IMPACT OF THE E-ECONOMY ON TRAFFIC AND TRAFFIC-RELATED INDICATORS IN URBAN AREAS

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Abstract

As part of the POET project for the European Commission, the impacts of the e-Economy (including an increasing uptake of teleworking and teleshopping, and better use of intelligent transport systems) on transport in a number of selected urban areas in Europe were modelled. The modelling for the urban areas used existing transport models (passengers and freight) for Paris, Stockholm, Naples, Hamburg and The Randstad (The Netherlands). Secondly, it used several scenarios on the amount of ICT adoption for the year 2010. The third element in the modelling at the urban level is the use of so-called front-end models, estimated on new stated preference data. The outcomes in terms of vehicle kilometres were also used to calculate impacts of the e-Economy on energy use, emissions and traffic accidents. Also for some areas, we calculated impacts on congestion and accessibility. For some of the areas and scenarios we found considerable reductions in passenger kilometrage as a result of e-Economy developments, but freight transport increases.

1.   INTRODUCTION

1.1   Background

Several studies have looked at the potential effects on transport of components of the emerging e-Economy, especially the effect of teleworking (*1*), (*2*), (*3*). The effect of teleshopping has been studied less frequently (*4*) and so has the effect of developments in electronic communication on freight transport (though there is considerable literature on logistic trends (*5*)). Most of these existing studies focus on a specific aspect of the e-Economy (e.g. teleworking) and often on the effects within a specific (pilot) project. In this paper we present the results for the effects on transport, emissions and accessibility for several urban areas in Europe of a combination of a wide range of e-Economy developments. We are using existing (largely disaggregate) urban transport models, in combination with new stated preference models.

The POET (Prediction Of E-economy impacts on Transport) project was carried out in the period 2003-2005 for the Directorate-General for Transport and Energy (DGTREN) of the European Commission. The overarching goal of POET is to understand the potential impacts of the e-Economy on the future demand for passenger and freight transport in cities and regions. To enhance our understanding of the impacts of the e-Economy on transport, a wide variety of tasks has been performed, including a literature review, the development of system diagrams and choice profiles, scenario development, and the conduct of actual and virtual case studies. Results from these tasks have been used as input to the final phase of the POET-project, the modelling of the impact of the e-Economy on five selected cities and regions.

1.2   Research scope

The focus of the modelling in POET is on understanding the impact of changes in choice behaviour of individuals, households and businesses with regard to transport, resulting from. developments in the e-Economy (such as an increasing uptake of teleworking and teleshopping, and better use of intelligent transport systems). The modelling in POET concentrated on:

- **Five urban areas.** POET has modelled passenger transport and freight distribution in urban environments using a number of existing models developed for different cities and regions, namely Hamburg, Stockholm, Naples, Paris and the Randstad (in The Netherlands).
- **Time horizons 2004 and 2010.** The impacts of the e-Economy on transport were determined for several scenarios for 2010. Model runs were also done for 2004, to enable comparison of potential future scenarios with the current situation.
- **Selected outcomes of interest.** The impact of the e-Economy on urban transport (passenger kilometres, vehicle kilometres, etc.) was modelled, and the outcomes of these models were translated into relevant impacts: energy use, emissions, accessibility.

1.3   Structure of the paper

Section 2 gives an overview of the main characteristics of each of the five transport models employed in POET. Section 3 describes the research methodology for the urban model runs for 2004 and 2010. It describes the results of previous work packages of POET and how these are used as input for the urban model runs. Section 4 describes the outcomes of the modelling on the outcomes of interest for each of the cities and regions. It focuses on both transport outcomes and other relevant outcomes of impact such as environmental impacts and the impact on regional development. Finally, Section 5 summarises the results of the urban modelling in POET and discusses their implications for policymaking at European, national, regional and local level.

2.   DESCRIPTION OF THE URBAN TRANSPORT MODELS

2.1   The transport models used in POET

In POET, transport models have been used to simulate the impacts of the e-Economy on transport. These are models for selected urban areas:
- The Randstad (in The Netherlands): passenger transport
- Paris: passenger transport
- Stockholm: passenger transport
- Naples: passenger and freight transport
- Hamburg: Passenger and freight transport.

