Virtual Mobility and Pollution Prevention

The Emerging Role of ICT Based Communication in Organisations and its Impact on Travel

Doctoral Dissertation
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The watercolour on the front cover was painted by Maria Attström in 1999, illustrating the emerging digitalisation in interactions between organic entities.

The painting was originally created and used for the front cover of my Licentiate dissertation. As this doctoral dissertation is a further development of my licentiate work, I have chosen to use this artwork also here.
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Executive summary

Background and Rationale for the Research

The emerging Information and Communication Technology (ICT) provides us with the possibility to access information and services, and to communicate with persons who are spatially remote. With the help of telephones, videoconferences, and computers, it is possible to have a business meeting without having to travel to a specific place; to work outside the office; or to get consultation from a doctor without having to go to hospital. Consequently, the technology has the potential to substitute some of the travel that is presently associated with those activities. This substitution of travel through ICT based communication has been termed Virtual Mobility.

For long, this potential has attracted attention and raised expectations of travel savings. Travel has high societal costs, including environmental impact. The emission of CO₂ and other greenhouse gases from the transport sector is far from what is considered a sustainable level. Therefore, if virtual mobility could lead to a reduction of emissions from travel, this would be well received. However, the total travel volume has continued to grow and the impact of virtual mobility has not been able to reverse this trend. Travel is also projected to continue growing in the foreseeable future. Moreover, there are reasons to believe that ICT stimulates more travel, as it facilitates more contacts in a given time over larger distance, and that these contacts generate the need or willingness to meet face-to-face. This may lead us to conclude that ICT and virtual mobility cannot assist in reducing travel volumes, and should thus be dismissed as a means to reduce costs and impacts of travel. However, the magnitude of the problem calls for that the assumption is worth challenging.

Focus on organisations and applications

In this dissertation the attention is directed towards the effects of virtual mobility on individual organisations, such as companies, municipalities, agencies, universities, NGOs, and other employers. Travel, in many organisations, is not only associated with large expenses, but it also constitutes a major source of environmental impact. Combined with increasing travel costs, and the fact that these organisations are required to take on a larger responsibility for the environmental impact related to their
activities, including transport, the virtual mobility alternatives become more interesting.

This dissertation addresses specific applications of ICT, not the technology as a whole. Two virtual mobility applications have been studied: virtual meetings – the use of audioconferencing, videoconferencing and web-meetings to communicate and collaborate in business; and telework – the use of a computer and a network to work from home or at another location outside the normal office. Moreover, telemedicine has been approached as an indication of the degree to which findings of virtual meetings and telework can be generalised.

The type of travelling that these applications have the potential to reduce represents nearly one third of all travel in Sweden: commuting (21% of all travel in passenger kilometres), business travel (10%), and health care related travel (1%).

Research Design
This dissertation attempts to answer four research questions:

1. Can virtual mobility applications lead to travel substitution in an organisation?

2. Can promoting virtual mobility applications be justifiable from a pollution prevention perspective?

3. What are the main drivers and barriers for an organisation to obtain environmental gains by using virtual mobility applications?

4. In what ways can an organisation influence the environmental outcome of a virtual mobility application?

The questions were approached by studying a number of different organisations, including companies, municipalities, and NGOs, using surveys, interviews, and workshops. In total, studies of six organisations using virtual meetings, and four telework studies were conducted. An action research approach was used, supported by theories from a number of disciplines, including economics, management, environmental science, environmental management, and communication.
In order to estimate the overall environmental and economic impact of two of the applications: telework and virtual meetings, a calculation model was developed. The model includes four focus areas, namely transportation, office space, equipment and communication. In addition, the impacts from the reduced use of hotels were included for virtual meetings and the increased use of home space for telework. The model was applied to a fictitious company for which two scenarios were constructed. The emission of CO₂ was used as environmental indicator.

In addition to estimating the actual and potential environmental and economic impacts, some social aspects were addressed.

Research Questions, Findings and Conclusions

The main findings of this study are structured as answers to these four research questions.

1. Can virtual mobility applications lead to travel substitution in an organisation?

The dominant effect of videoconferencing on business travel was substitution. In the two largest surveys, on average 64% of videoconferencing users experienced that the application substituted either their own business travel (45%) or travel for someone else (19%), while 33% of respondents experienced little or no change, and on average 3% found that videoconferencing had generated more business travel. Two smaller surveys had similar results. At for instance Tetra Pak, the company’s use of videoconferencing resulted in an estimated 10% reduction of total travel costs in 1998.

Audioconferencing combined with NetMeeting at Telia Nära was found to replace specific types of regular meetings in the line organisation. Since 1997, the Telia group has experienced a three-fold increase in the use of audioconferencing, in parallel with a substantial decrease in air travel. Other studies in the area also support the findings that organisations using virtual meetings experience a substitution of business travel.

A telework survey at Telia showed that 45% of the teleworkers reduced their overall travel, 3% experienced no difference and 10% had an increase in travel. In a smaller study at Scandinavian Network for Telework (SNTW), 42% experienced a travel reduction due to their telework.
Consequently, the studies indicate that people who telework and participate in virtual meetings, foremost experience a substitution effect that exceeds the generation effect on their commuting and business travel. Indications of travel reduction on an organisational level were found as well. These travel savings appear on an application level, i.e. savings that can be directly associated to the organisation’s activities.

2. Can promoting virtual mobility applications be justifiable from a pollution prevention perspective?

Transport comes at a high cost, including its environmental impact. Climate change and the emission of CO₂ from combustion of fossil fuels is one of the major environmental concerns of today. Transport is accountable for 35-40% of the CO₂ emissions in Sweden, and as travel makes up nearly two-thirds of these emissions, and business travel and commuting about one third of all travel, 7-8% of all CO₂ emissions can be associated to these travel purposes. However, most Swedish companies do not take any action to address environmental impact from commuting or business travel.

Virtual meetings and telework do not only have travel implications that are environmentally relevant, but the applications change the need for ICT and other equipment, network communication, and space. By making approximate estimations the CO₂ emissions in different scenarios: a) the relative importance of these impact categories could be weigh against each other, and b) also the outcome of different scenarios could be compared.

The results from these case studies illustrate that for telework, the total CO₂ emissions are largely dependent on the effects of commuting, but also significantly influenced by the need for extra ICT equipment, and changes in area required in the home and at the office. Depending on the telework arrangements, telework can lead to a reduction or an increase of CO₂.

Applying the approach for virtual meetings, we find that even a very limited substitution of business travel (once per month in the scenario ‘business-as-usual’) leads to an overall reduction of CO₂ for an organisation. In comparison to the impact from travel, video- and audioconferencing equipment and virtual meeting premises have a limited impact.

