

Travel substitution issues	Relevant Factors/ Evidence	Some Implications
<b>DEFINITION</b>	“ <b>Travel substitution</b> ” in this context means using <b>Information and Communication Technologies (ICT)</b> in various ways to replace the need for physical travel.	Travel substitution is an issue with wide implications beyond the workplace. The potential benefits (or otherwise) are great for society and for the environment although there is fear that the latent demand for travel will swamp any such benefits.
<b>ICT-BASED ACTIVITIES</b>	<p>The following types of ICT-based activity all have potentially a travel reducing effect:</p> <ul style="list-style-type: none"> <li>• <b>Collaborative working</b> with partners, contractors and suppliers over electronic networks – e.g. <b>teleconferencing</b>.</li> <li>• <b>Remote working</b> by employees – “<b>teleworking</b>”. This may be from other company sites, on the road (e.g. from variable locations between visits to clients or sites), or from home.</li> <li>• <b>Electronic service delivery (ESD)</b> and <b>electronic commerce (e-commerce)</b> – delivering services and products to customers electronically.</li> <li>• <b>Remote monitoring and remote diagnostics</b>.</li> </ul>	<p>The development of IST technologies is an essential prerequisite for the Information Society.</p> <p>Despite increases in ICT-based activities, traffic levels are still growing.</p> <p>The continued diffusion of ICT will undoubtedly continue the process of “dematerialisation” of the economy.</p>
Technological challenges	<p>The main <b>technological challenges</b> seem to be how far we will be able to move towards a <b>seamless high capacity information infrastructure - ubiquitously diffused</b> across the globe and <b>universally available</b> to people at an affordable cost.</p> <p>A major challenge (as well as an enormous business opportunity) is providing cheaper, faster and more secure access to the internet e.g. using <b>Cable or Broadband</b>. This has the potential to transform the internet, both in terms of what it offers and how it is used. For example a two-way high speed connection could be used for interactive applications such as online classrooms, showrooms or health clinics where teacher and student can see and hear each other through their computers. An “always on” connection could be used to monitor home security, home automation, or patient health remotely through the web.</p> <p>Multiple transmission media or technologies can be used to provide broadband access. These include cable, an enhanced digital telephone service (ISDN), satellite technology, terrestrial wireless technologies and others. Cable and ISDN are currently the most widely used. Within Europe the TEN-Telecom program<sup>1</sup> aims to facilitate the transition towards the e-society for all – facilitating the interconnection of networks, either fixed, mobile or satellite, and the interoperation of networking technologies.</p>	<p>Technological breakthroughs are needed to achieve some of the critical technologies required.</p> <p>New requirements emerging from the e-society demand high performance access and backbone infrastructures.</p> <p>Some changes are “time critical” – developments in one area will depend on the rate of change elsewhere.</p>
<b>COLLABORATIVE WORKING</b>	<b>Videoconferencing</b> connects remotely located individuals and groups together for a meeting or conference by live sound and sometimes video links, often supported by facilities for immediate exchange of documents, slides and other information. Digital lines, such as ISDN, are used to carry the large amount of	<p>Both types of conferencing can provide time and financial savings as well as environmental benefits from not having to travel. They particularly present opportunities for business.</p> <p>There are compelling economic reasons for businesses to replace as many</p>