All of these models do not have 'buttons' that can be pressed to give the travel demand impacts of developments in the e-Economy. In order to be able to simulate e-Economy impacts the model inputs need to be modified. This was done by first applying new models, so-called 'front-end models' developed earlier in POET on the basis of the information collected in the POET virtual case studies.

2.2   Passenger transport

In Figure 1, the changes in inputs for the passenger transport models are depicted. The boxes give the existing components of the models for passenger transport. All five models have components that determine the number of tours (round trips) or trips by travel purpose, the distribution and mode choice, and routines for assigning traffic flows to the networks. Usually, the new travel times after assignment can be fed back to the travel demand components, to reach equilibrium between supply and demand.

- Insert Figure 1 here -

These model components have not been changed in the runs for POET. What was done to simulate the effects of developments in the e-Economy on transport is the following; Changes in the e-Economy that influence mainly the level-of-service of the existing transport modes (e.g. increase the level of comfort or reliability, decrease the cost of transport, make transport faster or make travel time more productive, such as mobile phones and portable computers) can be simulated by changing the level-of-service inputs or the network capacity of the different modes, without having to use the front-end models. This has been done in scenarios that will be described later.

Other developments in the e-Economy might influence the tour generation (directly, and through the distribution of the population over the zones, as changes in residential choice). This will especially be true for telecommuting, teleshopping and other teleservices. The new front-end models (see Figure 1) give the impact of some development in the e-Economy on the full daily tour pattern, in terms of percentage changes (up or down) by travel purpose. After having changed the inputs of the existing transport models in term of tours or trips, these models have been run as they are, to give mode, destination and assignment results. Other changes in transport model inputs from the front-end models are changes in average trip length. Furthermore, front-end models for changes in the location of the population as a result of the e-Economy were developed, but these were not used for producing the results presented in this paper.

2.3   Freight transport

The two available urban freight transport models (for Naples and Hamburg) include components for production, distribution, mode choice and assignment (taking into account the joint use of the networks by passenger and freight vehicles). This is all quite similar to the passenger transport models as depicted in Figure 1. Besides these submodels, freight transport model systems usually have sets of conversion factors:

- Value-to-weight ratios, to convert the production of trade flows (measured in financial terms, as is the case when based on trade or input-output statistics) to transport flows in tonnes.
- Load factors, to go from tonnes and tonne-kilometres to vehicles that can be assigned to the network.

As for passenger transport, developments in the e-Economy could change the level-of-service (e.g. transport time, cost, comfort, reliability, flexibility) provided by existing modes of freight transport or the network capacity.

For freight transport, the activity is not the driver of transport, but it is the demand for the commodity that is supplied from somewhere else. Only in some specific market segments (e.g. mail) there is the possibility of substituting the commodity by an electronic alternative. Therefore the addition of a front-end model that changes the transport production is less important for freight transport than for passenger transport. However, delivery transport would grow if teleshopping would become more popular. This was modelled from the consumer perspective, in the form of the front-end model for e-shopping (passenger transport).

Furthermore, developments in the e-Economy –certainly when coupled with logistic innovations- can cause changes to the load factors. Developments in the e-Economy could be applied in information systems that will reduce the share of empty and not-fully-loaded vehicles. Other developments in the e-Economy and logistics (further consolidation and distribution, just-in-time delivery, smaller inventories) could increase the use of small-vehicle trips in the cities. This was modelled in the front-end models for freight transport.

2.4   Indirect effects

The impacts of developments in the e-Economy on mobility pattern, activity patterns (whether certain activities will be performed at home or at a travel destination) and travel patterns come directly from the above-mentioned transport models. Evidence on (expected future) energy, noise, accidents, and emission rates from other studies was combined with the transport models to give the impacts on these negative externalities from transport. Other indirect effects were handled in a qualitative fashion.

3.   INPUTS FOR URBAN TRANSPORT MODELS: THE METHODOLOGY

3.1   The front-end models

The front-end models were run before the urban transport models and provided new inputs for e-Economy scenarios that were processed further in the transport models.