In conclusion, the significant environmental impact of work related travel, and the possibility that the studied applications offer a prevention of this impact at source by substituting travel, makes it relevant to consider the
applications from a pollution prevention perspective. Moreover, it seems reasonable to promote the applications as means for reducing the environmental impact from travel. However, it has to be recognised that the overall environmental impact largely depends on the way the technology is used, set up and applied. Consequently, pollution prevention efforts cannot be limited to promoting the applications, but must also influence the way they are set up.

3. **What are the main drivers and barriers for an organisation to obtain environmental gains by using virtual mobility applications?**

Enhancing environmental gains from the use of virtual meetings means foremost to substitute more business travel with virtual communication. In general, the use of virtual meetings are cost effective for the organisation as compared to its travel alternative. Although the initial investments in equipment may seem high, the possible savings in travel expenses, including substantial timesavings, can result in a very short payback time. Thus, this constitutes a driver for virtual meetings from an organisational perspective. However, the individual user has hardly any economic incentive to use the virtual meetings alternative. Rather the opposite is true as travelling is often compensated with a travel allowance, which commonly exceeds the standard cost of the trip.

Included in the many social effects of virtual meetings, we find that time plays an important role. On the one hand, these meetings offer large timesavings, and less time away from family and friends. However, a ‘time-rebound’ effect emerges as more meetings are scheduled. Complaints have been raised that people do not have time for reflection between all the meetings. Additionally, users of virtual meetings often express a concern that they miss the small-talk common in physical meetings. In audioconferencing, non-verbal cues are lost, which reduces social presence and can give a feeling of isolation.

Factors that influence virtual meetings can be divided into situational factors (type of meeting, issues to be discussed, persons involved etc.) and contextual factors (organisation, technical infrastructure, training, policies, etc.). In terms of situational factors, it is important to identify the situations when it is cost effective to use virtual meetings. Moreover, if a virtual meeting is chosen, selecting the most suitable technology is critical. Among the contextual barriers we find four categories: organisational, personal,
practical and institutional. Organisational barriers towards an increased use of virtual meetings are embedded in the corporate culture. In addition, virtual alternatives are seldom considered in well-established routines and organisational functions (e.g. travel policy).

Personal barriers for virtual meetings are strongly associated to a reversed incentive – the attractiveness of travel. Most people like to travel, and business travel is surrounded by an aura of success and prestige. Travel allowances, frequent flyer programmes, tax-free shopping, and the possibility to combine the trip with a holiday, further enhance the business trip’s magnetism. A critical detail is that the persons who travel the most are often also the most influential in the organisation. As a virtual meeting is a new way of interacting, it takes time for the innovations to diffuse into the mainstream way of working. Fear of approaching new technology (and the risk of making a fool of oneself), lack of interest, knowledge, training, and skills are barriers that cannot be ignored.

Among the many practical barriers that can be mentioned, availability is a crucial point in two respects; the extent to which virtual meeting equipment is available at the organisation, and availability of equipment at other organisations. When these conditions are in place, other barriers commonly include poor reliability (particularly videoconferencing) and an insufficient support environment (assisting technology, booking systems, rooms and furniture, support functions, etc.).

From an institutional perspective, the present policies that could control and limit the business travel, are mainly relying on market-based incentives. In the case of business travel, this disincentive is less effective, as the individual traveller is not paying the ticket her/himself. Consequently, a transport policy solely relying on increasing costs as means to steer business travel to a sustainable level, may not be sufficient in reaching targets set.

Telework has repeatedly been reported to yield large economic savings both for the employer and for the employee. Moreover, the fact that a growing number of people voluntary decide to telework indicates that it is also considered socially acceptable or preferable. These conditions promote telework in general, but not necessarily a transport substitution. The fact that less than half of all telework actually leads to travel savings, due to the fact that work is allocated to parts of days, evenings and weekends, raises the question if the work form could be designed in a way that a larger percentage of teleworkers would experience a travel saving effect. A number
of factors have been identified that act as barriers to more telework taking place during whole days. These factors can be divided into organisational, personal, institutional and practical.

An important factor is that the commuting of employees is presently not regarded as being within the realm of the organisations’ responsibility. Therefore, the organisation has no direct economic or environmental incentive to facilitate the teleworking actually leading to a travel substitution. This can be of vital importance as the employer is highly influential in creating conditions that can promote whole telework days. Conditions that may act as barriers against telework during whole days include a lack of policies and written agreements regulating telework, lack of acceptance from managers, no consideration for teleworkers when scheduling meetings at the office, poor/insufficient equipment and network connection, and limited availability of information electronically.

Consequently, the employee often considers it as a privilege to telework. There is a tendency that s/he also works evenings and weekends, particularly if the work environment makes it difficult for the person to work whole days remotely. In this way, the employer (in the short run) ‘gets more work out of the employee’, while the benefits for the teleworker are less, due to the risk for over-work and problems of making a distinction between work and free time.

We find that economic factors play an important role as drivers for the applications. However, lack of economic incentives for the organisation to reduce commute travel, and a lack of economic incentives for the employee to reduce business travel, can constitute barriers for virtualisation of mobility. Lack of supporting policies and norms promoting the non-travel alternatives can also be seen as a barrier. The utility and attractiveness of travelling itself must not be disregarded in the overall equation of how virtual mobility may succeed in replacing certain travel activities. The fear of losing social contact makes people instinctively recoil from the virtual options.

4. **In what ways can an organisation influence the environmental outcome of a virtual mobility application?**

A prerequisite for *virtual meetings* is to provide the technical infrastructure, but the realisation of a functional and a well-used virtual communication system relies heavily on non-technical issues as well. In order to obtain a
system that better supports and utilises the advantages of virtual meetings, the organisation will have to fundamentally rethink in terms of access and meetings, and to adopt a system that supports both physical and virtual forms of meetings.

Tackling these problems may involve expanding the scope of these functions to also involve the virtual alternatives, i.e. as a meeting policy, allocation of money for meetings in projects, a meetings manager, and a meetings agency (with emphasis on communication instead of meetings). It is important that the incentive structure is designed so that it stimulates actors in the system to find the most suitable form of meeting from a cost-effectiveness perspective, including social and environmental concerns. Investing in good and appropriate technology is the foundation of success, but the too-often neglected auxiliary services must not be forgotten. Moreover, suppliers of solution for virtual meetings have much to learn from the travel and hospitality industry.

The different forms of virtual meetings offer a varying degree of social presence. However, this is depending not only on the technology but also, to a large extent on how experienced and skilled users are in managing the communication tools. Remedies may include testing of available technologies for all employees, training of new employees, routines and planning for regular meetings, and training in meeting management particularly for managers and project leaders.

As for virtual meetings, the two basic criteria determining the usefulness of telework as a means to tackle emissions from, in this case, work commute trips, is a) the number of teleworking occasions, and b) the design of the telework. Realising the potential for telework in practical terms means making it possible for those who can and are willing to telework to do so, and designing the telework setting in a way that telework during full days are made possible and stimulated.