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	<p>information contained in the video signals. <b>Audioconferencing</b> involves the same principles but uses a normal telephone line to provides speech communication only.</p> <p>Videoconferencing is increasing rapidly. The worldwide videoconferencing market was expected to reach US \$4.5 billion by the end of 1997. British managers attend an estimated 1,171 million meetings each year and a fifth spend ten or more hours every week just travelling to and from meetings. Nissan held nearly 1,500 videoconferences during 1996, many involving sites overseas.</p> <p>There are demonstrable economic benefits to companies and also wider environmental benefits. A Swedish study has calculated that videoconferencing is 100 times less harmful in terms of greenhouse gas emissions than a journey by shuttle bus and plane<sup>2</sup>.</p> <p>New conferencing technologies are emerging to make videoconferencing more attractive and easier to use, for example, cameras that track the speaker as he/she walks around the room. BT is testing conference services that allow customers to make audio-conference calls on demand, quickly and conveniently, either by using a Touch Tone telephone or via the Internet.</p>	<p>possible traditional trips to meetings by tele or video conferencing. However, videoconferencing facilities might open up new opportunities for physical travel by bringing together people from distant locations.</p>
<b>DISTANCE LEARNING</b>	<p>Distance learning is currently used across the educational spectrum – at secondary school level, by universities (nationally and internationally), and for in-company and further training. “<b>E-learning</b>” and “<b>e-training</b>” are thought to have the greatest potential in the latter field. Virtual laboratories and libraries are all possible. Many companies are increasingly making use of distance training or interactive training, with at least parts of the training taking place via the internet. Learn2.com estimates that 9 out of 10 US companies uses on-line courses to meet at least part of its training requirements. George Washington University predicts that by 2006, schools and colleges will routinely offer computerised teaching and distance lectures.</p> <p>With the move towards a more flexible workforce and decreasing job stability, people will need to retrain to up-date their skills and the concept of life-long learning will become important. The ageing population will also desire further education opportunities.</p> <p>Several TEN-Telecom projects focus on internet-based teaching and learning. The LILIENTHAL Project is developing a distance learning platform and virtual school for European pilots<sup>3</sup>. POSTDOC provides post -Graduate Training for Doctors in Europe - GPs have to be lifelong learners in order to maintain their broad range of expertise.</p>	<p>There is scope for information systems to play an increasingly important role in education.</p> <p>There is potential to reduce the volume and distance of travel, particularly by public transport in the case of students.</p> <p>There will be growing demands for post experience adult education to meet the increased skills needed by industry, as well as a healthy demand for higher education from school leavers.</p> <p>Educational establishments will draw students and pupils from a much wider catchment area, even internationally, and this may produce a pattern of infrequent long-distance trips interspersed between the virtual study sessions.</p>
<b>DISTANCE WORKING</b>	<p>“<b>Teleworking</b>” is the term most commonly used for any form of regular working (e.g. 2 days per week) which meets the twin criteria of being undertaken</p>	<p>Teleworking has the potential to eliminate or shorten trips as ICT lets people achieve the functionality of going to a place without actually going there.</p>