The front-end models were estimated on stated preference data from the POET virtual case studies on the potential impacts of e-Economy scenarios (*6*). In the virtual case studies, decision-makers (e.g. individuals, shippers) were provided with scenarios describing a future situation in which new ICT would be available (in urban and/or suburban areas) and were given a set of choice alternatives under each scenario. These surveys were carried out largely

via the Internet, in five countries. For the passenger case studies, three surveys were conducted focusing on:

1. Teleworking, residential location and commuting patterns;

2. Business travel and commuting;

3. E-shopping.

The surveys on teleworking and e-shopping were sent to individuals who were asked to answer questions regarding their own future. The survey on business travel was sent to human resource managers of companies who were asked to answer questions regarding the future of teleworking in their organisation. The number of successfully completed interviews is 182 for business, 321 for e-shopping and 1022 for residential choice (each interview contained several choice observations).

The freight survey was conducted by interviewing logistic managers of medium to large companies over the telephone. The interviewees were presented with different sets of potential ICT-developments for the year 2010, and were asked to assess how these developments would affect freight transport and logistics. In total, interviews were successfully completed.

The following front-end models were estimated on the data from the virtual case studies:

Passenger transport:
- The probability of relocation (not used in this paper)
- The number of teleworking days per month (which gives the impact on commuting trips and tours) for persons that relocate (not used in this paper)
- The number of commuting trips/tours for people that do not relocate
- The number of business trips/tours
- The average business trip length
- The number of shopping trips/tours.

Freight transport (for transports to retailers):
- The average load per truck
- The probability of a return load
- The load factor (load divided by capacity) for the return load
- The share of empty kilometres
- The growth in the number of delivery tours
- The number of stops on a delivery tour
- The share of cars and vans in the delivery transports.

Concerning the impact of the e-Economy on tours/trips for other purposes (e.g. when telecommuting would increase, there might be more non-commuting trips, as found in some of the literature), we did not find evidence for increases in trip-making for other purposes in the virtual case studies.

3.2   Expansion of the front-end models

The front-end models for passenger transport include some attributes of the individual respondents (such as age class) as dummy variables with a direct effect on the endogenous variable. To derive inputs for the transport models, the front-end models are applied on their estimation sample, but expanded differently for every region that we study. We use assumptions here on the values of the Stated Preference attributes, such as internet payment security and solutions to delivery problems for goods bought on the internet, to reflect our scenarios. The expansion is done by using population statistics for that region, or for every

zone within the region (if possible we use forecasts for 2010). So we have expansion factors for the Randstad and different expansion factors for Naples, etc. Expansion variables include age, gender and household car ownership for shopping, and sector of employment and area type for the business models. The expansion means that each person receives a weight to correct for the fact that the population share for this person type may differ from the share in the estimation file.

For freight we did not find any significant variables that can be used in expansion. The front-end models (for transports to retail) are only used for transports to retail (consumer products, no raw and intermediate materials and semi-finished goods). Some of the freight front-end models have dummies for North that were used in application only in the Northern countries (Sweden, Germany, The Netherlands).

After the expansion, we obtain different aggregate results (e.g. changes in tour or trip frequencies by purpose for the region as a whole or by zone in the region) for the different regions, which are used to overwrite/change the tour frequency outputs of the transport models, and then combined with the mode-destination models and assigned to the networks. The front-end model for changes in average business trip lengths was more difficult to implement in the transport models, because it implies that the travel destinations and therefore also the origin-destination (OD) patterns would change. We changed the outputs in terms of passenger kilometres after the transport model runs (post processing) to reflect the business trip length changes from the front-end models. This does not affect the assignment to the networks.

3.3   Running the transport models in combination with the front-end models

The transport models have been run for 2004 and for various scenarios for 2010. The POET base-year is 2004. The transport models provide tours/trips, passenger kilometres, tonnes, tonne-kilometres and vehicle kilometres for 2004. This is an existing run, or interpolation of existing runs. For the 2010 Stagnant City scenario (low adoption of the e-Economy), we used existing Reference Scenario runs. These give expected changes in income, population, car ownership, cost and speed by mode, etc.. For the Randstad and Naples we changed one variable (car cost and motorisation respectively) to make the five reference scenarios broadly consistent. New reference runs for 2010 were carried out for those two areas.