Extending the environmental responsibility of the organisations to incorporate commuting of its employees, would create incentives to reduce this impact for the stakeholder who is central in making this possible. Arrangements that give the employer economic incentives to take on this responsibility would naturally further enhance this effect.

Critical issues in this respect are to adapt the organisational policies and routines in a way that supports telework, for instance: scheduling of
meetings, information handling, work planning and agreements for telework. Providing good equipment and office furniture, fast and secure access to the server of the central workplace are other success factors. Moreover, as telework represents a different type of work and also affects the private sphere considerably, some consulting in how to set up and manage the telework situation may be a well-spent resource.

The strong role of the organisations is key to its success. However, the willingness of the organisation to engage in reducing travel impacts can be influenced by policy measures, and the willingness of individual to travel can be influenced both by the organisation and by public policy. Consequently, the effect of virtual mobility relies on a combination of efforts from individuals, organisations and policymakers. The formation and distribution of incentives to organisations and individuals are essential.

To conclude, the organisation must recognise that virtual mobility can play a role in substituting travel, but also that the environmental outcome depends on a number of factors. Providing sufficient technology is a prerequisite, but most of the success factors involve issues beyond provision of technology. As this dissertation shows, realising the potential of virtual mobility is not a matter of one ‘quick fix’, but rather a combination of more far-reaching changes on several different levels. Some of this adaptation is likely to spontaneously happen, but it may take a long time if the challenges are unknown and every organisation has to find out how to handle them ‘the hard way’. To speed up the process in a desirable direction, is to see to that the right incentives are directed to the parties that can affect the situation.

Telemedicine was discussed in parallel with virtual meetings and telework in terms of travel and environmental impact. Judging from secondary data sources, telemedicine appears to follow the pattern of both virtual meetings and telework, with substantial savings possible in terms of travel and environmental gains for the organisation.

It may be speculated that the missing incentive for hospitals to lessen patients’ travel, may act as a barrier to limit potential travel savings. The organisation, in this case a hospital, plays a key role in shaping the effect and impact that the application will have, including transport reduction and environmental effects. Also here, it is likely non-technical issues are equally or even more important than the equipment itself. As for the two other applications, the social aspect of telemedicine is important for its extent and
design. The most important benefit of introducing telemedicine is undoubtedly the possibility to provide more people with a better quality healthcare. Nevertheless, there are indications that telemedicine could also have an important virtual mobility role. As telemedicine offers possibilities to provide diagnosis at a distance (e.g. via medical information teleservice), the large number of people entering the medical system in vain, could be reduced.

Consequently, a number of parallels can be drawn to the findings from virtual meetings and telework. The experiences from these areas can enhance the understanding of how to succeed with obtaining positive effects of telemedicine.
There is nothing more difficult to plan, more doubtful of success, nor more
dangerous to manage than the creation of a new system.

For the initiator has the enmity of all who would profit by the preservation of
the old institutions, and merely lukewarm defenders in those who should gain
by the new ones

Machiavelli
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<th>Description</th>
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<tbody>
<tr>
<td>ADSL</td>
<td>Asynchronous Digital Subscriber Line</td>
</tr>
<tr>
<td>B2B</td>
<td>Business to business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business to consumer</td>
</tr>
<tr>
<td>BSC</td>
<td>Balanced scorecard</td>
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<tr>
<td>CO</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>CP</td>
<td>Cleaner production</td>
</tr>
<tr>
<td>DoE</td>
<td>US Department of Energy</td>
</tr>
<tr>
<td>EEE</td>
<td>Electrical and electronic equipment</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental impact assessment</td>
</tr>
<tr>
<td>EMAS</td>
<td>Eco-Management and Auditing Scheme</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental management system</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>EPR</td>
<td>Extender Producer Responsibility</td>
</tr>
<tr>
<td>ETD</td>
<td>European Telework Development</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUR</td>
<td>European common currency Euro</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
</tr>
<tr>
<td>HC</td>
<td>Hydrocarbon</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and communication technology</td>
</tr>
<tr>
<td>IIIEE</td>
<td>International Institute for Industrial Environmental Economics</td>
</tr>
<tr>
<td>IP</td>
<td>Internet protocols</td>
</tr>
<tr>
<td>LAN</td>
<td>Local area network</td>
</tr>
<tr>
<td>LCA</td>
<td>Life cycle assessment</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>MIPS</td>
<td>Material input per service</td>
</tr>
<tr>
<td>NEPI</td>
<td>National Environmental Policy Institute</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organisation</td>
</tr>
<tr>
<td>NO\textsubscript{x}</td>
<td>Nitrogen oxides</td>
</tr>
<tr>
<td>pkm</td>
<td>Passenger km</td>
</tr>
<tr>
<td>PM</td>
<td>Particulate matter</td>
</tr>
<tr>
<td>POTS</td>
<td>Plain Old Telephone System (Normal telephony)</td>
</tr>
<tr>
<td>SBTA</td>
<td>Swedish Business Travel Association</td>
</tr>
<tr>
<td>SEK</td>
<td>Swedish currency Kronor</td>
</tr>
<tr>
<td>SNTW</td>
<td>Scandinavian Network for Telework</td>
</tr>
<tr>
<td>TWO</td>
<td>Telework Online</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile organic compound</td>
</tr>
<tr>
<td>WAN</td>
<td>Wide area network</td>
</tr>
<tr>
<td>WBCSD</td>
<td>World Business Council for Sustainable Development</td>
</tr>
<tr>
<td>UMTS</td>
<td>Universal Mobile Telecommunications System</td>
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1 Introduction

1.1 Background

When the punk rock group The Clash entitled one of their songs ‘Should I stay or should I go’ (CLASH 1979), they were probably unaware that they had nicely framed a decision that was always important, but is even more relevant today. The possibility to communicate with a physically remote person or group without actually having to go and visit in person (or vice versa) has made this choice a reality. Since much of our private and professional communication involves people outside our immediate physical reach, we are constantly making decisions (consciously or unconsciously) whether to physically go and visit a person, or to utilise the virtual options available, for example by telephone or computer.