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<b>WORKING</b>	<p>at a distance from the conventional workplace, and being made possible by the use of ICT technologies. This may be from other company sites, on the road (e.g. from variable locations between visits to clients or sites), at a local work centre or from home.</p> <p><b>Satellite offices</b> involve a number of employees from the same company but with different tasks and functions and from different departments being brought together under one roof. Satellite offices are normally situated in or close to large residential areas. They are most common in large cities in California and on the US East Coast. Many analysts predict that this will be one of the fastest developing forms of flexible working in years to come<sup>2</sup>.</p> <p>It is not just in work location, but also in work time that there are new possibilities for flexibility. Communications networks are available round-the-clock so information can be accessed and work undertaken at any time. There are possibilities for undertaking work internationally, by taking advantage of time zone differences.</p> <p>Mobile communications can save time and journeys and benefit the growing numbers of teleworkers. BT's single number service enables an individual to provide a single number point of contact to colleagues and then use virtually any UK fixed or mobile phone to take their calls wherever they may be. Voicemail enables people to send and retrieve messages from anywhere in the country.</p>	<p>achieve the functionality of going to a place without actually going there. However the insatiable demand for transport may mean that any slack released in this way is rapidly taken up by other users or uses.</p> <p>Whilst new ICT technologies mean that we will not have to travel as much, it is obvious that we are still going to need to travel.</p> <p>One consequence of teleworking may be that traffic is more evenly distributed throughout the day as more people take advantage of flexible patterns of work, with mixed patterns of office and teleworking.</p> <p>Any measures to raise the cost of travel, such as road tolls or higher fuel prices, would serve to stimulate the substitution of telecommunications for travel.</p>
How widespread is teleworking?	<p>Telework has spread rapidly in recent years throughout Europe, although measuring its true extent is hampered by problems concerning definition and methodology. In 2000 there were almost 10 million teleworkers in Europe<sup>4</sup>. Of these around a third are regular home-based teleworkers, one third are occasional ones, one-fifth are mobile teleworkers, and the remainder are self employed. 75% of all teleworkers are male. Results from the EU TELDET<sup>5</sup> project suggest that the potential for teleworking in Europe is around 1/5<sup>th</sup> of the labour force. In Denmark 20% of employees are already covered by some form of agreement covering the arrangements for tele-working. Finland has the target of establishing a multi-media tele-centre in every community by 2002 thus providing alternative workplaces near to home whilst overcoming the isolation of homeworking.</p>	<p>Teleworking is never likely to be appropriate for all kinds of work, nor all types of people.</p> <p>Most telecommuting is ad hoc in response to employee requests for flexibility. Telecommuting is usually set up on a voluntary basis.</p> <p>Teleworking will spread slowly as part of flexible working arrangements – people still need groups for social interaction, team working and problem solving.</p>
Teleworking in UK	<p>The Spring 2000 Labour Force Survey estimates that about 1.6 million people are involved in some form of teleworking – about 6% of the working population<sup>6</sup>. 70% of these are male although female home teleworkers make up just over half of the total of home teleworkers. Around a third of all teleworkers work in the banking, finance and insurance sectors.</p>	
Teleworking in US	<p>Teleworking has become an accepted way of working in the US, with the most</p>	

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	<p>typical tele-worker operating from home no more than 2 days a week. A US nationwide survey indicates that telecommuting from home as of 1999 is at 19.6 m workers, about 10% of adults<sup>7</sup>. Some 27% of American households have members doing some work from home. Formal organised telecommuting programs are begun by organisations as a response to tight labour markets and opportunities to reduce office space requirements. 80% of telecommuting employees work for companies with fewer than 100 staff.</p>	
Does teleworking reduce the need to travel ?	<p>More contentious is whether teleworking can also achieve significant reductions in traffic. Teleworking clearly has a <b>direct</b> traffic substitution effect – if a worker is not travelling to work, or not travelling so far, then it is clear and measurable that fewer miles are being travelled for work purposes. However it is not clear whether new traffic might be generated to fill the space in trips removed from congested areas, or generated elsewhere.</p> <p>BT has created a computer programme to compare telecommunications as an alternative to travel<sup>8</sup>. An individual inputs information into the programme on the business trips they make every month and the percentage of travel by car, train or aircraft that these involve. The programme then shows telecommunications options as alternatives, such as different types of videoconferencing or audioconferencing. It also indicates the cumulative energy and financial savings.</p>	<p>The jury is still out on the global effects of ICT on travel behaviour. Teleworking has not formed an explicit part of the policy strategy to reduce traffic and improve the environment.</p>
Transport benefits of teleworking	<p>The <b>potential impact of teleworking is unclear</b><sup>9</sup>. Optimistic views expect that teleworkers will ease traffic congestion mainly by saving fuel. Alternatively, the widespread application of Information and Communication Technologies, (ICT) may <b>generate</b> new types of transportation as well as reduce the need for physical transport. ICT facilities provide increasing opportunities to make contacts beyond geographical boundaries which may gradually result in face-to-face meetings.</p> <p>Some research suggests that there are significant net savings to be made in terms of hours and miles travelled, plus reductions in vehicle emissions by those who are able to work from home or closer to home at a telecentre.</p> <p>Teleworking tends to appeal more to people who live further away from their workplace. An evaluation of the traffic effects of Surrey CC Epsom telecentre concludes that the average length of car journeys fell by 19% , the average journey duration fell by 36% and based on current telecentre usage there is a travel distance saving of 30K veh-miles per year<sup>10</sup>.</p>	<p>Teleworking is only one possible policy initiative – on its own transport substitution through the use of ICT will deliver only modest traffic reductions – work-related trips are only half of all trips by car, only about 30-40% of work can effectively be done on a flexible location basis. It is possible/probable that other trips will be generated.</p> <p>Workers with difficult journeys (either because of length, complexity or congestion) are the most willing to take up flexible working.</p> <p>It is also attractive as an option for workers with family commitments, single parents, and carers etc.</p>
Forecasts of travel reduction	<p>There are some <b>big claims</b> about possible trip reductions – an RAC Study<sup>11</sup> concludes that by 2010 teleworking will cut commuter traffic by 15%, videoconferencing will cut business travel by 5%, use of IT will cut lorry</p>	<p>Reductions in travel, especially long trips, will lead to reduced congestion and pollution.</p>