All other scenarios involve a faster adoption of ICT. The other variants for passenger transport are:

- High Adoption. All e-Economy levers in the front-end models are on (e.g. a dummy variable for high ICT capabilities at low prices in the model for business trips; a dummy for smooth delivery of the goods and a dummy for payment security in the shopping model; see POET Consortium, 2005a). For all individuals in the front-end models these dummies are set equal to 1. For the dummies for a journey time increase (commuting and business models), we use the journey time increase and traffic increase by area type as predicted by the transport models for the 2010, and apply the dummy coefficients proportionately. The high adoption run also contains a 5% increase in road capacity to represent the impacts of traffic information and vehicle guidance.
- Medium Adoption. We have the impression that the responsiveness to e-Economy changes from the front-end models will more likely be biased upwards than downwards (early adopters can be expected to be more likely to respond to the surveys). Therefore, we also use the same models to produce a more conservative estimate of the impacts of the e-Economy. We used the lower boundary level of

the 95% confidence interval around the e-Economy coefficients of the front-end models to define lower boundary adoption coefficients. Then we used these coefficients to run the expanded front-end models again for all levers on (but with lower impact): The upper boundary of the same coefficients could be calculated too, but this was not tested, because we did not expect that the front-end models would contain a downward bias of the impacts of the e-Economy. Road capacity is increased by 2% only in this scenario.

- <u>High Adoption Plus</u>. This scenario is the same as the high adoption one, but we now also assume that the number of education tours (for persons of 12 years and older) reduces by 10% as a results of e-learning and that car sharing results in 1% less car driver kilometres in the urban areas, for all purposes except leisure and social travel (implemented through post processing).

For <u>freight transport</u> we have the same variants (but no High Adoption Plus):
- Base year 2004;
- Reference Scenario (Stagnant City) 2010;
- High Adoption: all e-Economy levers in the front-end models are on;
- Medium Adoption: all e-Economy levers in the front-end models are on, but we use the lower boundary coefficients for these.

4.   OUTCOMES

4.1   Passenger transport demand

In Table 1 we summarise the effects on passenger kilometres from the five different models for passenger transport. More detailed results can be found in (*7*). In the column for the Randstad, we also give the results for The Netherlands as a whole (in brackets). All results in this paper are for runs in which we kept the residential choice the same as in the Reference 2010. We also carried out runs for the 2010 e-Economy scenarios with relocation of the population, using the relocation model from the virtual case studies. The outcomes of these can be quite different for some of the urban areas (e.g. Stockholm). We only present results without relocation here because we regard these as more reliable.

- Insert Table 1 here -

From this table we draw the following conclusions for the different scenarios:
<u>High Adoption scenario:</u>
  If:
- The e-Economy itself develops very positively, and
- People react to it very positively,
  Then:
- Substantial reductions in physical mobility are possible. The impacts on passenger kilometrage for Naples, the Randstad and Paris are between –7 and –9%. Especially the number of shoppings tours is reduced considerably, but commuting and business travel also go down. In Stockholm and Hamburg, the effect on passenger kilometrage will be more modest (-3%), but for this scenario we do not get increases in kilometrage for any of the study areas.
- Also (not in the table) the car share is likely to decline somewhat;

Medium Adoption scenario
>   If:
- The e-Economy itself develops very positively, and
- We take a more conservative view on people's response to it,
>   Then:
- Considerable reductions in physical mobility are still possible, but less likely. The reduction in total passenger kilometrage in Naples, the Randstad and Paris is between –6% and –7%. These reductions still compare favourably to the impacts on passenger kilometrage of most policy measures (e.g. (*8*)). In Hamburg, the reduction is passenger kilometrage is only –1%, but for also this scenario we find no increases in passenger kilometres in any of the areas studied.
- Furthermore (not in the table), the car share is likely to decline somewhat;

High Adoption Plus (not shown in Table 1)
>   The impacts for this scenario are very similar to those for high adoption and the conclusions are the same. The addition of e-learning and car-sharing did not contribute much to further reducing mobility.