The word virtual originates from the Latin virtus meaning strength or virtue. Today, the word is an attribute for ‘being such in essence or effect though not formally recognized or admitted’.1 This dissertation will introduce a set of terms using virtual as a prefix. First of all, ICT mediated communication is referred to as Virtual Communication. If this communication facilitates a substitution of physical travel, it is termed Virtual Mobility. Furthermore, when virtual communication is used to facilitate business meetings, the term Virtual Meeting is used.2

The potential of virtual communication as a substitute for travel was recognised early. Not long after Alexander Graham Bell invented the telephone in 1876, a letter to the editor of The Times published May 10, 1876 wrote:

1 Encyclopaedia Britannica Online.

2 The ICT applications that are included in the concept of virtual meetings are audioconferencing and videoconferencing, which both are associated to teleconferencing, and computer based web-collaboration software tools called web-meetings. These terms will be defined in Section 1.2 and further discussed in Chapter 2.
1879, pointed out that the obvious benefit of Mr. Bell’s invention was that it could ‘replace the rapid journeying which wearied the businessman of today’ (Albertson 1980). Since then, technology has evolved and innovations have continually emerged. What we today term Information and Communication Technology, or ICT, provides us with an array of possibilities to communicate with others who are spatially remote. Modern telecommunication technology has made it possible to meet through audioconferencing or videoconferencing. Via computers and the Internet we can collaborate by sending text, picture and voice messages, and work jointly on the same documents. This expansion and strengthening of the virtual communications toolbox has been accompanied and driven by the growing demand for more numerous and remote contacts in the globalised economy. Today, virtual meetings have become reality and increasingly a normal part of business communication.

Other applications of ICT could facilitate virtual mobility. Telework is one example, where technology makes it possible to replace commuting back and forth to the office. A common term for telework in the US is telecommuting, which clearly emphasises this substitution possibility. Finally, a third application will be mentioned: telemedicine is an overarching term that includes numerous applications of virtual communication in modern healthcare. This field includes functions such as remote surgery and expert advice, remote monitoring and medication for patients in their homes, digitalisation of X-ray services with remote examination, and continuous e-learning courses via videoconferencing. All of these can alleviate the necessity for patients or medical personnel to travel.

There are several other interesting ICT applications that apply to the virtual mobility concept. A vigorously debated application at this time is business-to-consumer (B2C) e-commerce, i.e., via the Internet consumers can order products and services online. This can completely substitute the need for a customer to go to a shop in person (e.g. downloading films and computer programmes), or to transfer this trip to another transport service, i.e. via postal mail or truck delivery. Moreover, ICT applications such as telebanking and telesurveillance can also act as travel substitutes, and the list of applications is growing continuously.

As transport is a major energy consumer and source of CO₂ and other emissions, as well as creating noise, accidents and congestion, it is associated with a high societal cost. External costs of transport are estimated at approximately 8% of GDP (EEA 2001). The impact of transportation is
further elaborated on in Section 3.1. The opportunity of finding a viable substitute for travel inevitably raises expectations that virtual communication could be the long sought cure that could help solving the problems associated with the ever-growing transport demands.

The conceptual idea of virtual mobility goes well in hand with environmental strategies such as cleaner production and pollution prevention, claiming that prevention is better than cure, and that more sustainable systems should replace the existing ones. By approaching the root of the problem instead of its consequences, and by finding alternative, preventive ways of fulfilling the need to get access to a certain service without travel, it hoped to solve transport problems even before they arise.

Policy-makers, members of the research community, and particularly the ICT industry itself have all shared this hope. Telework is probably the most elaborated application in this sense. For example, calculations were made as early as 1976 on the number of oil barrels that could be saved (Nilles 1976). Extensive research efforts have been made since then to understand, model and examine empirically the impact of telework on transportation, as presented in Section 3.3.3. Virtual meetings have also been the subject of numerous studies. Some of the most important studies, of which many have focused on how the technology would influence the aviation industry, are reviewed in Section 5.4.1. In the last few years, the focus has been shifted strongly towards the emergence of e-commerce, and efforts are being made within the research community to anticipate changes in transportation systems, consumer patterns, use of electronics and networks, etc., and the aggregated environmental impact of these.3

However, these ‘miracle cures’ have not been able to live up to expectations as transport substitutes. Despite the fact that for example telework and teleconferencing have grown strongly for decades, their relatively limited substitution effects have not been able to compete with other drivers generating growth in the transport sector. Empirical findings have supported a predominant net effect of a ‘complementarity’ between virtual

communication and travel (Mokhtarian and Salomon 1997). Moreover, virtual mobility applications are believed to have considerable so-called rebound effects, eroding the potential positive effects of the applications by increases in overall activities, with an associated increase in consumption of material and energy. The most commonly quoted example of ICT rebound effects is the computerisation of offices during the 1980s and 1990s, when expectations were raised that this would create ‘the paperless office’. As we all know, these anticipations fell short and paper consumption has actually increased rather than decreased. For example, between 1960-97 paper consumption rose five-fold in absolute terms in the US (Fishbein and Young 2000). This may be explained by the parallel facilitation of convenient printing and copying, and that computers have made it easier and faster for more people to write more and longer documents. In addition, a growing use of the Internet is probably a significant parameter in the complex rebound equation.

Telework and teleconferencing are expected to be afflicted with several rebound effects, a number of which have been tested empirically. The transportation implications of e-commerce are currently disputed, and some maintain that rebound effects will cancel out any potential savings and result in a net increase of transport (Vedin 1995; Hinterberger, Luks et al. 2001).

Consequently, as we are moving into an ICT era, an opportunity for virtual mobility has emerged that unfortunately does not appear to be as environmentally promising as it may have seemed at first glance. Should this be interpreted as a reason to dismiss its potential to achieve environmental improvements? The author’s firm belief is that it would be premature to do so, considering the gains that may be lost. It is therefore important that the potential environmental benefits and rebound effects of this growing field of virtual mobility are continuously identified, analysed and communicated to those who can realise their potential: policy makers, companies and other organisations, and to the individual users of the technology. However, there


5 Commonly also labelled the Information Society or Knowledge Society.
is an important gap in the knowledge sphere of virtual mobility. The research conducted is almost exclusively limited to describing the past, current and future situations, and how the development has impacted, is impacting, and will have an impact on society. The question of how to influence this development in a positive direction is left for decision makers\(^6\) to tackle, for example through interpretation of research results. This requires a thorough knowledge of what parameters need to be manipulated and how to create change – a knowledge that is lacking.\(^7\)

This dissertation aims to fill part of this knowledge gap. It is important to recognise that these ICT applications possess both possibilities and challenges, but also that they are new, highly dynamic and developing phenomena, and their shape is far from fixed. The focus of this work is thus not to determine whether for example virtual meetings per se reduce or generate more travel. The work is more based on the premise that virtual meetings could replace a number of business trips, if favourable conditions apply. The question of interest is thus: What conditions would support substitution, and how can these conditions be obtained?

Another serious gap in the research literature and ongoing debate surrounding virtual mobility issues is in the role of different stakeholders – who can and should do what? The role and responsibility of both individuals and society/policy makers has been considered and discussed, while the role of organisations such as companies, NGOs, hospitals, municipalities, and governmental institutions is neglected. This dissertation will therefore emphasise the role of these important stakeholders.

Virtual communication will likely grow and develop regardless of its environmental impact. However, there is a possibility to influence this development in an environmentally positive way. This dissertation is hopefully one small step in that direction.