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	<p>journeys by 18%, and new communications will cut shopping journeys by a tenth. More cautious views suggest that the long term potential is for some 5-12% of total car use to be substituted by telecommuting<sup>12</sup>.</p> <p>A study in Dublin adopting a “current practice” approach rather than trying to incorporate changes in technology and work behaviour, finds only a 1.5% potential for 2016<sup>13</sup>.</p> <p>A study for DETR in 1997, using Cambridgeshire CC as a test site, tried to identify the types of work which, in a large organisation, could most effectively be carried out on a “location independent” basis and then quantified the resulting traffic effects. All forms of ICT enabled work were considered and the study concluded that if employers in the Cambridge area adopted the various forms of teleworking for suitable tasks, the traffic effects would be a 4-8% reduction in traffic across the day, with greater reductions during peak hours.</p> <p>Sociological studies suggest that those who predict that tele-methods will have a major impact may have seriously under-estimated the importance of inter-personal contacts, group working and the informal networks that develop around a workplace or an educational establishment. This human need for inter-personal contact will lessen the take-up of telework, distance learning and the like<sup>14</sup>.</p>	<p>ICT opens up more opportunities for businesses in rural areas.</p> <p>Despite these forecasts, the net result of human activity in the emerging information age has been a growing level of travel.</p>
<b>LATENT DEMAND</b>	<p>There is a fear that the benefits of travel substitution, however real to the individual or company, will not add up to any substantial environmental benefit at the end of the day. The key issues are:</p> <ul style="list-style-type: none"> <li>• To what extent will latent demand be realised by other road users taking advantage of “liberated” roadspace?</li> <li>• To what extent will other trips be made by the home/telecentre worker during the course of the day that would otherwise not have been, or by other family members using the family car?</li> <li>• How proportionately will transport substitution affect different traffic modes?</li> <li>• Will ICTs in the longer term affect location decisions so that people will tend to live further from their places of work, and therefore make fewer but longer trips?</li> <li>• Will new, more intensive patterns of mobile services and home delivery substitute for people travelling to their workplace or going out to buy services?</li> </ul>	<p>Many of the issues surrounding latent demand are not resolved.</p> <p>Any traffic reduction due to telecommuting is likely to be swamped by travel growth. Despite opportunities to use telecoms to reduce travel, people on average drive more every year.</p> <p>There is some evidence that public transport trips are more likely to be substituted than trips formerly made by car. This has implications for public transit authorities.</p>