4.2   Freight transport demand

The number of vehicle kilometres (only looking at lorries for transports within the study areas; other modes are not affected) increases relative to the 2010 reference, both in the High Adoption scenario (Hamburg +6%, Naples +10%) and the Medium Adoption scenario (Hamburg +3%). This is the net result of two forces working in opposite directions:
- On the one hand there are developments in the e-Economy that increase the efficiency of freight transport, especially at the operational level (more optimal planning of delivery tours, information and e-markets for return loads), leading to less vehicle kilometres for the same transport volumes;
- On the other hand there are developments in the e-Economy (smaller inventories, just-in-time management, smaller and more frequent deliveries, effective and fast consumer response systems) that decrease the efficiency of freight transport, especially at the tactical level, leading to more vehicle kilometres.

In both study areas (as well as in the literature and the interviews with industry experts) we see clear indications that the latter effect will be stronger than the former: the number of road vehicle kilometres will increase because of the e-Economy developments. This will also lead to more energy use, emissions and hours lost in queues relative to the reference 2010.

4.3   Passenger and freight transport demand combined

In the Hamburg application, the impacts on passenger transport exceed those in freight transport. The net effect for combinations of passenger and freight scenarios therefore is a small decrease in total passenger and freight vehicle kilometres. For Naples the net effect is also a small decrease in total passenger and freight vehicle kilometres. Given that the impacts for passengers in Stockholm, Paris and the Randstad are greater than or equal to the impacts on passenger kilometrage in Hamburg, we expect that for those areas the reductions in passenger car kilometres would also outweigh the increases in lorry kilometrage.

4.4   Transport-related indicators

Both for Stockholm and the Randstad we calculated impacts of the e-Economy on congestion. In this paper we present the results for the Randstad, using as congestion indicator the number of hours lost in queues (in the peak periods). Between 2004 and 2010 (reference), this measure of congestion will grow by 16%. The changes in congestion in the High Adoption scenario, Medium Adoption scenario and High Adoption Plus scenario (-12 to –22%), are substantially greater than the changes in kilometrage (around –7%).

We also calculated the impact on CO_2 emissions from traffic. In Hamburg (passenger transport) and Naples (passenger transport), Stockholm, the Randstad and Paris, in the Medium Adoption, High Adoption and High Adoption Plus scenarios, CO_2 emissions decrease relative to the reference scenario. Only in Paris (and passenger transport in Naples without relocation), CO_2 emissions decrease to below the 2004 level. CO_2 emissions related to freight transport in both Hamburg and Naples are substantially higher in all above mentioned scenarios relative to both the 2004 level and the reference scenario.

Detailed emission figures for local pollutants (CO, HC, NO_X and PM) were produced. As an example, in Table 2 we present the results for CO.

- Insert Table 2 here –

For both passenger transport and freight transport, the local emissions will be reduced between 2004 and 2010 (reference), because of improvements in vehicle technology (including filters and catalytic converters). In the case of freight transport in Hamburg and Naples, there is an increase due to the e-Economy developments relative to the reference for 2010. For passenger transport in Stockholm the e-Economy developments lead to a further reduction in the emissions of CO (and similarly for the other local pollutants). In Paris and Naples (passenger transport), there is a sizeable further reduction as a result of the e-Economy developments, and for the Randstad a further reduction also occurs, but of a smaller magnitude.

For Stockholm we have quantitative predictions on the changes in accessibility due to the e-Economy developments. Logsum measures were calculated for the Stagnant City, the High Adoption and the Medium Adoption case. The logsum gives the expected maximum utility from the choices in transport that the traveller makes (here: mode and destination choice). It can also be regarded as an overall (using information for all available modes) measure of accessibility. The logsums (in utils) were also transformed to monetary values. For High and Medium Adoption we find an increase in utility or accessibility of 0.05 euro per person for work and 0.01 for shopping and other purposes. These numbers reflect the increase in utility obtained from the changes in travel behaviour due to the ICT scenario effects. So in spite of the reduction in the number of tours for purposes such as work and shopping (for the other purposes the changes are considerably smaller), the utility from physical travel on average has increased (e.g. due to smaller disutility from shorter tour lengths, increased average car speed).

The above logsum measure does not include the increased utility from electronic communication, which will also be positive in the High and Medium Adoption scenarios. So the net benefit of those e-Economy scenarios is terms of physical plus electronic accessibility will clearly be positive.