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\(^6\) Such as politicians and other public policy makers, and people in corporate top management positions.

\(^7\) This was also one of the main conclusions drawn at the EU conference ‘Bridging the Gap’, bringing together environmental researchers and policy makers. The conference was hosted by the Swedish EPA in Stockholm, May 2001.
1.2 Nomenclature and Definitions

The term application is used here to describe the use of one or more information and communication technologies for a specific purpose or in a particular situation, for example using a computer to send an e-mail or making a telephone call using a conference telephone. In this dissertation ‘application’ is primarily used to describe virtual meetings, telework and telemedicine.

Information and Communication Technology (ICT) is a term used to describe all electronic information handling. ICT can be viewed as interchangeable with Information Technology (IT), but the additional ‘C’ emphasises the communication part of the industry, e.g. telecommunications. This includes hardware such as computers, telephones, televisions, cables etc.; the software to run them; and the whole theory surrounding this field.

Teleconferencing is a common term for both Audioconferencing and Videoconferencing. These applications of telecommunication are used for communicating between two or more geographically separate locations. Audioconferencing transmits sound only, while videoconferencing transmits both sound and pictures (video).

Telemedicine is defined as “the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care”. 8

Telework occurs when ICTs are applied to enable work to be done at a distance from the place where the work results are needed or where the work would have been done conventionally.

Virtual Communication: 9 Synchronous and asynchronous communication mediated by ICT, making it possible for two or more geographically remote persons to interact.

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8 As defined by the American Telemedicine Association.

9 The term Virtual Communication has been selected, although it can be argued that for example telephony is ‘formally recognised’ as communication, not only ‘being such in essence or effect’ as the prefix virtual indicates. The term is selected for conformity of the terminology used in the dissertation, and the ease of understanding the meaning of the term.
Virtual Meetings: Synchronous communication mediated by ICT, making it possible for two or more geographically remote people to interact.

Virtual Mobility: Providing access to activities by means of ICT and thereby substituting the need for travel.

Web-meetings: This enables two or more people to review and modify computer graphics while speaking to each other in real time.  

1.3 Purpose and Research Questions

The purpose of this research is to contribute to the understanding of how virtual mobility applications can be developed to reduce environmental impact by replacing travel.

In order to meet the above purpose, this dissertation attempts to answer four research questions. The presentation of each question is preceded by a short rationale.

The issue that makes it interesting to look at virtual mobility from a pollution prevention perspective is the possibility for an organisation to substitute travel. However, it is not self-evident that a travel substitution takes place. For long we have experienced a parallel overall growth of communication and travel volumes. From this we could deduce that virtual communication leads to no impact on or an increase in travel. However, what implications do virtual mobility applications have on travel associated to individual organisations? This leads to research question 1:

1. Can virtual mobility applications lead to travel substitution in an organisation?

Furthermore, an increased use of virtual mobility applications does not only have travel implications, but also affect the way we work, our need for equipment, buildings, networks, etc. These changes have an environmental impact as well, which should be taken into account if the applications

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10 Other synonymous terms include web-conferencing, online conferencing, multi-point data conferencing, and a term often used is Net-Meeting (branding as it is a Microsoft software).
should be promoted as a pollution prevention measure. This leads us to research question 2:

2. **Can promoting virtual mobility applications be justifiable from a pollution prevention perspective?**

If an organisation intends to implement a virtual mobility application, what challenges does it face? A shift from face-to-face to virtual communication is a complex issue, associated with numerous consequences beyond the technical issues. If an organisation intends to promote virtual mobility in order to obtain positive effects associated with a travel reduction, research question 3 is important.

3. **What are the main drivers and barriers for an organisation to obtain environmental gains by using virtual mobility applications?**

After having identified critical drivers and barriers, the question remains: How can the organisation utilise the drivers and bypass the barriers in a way that promote an environmentally sensible use of virtual mobility? The organisation may be able to influence how effectively it manages to use virtual communication and benefit from potential environmental, economic and social gains. Hence, it is essential to identify the principal factors affecting the success or failure of virtual mobility applications, and which actors are in a position to change these factors. This leads to research question 4:

4. **In what ways can an organisation influence the environmental outcome of a virtual mobility application?**

### 1.4 Scope and Limitations

The scope of this research is limited to organisations that engage in inter- or intraorganisational communication, that generate a perceived need for people who are spatially remote to travel in order to meet. The research presented in this dissertation focuses on virtual meetings i.e. videoconferencing, audioconferencing, and web-meetings. In addition, telework has been examined in its context as a potential tool to reduce commuting, and to a limited extent the effects of telemedicine are discussed in terms of changing needs for travel. The process is illustrated in Figure 1,
and will be re-addressed in Chapter 2, when a number of terms associated with virtual mobility are explained.

![Conceptual framework for the selected virtual mobility applications.]

The study focuses on Swedish organisations. Sweden has been quick to adopt the new technology and has been considered one of the world’s most enthusiastic countries in disseminating and utilising telecommunications and information technologies (Cairncross 2001; Holst, Thorngren et al. 2001). Sweden has for three consecutive years been ranked first among the countries included in the International Data Corporation’s Information Society Index.11 This has led to Sweden being viewed to some extent as a vanguard and perhaps also a test ground for ICT applications. This makes the Swedish empirical experiences of this research interesting in an international perspective. The study has also been supplemented by secondary data from mainly European and US studies.

Travel associated to organisations differs from leisure travel in many aspects, e.g. purpose of making the trip, incentives to reduce costs and time

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11 The International Data Corporation (IDC) annually ranks 55 countries in an Information Society Index, evaluating the progress of societies around the world with regard to various aspects of the Information Age. The index shows each country’s ranking with regard to its ability to access and absorb information and information technology in the future.(cited in a press release by the Swedish Ministry of Foreign Affairs, March 1, 2002).
spent, and possibility and willingness to substitute the trip with virtual communication. Thus, the research focuses upon professional communication and travel and thus excludes most private communication and leisure travel. However, in telemedicine, private hospital trips are addressed.

The research has a clearly Western and post-industrial perspective, as the ICT communication tools described are highly dependent on a well-developed telecommunications network and a high penetration of electronic equipment. Moreover, this perspective influences for instance the value judgements. Nevertheless, the virtual mobility concept as such is applicable in any society.

1.5 Research Design

1.5.1 General Research Structure

The research presented in this doctoral dissertation is the result of a research journey that has two major and distinct parts – licentiate and post-licentiate research. The first part, the licentiate research, was presented and defended in October 1999, and is documented in the licentiate dissertation: Information in Pollution Prevention – Telework and Teleconferencing used as Tools in the Reduction of Work Related Travel (Arnfalk 1999). The post-licentiate research is a continuation and development of the licentiate research. The doctoral dissertation encompasses both research phases and this document therefore presents the PhD research as a whole. However, for a more in-depth presentation the first phase of the research, the reader is referred to the licentiate dissertation.