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	<p>Some argue that people often combine work trips with other trips and that leisure travel will be extended. This argument is in line with the long-term observation that the <b>daily travel time budget has remained constant</b> over past decades – despite substantial technological transformations. A critical view is that other travellers may take the space vacated by teleworkers e.g. family members who usually take the bus may start to use the car instead.</p> <p>A study in San Diego found no overall change in modal split before and after introduction of teleworking. On the other hand, a study in the Netherlands found that teleworking nearly always replaced trips by bicycle and public transport. It did not replace car travel and resulted in a mode shift towards the car<sup>15</sup>. The Dublin study also found a significant shift away from public transport, notably suburban train. A possible explanation is that trips by public transport are usually less convenient, and therefore most likely to be substituted if the teleworker liberates a car for other purposes.</p> <p>Latent demand within rush-hour periods might be considered as “triple convergence”. Any freed up road space produced from marginal reductions in commuting (or new capacity) is consumed quickly by 3 sources of ever present demand: (i) those travelling just outside the peak who would shift back in; (ii) those driving on less optimal routes who would take advantage of lowered congestion on the most popular roads; and (iii) those on slower public transport modes, who would prefer to drive if there was more space on the roads.</p>	
Trip stimulation and modification	<p>Telecommunications can simply and directly cause new trips to happen by conveying messages to potential travellers about necessary or desirable trip destinations – witness the plethora of travel web sites. Alexander Graham Bell’s first words over his newly invented telephone in 1876 were “Watson, come here I need you”!</p> <p>Or telecommunications can change the length of trips, making them longer or shorter. For example, an on-line information system could tell users the nearest place to buy a needed item, thus minimising the distance travelled. Alternatively, telecommunications support urban sprawl with its longer trip patterns, since people can use telecommunications to operate instead of commuting daily to a distant central office. Advanced Traveller information systems giving real-time information about modes and routes will also encourage users to modify their trips – e.g travel on a different route/ at a different time/ on another mode and/or attempt journeys that would otherwise be too difficult to navigate.</p>	<p>More research is required to understand how ICT both generates and reduces travel at the same time.</p> <p>ICT usage supports and spurs economic growth and consumption, and thus is likely to increase the demand for transportation, which has historically risen in tandem with increasing GDP.</p>
<b>E-COMMERCE</b>	<p>The growth of e-commerce is a fundamental challenge to traditional retailing and distribution. The success of the e-commerce revolution depends critically on the issue of <b>fulfilment</b> – the ability of suppliers to deliver successfully the</p>	<p>More research is required on how telecommunications changes the transport patterns of evolving economies, including service delivery and goods movement.</p>