5. SUMMARY AND CONCLUSIONS

5.1   The approach

In the modelling of the impacts of the e-Economy on transport in a number of selected urban areas in Europe, several pieces of information within POET come together. The modelling for the urban areas used existing transport models (passengers and freight) for Paris, Stockholm, Naples, Hamburg and The Randstad (The Netherlands). It also uses scenarios for the year 2010, based on the scenario work earlier in POET. The scenarios used are:

- Stagnant City (=reference 2010);
- High Adoption of the e-Economy: ICT develops very favourably, and people and firms react very positively to it;
- Medium Adoption of the e-Economy: ICT develops very favourably, but we take a more conservative view on how people and firms react to it;
- High Adoption Plus. This is the same as High Adoption, but with additional e-learning and car-sharing;

The third element in the modelling at the urban level is the use of so-called front-end models, estimated on the data from the virtual case studies of WP5 in POET. Because the existing transport models lack levers to include many of the e-Economy effects on transport, these effects are handled in new models for tour/trip frequency by purpose and efficiency in freight transport (the front-end models). These models were expanded to each of our urban study areas to take the specific socio-demographic structure of the population and employment in each study area into account. After that, the different scenarios were inserted into the front-end models and the outcomes of the front-end models were used as inputs for the transport models. The transport models produce mode and destination choice and assignment to the networks, with feedback effects of congestion on these choices. The outcomes in terms of vehicle kilometres were also used to calculate impacts of the e-Economy on energy use, emissions and traffic accidents. Also for some areas, we calculated impacts on congestion and accessibility.

5.2   The results

For the five urban areas we investigated, we found for the <u>High Adoption</u> scenario substantial reductions in passenger kilometres in Naples (-9%), the Randstad (-8%), Paris (-7%), Stockholm (-3%) and Hamburg (-3%).

In the <u>Medium Adoption</u> scenario, the reductions in the Randstad (-7%), Paris (-6%), Naples (-6%), Stockholm (-3%) and Hamburg (-1%) are the same or smaller, because the behavioural reaction of the travellers to the e-Economy is more modest. Given the nature of the data used to estimate these behavioural reactions (small samples, low response rates, probably with an overrepresentation of those interested in ICT and early adopters), this scenario seems more likely.

The <u>High Adoption Plus</u> scenario has almost the same outcomes as the High Adoption scenario. The addition of e-learning and car-sharing did only contribute marginally to further reducing mobility. Teleworking, e-business and teleshopping appear to have a bigger impact on travel demand.

For <u>freight transport</u>, we find that both in the High Adoption scenario and the Medium Adoption scenario, the number of lorry kilometres increases. This is the net result of two forces working in opposite directions:

- Developments in the e-Economy that increase the efficiency of freight transport: more optimal planning of delivery tours, information and e-markets for return loads.
- Developments in the e-Economy (smaller inventories, just-in-time management, smaller and more frequent deliveries, effective and fast consumer response systems) that decrease the efficiency of freight transport.

In both areas studied (as well as in the literature and the interviews with industry experts) we see clear indications that the latter effect will be stronger than the former: the number of road vehicle kilometres will increase by a few percent because of the e-Economy developments.

The net effect for combinations of passenger and freight scenarios is a (small) decrease in total passenger and freight vehicle kilometres: the reductions in passenger car kilometres will outweigh the increases in lorry kilometrage.

The expected reductions in vehicle kilometres lead to less energy use and emissions of greenhouse gases and local pollutants compared to the reference for 2010. Congestion decreases because of the e-Economy (Stockholm, Randstad) and in Stockholm accessibility increases slightly in spite of the decrease in the number of tours made.

5.3   Recommendations for policy making and further research

The net effect of the e-Economy on passenger and freight transport taken together in an urban area is likely to be a reduction in the number of vehicle kilometres. This is not an aim in itself. What matters for society is whether this will increase welfare. This is quite likely to happen. The reduction in passenger travel is for a large part reached by substituting electronic communication for physical communication, so for the relevant travel purposes, there is not really a reduction in activities that used to take place at other destinations than the home, but only in travel. Most of the gains from these activities will be retained (in principle there might even be an increase in the utility from those activities, now that they are carried out at home). For trips that are not substituted, the travel time decreases, as congestion is reduced. Furthermore, the external effects (energy use, emissions, accidents) from travel are reduced. And the reduction in congestion and increase in accessibility might make the region more competitive (e.g. with respect to location choice of firms).