1.5.2 Methodological Approach

This research is largely based on a number of case studies, carried out in different organisations in order to identify and to obtain a detailed understanding of components that influence the failure or success of virtual mobility applications.

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12 In Sweden (and a few other countries e.g. Finland), a licentiate degree can be taken halfway to the PhD, and officially requires at least one year of courses and one year of thesis work after the master’s degree.
Not only the environmental parameter is considered, but also economic and social dimensions are taken into account. Therefore, the arsenal of research approaches used is a combination of qualitative studies, based on literature studies, questionnaires, interviews, and search conferences, and quantitative studies based on questionnaires. This information gathering process of primary and secondary data is presented in this section.

In the first phase of the research, the main objective was to answer research questions one and two. In the second phase of the research, findings and conclusions drawn from the first phase of the research were challenged, and an effort was made to answer research questions three and four. A methodological approach used throughout the research, but particularly in the second phase, is action research, which is described in this section.

**Role of Theory**

By their nature, the research questions mentioned above are well suited for an interdisciplinary approach. It is evident that for research question 1 to 4, theories collected from a number of disciplines, including environmental science, management and environmental management, economics, and the field of communication, are relevant.

Leading theoretical frameworks for this study seems to make less sense from a research design perspective. In similar research cases, like the adoption and diffusion of new computer technologies in organisations, the so-called soft systems methodology (Checkland and Scholes 1990, Engel 1997, Cruel 2002) has been successfully applied. Similarly, in this case on Virtual Mobility, as the study enrols itself in time, for each respective evolving question, theories and their respective models and concepts will be specifically applied, both for analytical and explanatory purposes.

Although it is not the goal or set-up of this study to study or test a specific theory in-depth, it is expected, that the final conclusions will include a formulation of some questions that are particularly relevant for further testing in the theoretical fields of innovation and management.
Primary Data Sources

Selection of methods for information gathering

Primary data was collected via questionnaires, with the intention of collecting quantitative information from statistical analysis of the data, as well as qualitative information from comments given in the questionnaires. The web-based evaluation tool e-Val was used for this purpose. Efforts were made to design the different surveys identically to facilitate comparisons, but the questionnaires were, to some extent, individually adapted for each organisational structure. The questionnaires used in these surveys are found in Appendixes I - IV.

In addition to questionnaires, a number of interviews were carried out in person and by telephone. In the second phase of the research, search conferences were arranged and used as a source for gathering information.

Organisations studied

A number of companies, hospitals, NGOs, and municipalities have been involved in the research. Selection of the organisations was based on the following basic criteria and preferences: organisations should have experience of the virtual communication activity of interest, they should be willing to participate in the survey, and should be active in Sweden. In addition they should preferably be drawn from different types of organisations (companies, municipalities, public authorities, associations etc.), and preferably be of different sizes and geographic distribution (regional, national, international).

A presentation of the organisations can be found in Appendix V. The studies are briefly characterised below.

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13 The Internet-based survey tool e-Val was developed at Lund University and is now provided by the company LUVIT. Available online: http://www.luvit.com/.

14 Except in the case of Tetra Pak, where e-mailed, interactive, word-documents were used, and in the Vellinge Municipality cases, where paper questionnaires were a) handed out to commuters, and b) sent to households.

15 As explained in the Action Research Approach section in this chapter.
Studies of virtual meetings and related issues

Five different studies of virtual meetings were conducted.

1. The Scandinavian Videoconferencing User Group (SVUG) was surveyed in a study in 1999. The reason for selecting this association was that its members represent a wide variety of videoconferencing uses in different organisations, complementing the studies of videoconferencing in single organisations with a broader and more general perspective. The response rate was 68% (81 respondents out of 120).

2. The use of videoconferencing was studied and surveyed at the company Tetra Pak in 1999. The company was selected as it is a large, multinational organisation with considerable need for remote communication worldwide. The survey response rate was 35% (35 respondents out of 100). Additionally, the videoconferencing manager, representatives from the travel department and the in-house travel agency were interviewed. A follow-up study was conducted in 2001, interviewing the videoconferencing manager.

3. The use of videoconferencing at telecom company Telia AB was studied and surveyed in 1999. The organisation was included as it is one of the largest users, with relatively long experience of videoconferencing in Sweden. They represent an organisation with considerable remote communication needs, mainly on a national basis. The survey response rate was 24% (245 respondents out of 1000). Interviews with videoconferencing personnel and environmental managers were conducted.

4. The use of videoconferencing at the farmers association Skånska Lantmännen Group,\(^{16}\) was surveyed both in 1999 and in 2001. The association was chosen as a contrast to the larger companies, being much smaller and a less frequent user of the technology. Their remote communication needs are mainly local, and, to some extent, national. The survey response rate was 48% (31 respondents out of 65). Interviews with the videoconferencing personnel and the environmental manager were made.

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\(^{16}\) The association is now called Svenska Lantmännen. This new organisation is a result of a merger of the regional Lantmännen associations, among those Skånska Lantmännen, that was previously studied.
5. The use of videoconferencing, audioconferencing and NetMeeting, as well as travel and meeting behaviour, was surveyed in the Telia AB subsidiary Telia Nära in 2001. The survey response rate was 43% (234 respondents out of 540). In addition to the survey, interviews were made with key persons within both Telia Nära and Telia AB, including controllers and representatives from human resource, environment, finance, travel and transport, information, and IT departments. Telia Nära was selected as a case company as they have been very successful in using audioconferencing in the organisation. In addition, interviews with users were made. Moreover, a search conference was arranged with 17 Telia representatives from the Telia group. As Telia Nära is a subsidiary of Telia AB, it was also included in the company-group wide survey described above.

**Telework studies**

Four telework studies have been conducted.

1. The largest telework survey was conducted at Telia AB, among employees who have remote access to the company’s network. The organisation was selected as it probably has the largest number of teleworkers within any organisation in Sweden, and that it has a relatively long experience of telework. A survey at this company was conducted in 1999. The response rate was 43% (2136 respondents out of 5000).

2. The non-profit telework association Scandinavian Network for Telework (SNTW), was selected as its members represent a number of different organisations, also representing different telework arrangements. The approximately 300 members of this organisation were surveyed in 1999. The response rate was 28% (83 respondents out of 300).

3. A study was made among employees at the City of Lund in 2001. The municipality was studied as it attempts to use telework to reduce its employees’ environmental impact from commuting. A survey was made with a response rate of 28% (704 respondents out of 2500). In addition,
a workshop was arranged with 19 representatives from the City of Lund.