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	<p>goods and services they have purchased. From the consumer's perspective, the critical issues are <b>timeliness, cost and convenience</b> of the delivery and the <b>quality</b> of the products when they arrive. Despite the recent demise of the dot.coms, e-business is seen in terms of a transformation of business models through the supply chain in every business sector<sup>16</sup>. It seems likely that e-commerce will continue to spread at an ever accelerating pace<sup>17</sup> – telecom deregulation and technology improvements will drive costs down and increase accessibility.</p>	<p>There is considerable uncertainty about the future of e-commerce and the impact this will have on logistics.</p> <p>IST technologies will be essential amongst businesses to maintain global competitiveness.</p>
UK online users	<p>Around 30% of UK adults now claim to have <b>internet access</b> at home<sup>18</sup>, although not all are e-consumers. The main areas of current dissatisfaction concern poor customer service, worries about internet security and confidentiality. The growth of home shopping via the Internet, third generation mobile phones and interactive digital TV (iDTV) will reduce the need for large-scale distribution, as fewer goods need to be moved to retail outlets and are distributed instead from main depots<sup>19</sup>.</p>	<p>Digital divide - increased competition and the use of new technologies could increase social exclusion, due to lack of access to the appropriate technology and the skills to use it. The most pressing issue for many businesses is the lack of technical skills and Internet culture.</p>
@ Your service – grocery market	<p>Grocery retailers expect that e-commerce will take between 2.5 and 10% of total UK grocery sales by 2005, and up to 15% by 2010<sup>20</sup>. However current explicit delivery charges do not cover the actual costs. One estimate is that picking costs alone are roughly £13 per order, against a typical delivery charge of £5. The shortfall must be made up by profit gained from the purchased goods. High service levels are an essential element for satisfying the demand of e-commerce customers.</p> <p>Two logistics models for grocery e-commerce are in current use in the UK. One involves picking goods from within existing stores and the other uses picking centres (e-fulfilment centres) specifically designed for and dedicated to e-commerce orders. New technologies will help to develop cost-effective and sustainable e-tail logistics models – e.g. vehicle design, communications technologies, automated picking technology, unattended goods reception devices, materials development and design and utilisation of buildings.</p> <p>The use of <b>collective delivery points</b> (CDPs) could offer a promising option to increase delivery density. Examples of possible CDP locations include workplaces, local stores or petrol stations, park and ride sites, out-of-town shopping centres, local urban delivery centres, leisure facilities, schools and railway stations etc.</p> <p>Retailers are already prepared to carry goods for their competitors as part of the upstream logistics chain. A willingness to share the use of a common delivery fleet would allow similar consolidation of home deliveries and would reduce congestion and other environmental impacts.</p>	<p>A critical factor is the extent to which home deliveries can replace personal travel to the shops. If instead consumers make other trips, home deliveries will supplement rather than replace personal travel, resulting in a net increase in traffic levels.</p> <p>Little is currently known about the level of delivery and freight traffic from existing shopping centres.</p> <p>Grocery retailers have moved into e-commerce because they believe it will form a substantial part of the future market.</p> <p>There may be scope for consolidating e-commerce deliveries. Otherwise, extra veh-kms may result.</p> <p>The potential for collaboration between non-competing manufacturers to offer a complementary selection of goods through a single site could revolutionise the logistics function.</p> <p>Internet shopping offers the opportunity to purchase from a global marketplace. This could result in transport over longer distances.</p> <p>With any form of home delivery there is a risk that the supply chain is left incomplete if the customer is not available to receive the goods.</p> <p>Collective Delivery points could help revitalise local communities, particularly in rural areas.</p>

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Electronic service delivery	<p>E-commerce is a recent phenomenon. Research both in Sweden and elsewhere shows that the purchase of household goods and perishables over the internet has particularly high potential for reducing energy consumption and emissions. "Shopping bots" also have considerable potential for reducing journeys by households in search of the "right" product in terms of price and quality. In principle all of the large search engines have their own shopping agent. However a book or CD bought over the internet in the UK from an American-shop may have to be sent by air, representing a probable increase in burden on the environment relative to a conventional purchase!</p> <p><b>E-banking</b> leads to reduced transport to and from bank branches, although issues of security and confidentiality will need to be overcome before uptake is widespread.</p>	More research is necessary on the connection between on-line trading as a whole and its wider economic and environmental effects.
TELEMEDICINE	<p><b>Telemedicine</b> makes it possible to replace travel with consultations and diagnoses over the internet. Its purpose is to link points of care and to develop supporting services. This involves teleconsultation and telediagnosis, including diagnosis and supervision of patients and citizens with special needs at home or in small, remote and isolated communities.</p> <p>MEDICATE is a TEN-Telecom project for monitoring asthma patients in their own homes<sup>21</sup>. Asthma sufferers will use a portable monitoring device to record their breathing patterns and send the data via a modem and their normal telephone line to a central disease Management System. The data is processed and results sent to the patient's consultant using a secure internet connection. The project eliminates the need for patients to travel and reduces discomfort of waiting both for appointment and when in hospital. The facility to monitor the patient's progress at home means that a greater frequency and adjustment of care can be applied.</p> <p>Ultimately we may all be equipped with PDHAs -Personal Digital Health Assistants - multimedia devices that know our medical history and can produce all sorts of different diagnoses and advice based on reports of our symptoms and complaints gathered by micro-minaturised real-time health assessment monitors implanted in each of us.</p>	Developments in telemedicine might reduce the need for physical travel for healthcare.

**Other relevant Factsheets**

Social, Housing, Community, Health, Education concerns.

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