Given the expected positive welfare gains from e-Economy changes on and through transport, policies to promote these e-Economy developments (e.g. standardisation, awareness campaigns, fiscal incentives, subsidies) would be beneficial. These policies should focus on the adoption of the e-Economy by private households, since that is the sector where reductions in kilometrage can be expected. Such policies could turn out to be more effective than more traditional transport policies (such as investments in specific public transport infrastructure projects). Slowing down the adoption of ICT by firms, as a means to avoid the likely increases in freight vehicle kilometers, is probably not a good course of action. This might harm the competitive position of European firms. If e-Economy developments should lead to more vehicle kilometers in freight transport and more emissions, these effects should be countered by transport and environmental policy measures, not by promoting a slower adoption of ICT by firms (if that were possible).

If the e-Economy would increase freight and reduces passenger traffic, then this would also have consequences for infrastructure planning, since passenger and freight transport have different Origin-Destination patterns, concentrate in different time periods, etc.

In this project, new models for residential choice and travel frequency in passenger transport and for vehicle loads and vehicle mix in freight transport were combined with existing transport models. One of the observations was that the final outcomes depend

crucially on the impact of the e-Economy on relocation. Given this outcome, we recommend to further investigate the impacts of the e-Economy on land-use, both in greater depth (a full-scale residential choice model based on a larger database) and in a broader sense (in POET we only shifted population, not employment). This can all be integrated in land use – transport models, a number of which already exist (e.g. in Sweden, The UK and The Netherlands).

Acknowledgements

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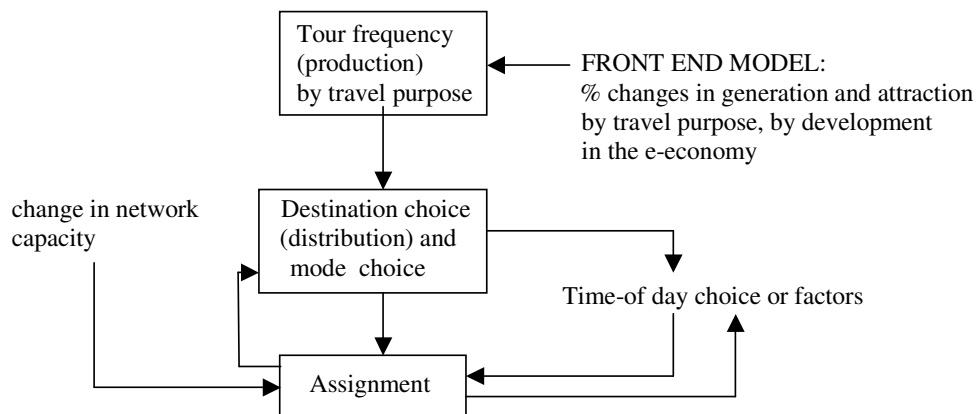
FIGURE 1 Changes in inputs in the passenger transport models

TABLE 1 Percentage change in total number of passenger kilometres (relative to 2010 reference) by study area and scenario

	Paris	Stockholm	Hamburg	Naples	Randstad (Netherlands)
High Adoption	-7%	-3%	-3%	-9%	-8% (-8%)
Medium Adoption	-6%	-3%	-1%	-6%	-7% (-5%)

TABLE 2 Emission of CO per study area (2004=100)

City	2004	Stagnant city	Medium Adoption	High Adoption
Hamburg passengers	100	67	66	65
Hamburg freight	100	79	82	84
Stockholm	100	69	68	67
Randstad	100	65	62	61
Paris	100	64	60	59
Naples passengers	100	61	57	56
Naples freight	100	72	n.a.	79

Figures:
FIGURE 2 Changes in inputs in the passenger transport models

Tables:
TABLE 1 Percentage change in total number of passenger kilometres (relative to 2010 reference) by study area and scenario
TABLE 2 Emission of CO per study area (2004=100)