that there is no evident correlation between the use of IT and a lower demand of natural resources. The potential of saving resources on the one hand, must be separated from the actual fall-out on the other hand.

The findings from this study lead us to conclude that IT might mitigate the resistance to adopt new competitive travel-plan alternatives and contribute as an essential part in reducing costs and emissions from personal transport within companies. The superior philosophy is to create win-win-win situations, where the individual, the organization (the company or the society for instance), and the environment all become winners. This makes micro econometrics automatically to a field of great potential in the search for tools and strategies, since it describes the individual's incentives in the choice of feasible alternatives. The results in this study further point at a general acceptance among the employees to adopt the more cost- and emission-efficient travel-plan alternatives, *if* at least some of the improvements tested are implemented in reality. From this perspective we conclude that companies have a great potential to contribute to a more sustainable transport system by developing new substitutes to present travel modes. Also we expect that more direct company policies, and information encouraging substitution towards the new travel-plan alternatives, would have a significant impact on the employees' travel behaviour.

However, the behavioural models used in this study have limitations. First, it is not a natural law that human beings behave like rational utility maximizers, and even if so, we could never expect to capture all the essential elements of the individuals' perceived utility. The models only serve as approximations of reality, and as a consequence, they have certain weaknesses. As discussed in section 4, tastes vary between individuals and some elements of the utility are not even possible to include in our models. Nevertheless, the behavioural models might still fill a certain meaning, if interpreting the results with caution. For instance, even if the models do not manage to predict the exact impact of the attributes on the choice probability between the different alternatives, they could probably tell us something about the importance as a relationship between the different attributes.

Furthermore, insight in the employees' behavioural response if confronted with new hypothetical transport alternatives is not the only element essential for a sustainable transport development in Nacka Strand. As discussed in paper 1, this aspect is only *one* of the elements in the backcasting framework, making the long-term goal feasible. Company policies, political decisions and technological developments are other examples of ingredients affecting the final outcome. However, if including all these aspects in an aggregate analysis, the results rely to a large extent on uncertain, external factors more or less impossible to predict. On the contrary, to independently derive the employees' criteria for accepting the new alternatives might even trigger the development of the external factors (e.g. creation of new, more far-reaching company policies and political initiatives). Paper 2 suggests some tangible proposals for company policies (e.g. bonus systems rewarding cost efficient behaviour) and investments (e.g. a web-based ride-matching system) worth considering in the process towards more sustainable travel alternatives. In paper 3 we show that companies might save rental expenses and get more satisfied personnel by introducing

encouraging telecommuting policies in combination with flexible offices. Our object of research (mainly employees working at Ericsson in Nacka Strand) is a quite homogenous group of respondents. Thus, the results may not be representative for Swedish companies in general. However, our all-embracing conclusion from this study is that more direct incentives and company policies, encouraging more efficient transport alternatives, would have a substantial effect on the employees travel behaviour. Consequently, companies play a vital role in the discussion of feasible paths towards a more sustainable transport system.

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