4. With the intention to follow the regional development of telework and evaluate the environmental effects within a municipality, the author initiated a workgroup called Distans Syd in 1996 together with representatives for Vellinge municipality.18 Two questionnaire surveys were carried out in the Vellinge municipality within this project. As the response rate in the two surveys was poor: 8% (389 respondents out of 5000), and 1% (49 respondents out of 5000), the results are not included in any quantitative analysis in this dissertation.

Master’s Theses

The author has initiated and acted as a tutor for a number of Master’s theses within this field. Thesis studies have provided valuable input to this dissertation, complementing and strengthening the author’s own empirical studies, and contributing to the understanding of the topic. The thesis works that have directly supported the findings in this work are:

- Travel impacts of videoconferencing at three multinational companies (Roos 1997);
- Environmental, economic and healthcare quality implications of telemedicine at the Visby County Hospital (Elander 2000);
- Introducing a corporate system for managing environmental travel information (Shaalan 2000);
- The use of virtual communication and how to manage the shift towards ‘Optimal Meetings’ in an organisation (Kogg 2000);
- Introducing measures for travel, meetings and environmental impact in the Balanced Scorecard, for the construction company Skanska AB (Nilsson 2001).

18 A number of other organisations were represented including Telia AB, Siemens Nixdorf, Daltek Vision, Telaris, Kinnarps and Almega. The work has, among other things, resulted in a locally held conference and a telecottage in Vellinge municipality. The group was dissolved in 1998.
Secondary Data Sources
Gathering information has been an ongoing process throughout this research. Due to the fact that the connection between ICT and the environment is a relatively new and unexplored area, literature with this particular approach is limited but expanding. Thus, information has been collected from a number of related disciplines, mainly environmental management, telematics – particularly telework and teleconferencing, economics and transportation, but also areas such as communication, and corporate management.

Virtual meetings have been the main area of interest, but telework has also been an important focus in the information gathering, mostly during the first part of the research. As for most subjects studied, the changing character of the subject has required continual updating of the material. The technological development of ICT is extremely fast, and the prerequisites for use of the technology are constantly changing, including the conditions for the applications studied. The number of people who access to high bandwidth networks is rapidly increasing. Computers have become communication tools and have moved into homes and schools, the Internet and e-mail have boomed, cameras have become common on computers, and so on. Following this development, people’s behaviour is gradually changing, both inside and outside the organisation walls. This development has had a number of effects on this research. One implication is that the research scope was expanded from videoconferencing to virtual meetings.

The Internet has also proved to be an increasingly common source of information. Firstly, the information can be (and usually is) updated often, which reflects the development of the entire ICT industry, and is a necessity when studying these issues. Secondly, users of the relevant ICT-applications often also use the Internet for communication and documentation.

Database searches have been made regularly, combined with database alerts. Conferences that are relevant to this topic are becoming more frequent and attending them has provided useful input material.

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19 A database alert is an automatically triggered search that with the help of specific search criteria, regularly scans selected databases for recently entered material.
Source Criticism

The material gathered in this research covering technical issues may quickly become dated. In order to minimise this problem, most of the primary information in the first phase of research was gathered during a short time period in direct conjunction with the writing of the licentiate dissertation. In addition, as this dissertation focuses more on people’s ability to adapt to new applications offered by the technology, and less on the technology itself, the findings should have a value beyond the next computer model.

As surveys had to some extent to be tailored to the different organisations examined, this limited the possibility of making complete, quantitative comparisons between the studies.

Primary information was largely collected at Telia AB. The fact that Telia is a major telecommunications company could be expected to skew the results because of bias among the employees towards telecommunications, ICT and the positive outcome hereof.

In Telia Nära, Skånska Lantmännen and Tetra Pak, strategic samples of the population (employees) were asked to respond to the surveys. In the case of Telia Nära, persons holding a position that normally requires frequent meetings and travelling were targeted. At Skånska Lantmännen and Tetra Pak, a mixed sample of (known and accessible) videoconferencing users and non-users were selected. This course of action limits the quantitative analysis, but can enhance the qualitative analysis. The overrepresentation among the respondents of those using virtual meetings provides a good picture of the users, but a less adequate picture of average conditions in the organisation.

Model Design

Based on knowledge of the present use of virtual meetings and telework, awareness of current barriers and facilitators, and with a prediction of the immediate future for the applications studied, a model of a company, Virtually Green, has been constructed by the author. The purpose of creating

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20 However, judging from the results presented in the Licentiate dissertation, quite the opposite seems to be the case. A possible explanation to this fact is that the requirements on their ‘own’ technology are higher; the experiences referred to date further back than for the other organisations studied, and are thus inflicted with larger technical problems as the applications were at an earlier development stage at that time.
the model was to make an estimation of the economic consequences of teleconferencing and telework possible, and to facilitate an approximate calculation of the effect for particular environmental emissions such as CO2.

This imaginary company uses telework and teleconferencing under different conditions, presented as two different scenarios: ‘Business as usual’ and ‘Collabication’. The environmental and economic implications of the two scenarios are estimated and quantified in terms of money (SEK) and kg CO2 emissions. The model used and the impact categories involved are illustrated in Figure 2.

![Figure 2. Evaluation matrix for environmental and economic implications of telework and teleconferencing (Arnfalk 1999).](image)

The equations used for the estimates can be found in Appendix VI. In Chapters 3 and 4, the outcomes of the model applied on the two scenarios are presented.

**Action Research Approach**

In addition to the primary and secondary information gathering methods mentioned above, it was considered necessary to obtain a deeper understanding of the internal organisational decision-making processes and the mechanisms that lead to change. Thus, action research methodology was employed in order to gain an insight into these complex issues.

Action research can be described as ‘learning by doing’ – a group of people identifies a problem, does something to resolve it, sees how successful its

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21 A word formed by joining the words ‘Collaboration’ and ‘Communication’.
Virtual Mobility and Pollution Prevention

efforts were, and, if not satisfied, tries again. This simplified description provides a picture of the basic idea of action research, but omits a number of key attributes that differentiate it from common problem solving in everyday life. Gilmore et al. (1986) give a more elaborate explanation of the essence of this research methodology:

*Action research ... aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously. Thus, there is a dual commitment in action research to study a system and concurrently to collaborate with members of the system in changing it in what is together regarded as a desirable direction. Accomplishing this twin goal requires the active collaboration of researcher and client, and thus it stresses the importance of co-learning as a primary aspect of the research process.*

If we are to look at action research from an epistemological perspective and place it within a certain research paradigm, it has been argued that the paradigm of *praxis* is where the main affinities lie. *Praxis*, a term used by Aristotle, is the art of acting on the conditions one faces in order to change them. It deals with the disciplines and activities predominant in people’s ethical and political lives. Aristotle contrasted this with *Theoria* – those sciences and activities that are concerned with knowing for its own sake (O’Brien 1998).

In practice, there are a number of critical elements in the action research methods that make up the foundation for the course of action. These major elements are presented briefly below and discussed in the context of this research.

- **Collaborating with organisations.** The action researcher should approach the problem systematically and ensure that the intervention is informed by theoretical considerations. In addition to the academic element, this type of research also has a social dimension. The research takes place in real-world situations and aims to solve real problems.

A general feature throughout the entire research period has been the numerous contacts made with various organisations, as described previously in this section. The character of these contacts has gradually shifted from being mainly information gathering through questionnaires and interviews, to a dialogue with discussions and joint analysis on how to implement virtual meetings policy. In addition, direct and indirect contacts with companies and other organisations were made through the author’s role as supervisor of master’s students.
- **Stating intention.** The initiating researcher, unlike in other disciplines, makes no attempt to enter the organisation value free, but openly acknowledges his or her values to the other participants. However, when analysing and describing the process studied, it is important that the researcher remains objective.

The author clearly stated his role and intentions (studying the organisation and at the same time initiate a change process) when making contact with each organisation. It has been particularly important to be clear on this point when involved in initiating a process of change in the organisations.

- **Search conferences.** One of the tools used within action research, exclusively developed to suit the needs of the action research approach, is the search conference. Usually the ‘search’ is carried out in groups composed of relevant stakeholders. The group meets, preferably completely isolated for two to five days. First the group reviews and clarifies the objectives. The content is contributed entirely by the members, the researcher acting only as facilitator. Items are listed without discussion, often posted on the walls, and then discussed in greater detail in smaller groups. The outcome of the smaller group discussions are reported and discussed in plenum. As the issue progresses into new stages, this group discussion sequence is repeated.²²

In the second phase of the research, small-scale search conferences were employed, with the intention of facilitating a realistic policy implementation of virtual meetings and/or telework. These conferences have been a means of conveying information and suggestions to various stakeholders in the organisation, but also a way to studying how the organisations reacted to this input, and to revise and strengthen the understanding and approach accordingly.

- **Cyclic approach.** Similar to, and most likely inspired by, the so-called Deming’s cycle of plan, do, check, and act, Kemmis and McTaggart (1988) have developed a cyclic model of the typical action research process, described in Figure 3. Each cycle has four steps: plan, act, observe, and reflect; then, in the light of this, plan for the next cycle.

²² The description of Search Conference is a synthesis of a number of different approaches to this conference tool.
The two phases of this research follow the cyclic approach suggested by Kemmis and McTaggart. The first (licentiate research) phase, was a complete cycle with planning, acting, observation, and reflection. The experiences and findings were used to plan, design and further develop the research approach in terms of scope, methodology and tools used in the second phase. However, the basic steps in the research cycle have been repeated in the second phase.

- Initiating a change process. The research process should nurture local leaders to the point where they can assume responsibility for the process. This point is reached when they understand the methods and are able to continue when the initiating researcher leaves (O’Brien 1998).

These characteristics of action research were all engaged throughout the research journey.
1.6 Dissertation Structure

The dissertation consists of two parts: the main text consisting of five chapters and an epilogue, and the second part, which is comprised of three papers.

Main Text

Chapter One: Introduction. The present chapter gives the reader an insight into why this research has been carried out and why this dissertation was written. Moreover, the chapter describes how the research was conducted, the methodology used, and in what way the research has focused on certain issues and has been limited in its scope.

Chapter Two: The Virtual Mobility Concept. In this chapter, the virtual mobility concept is introduced and explained. Moreover, the importance of having such a concept and the area it affects are discussed. The role of virtual mobility in pollution prevention is elaborated. The selected virtual mobility applications are explained. Finally, a framework for approaching virtual mobility applications is presented.

Chapter Three: Travel Implications of Virtual Mobility Applications. In this chapter transport and its implications, and the challenge of obtaining a sustainable transport system is discussed. This is followed by an analysis of the transport implications of three virtual mobility applications: virtual meetings, telework and telemedicine.

Chapter Four: Virtual Mobility Beyond Travel Implications. The environmental impact of ICT is analysed and an approach to how to structure different levels of impacts is suggested. This is followed by a discussion on the environmental impact of the different applications studied.

Chapter Five: Virtual Mobility Applied – Virtual Meetings. In this chapter, the shift from business travel to virtual meetings is analysed. At first, some basic characteristics of business travel are presented. This is followed by a presentation of the possibilities and limitations of virtual meetings. Moreover, communication theory is introduced to help understanding the implications of replacing a physical meeting with virtual communication. Barriers for such a shift are discussed. Finally, how to overcome such barriers, in order to promote a shift towards virtual meetings, is analysed.
Chapter Six: Virtual Mobility Applied – Telework. The chapter starts with a presentation of some basic characteristics of commuter travel. Factors influencing the environmental outcome of telework are investigated. This is followed by a discussion on how to realise the environmental outcome of telework and how to influence the virtual mobility potential of the application.

Chapter Seven: Concluding Discussion. This chapter concludes the previous ones, and returns to the research questions for presenting the lessons learned from the virtual meetings and telework research. These findings are used to make a parallel to the third application included in the thesis: telemedicine. A reflection on the usefulness of the virtual mobility concept is made. In the end, questions for further research are suggested.

Chapter Eight: Epilogue – The Research in Hindsight. A final reflection is made on the actual impact this research journey has induced.

Papers


This is a book chapter that provides a brief introduction to the research on virtual meetings.


This article is a more in-depth presentation of the results of two studies at the companies Telia Research and Telia Nära. The focus of this article is on the changing of meeting behaviour.


This paper discusses non-organisational policies that influence business travel in Sweden.
2 The Virtual Mobility Concept

While conducting research within the field, and while writing this dissertation, the author has felt a need for a concept that unites a number of approaches linked by the common idea of substituting travel by the use of ICT applications. The term virtual mobility has been chosen for this purpose.

In this chapter, a discussion about the concept and its importance is joined by elaboration on how virtual mobility can give the term accessibility an extended meaning. The relevance of the concept in an environmental perspective, and particularly for the field of pollution prevention, is discussed. Moreover, the character of three virtual mobility applications studied, are presented.

2.1 Introduction to the Concept

2.1.1 What is Virtual Mobility?

The concept of virtual mobility is closely associated with the word accessibility. In geographic literature, accessibility has been considered the opportunity individuals have to participate in necessary or desired activities, or to explore new ones. This opportunity is dependent on their ability to reach the right places at a reasonable time and at a reasonable cost in terms of resources and effort (Couclelis 2000). With the advent of ICT, technology offers a viable and often preferable alternative to physical movement for accessing and engaging in economic, social, and cultural activities.

The term virtual mobility is not new, and it has been used to describe a wide variety of phenomena, including different e-learning activities. Clearly

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23 A search for the term ‘Virtual Mobility’ on the Internet using the search engine Alta Vista, generated more than 1000 ‘hits’ [January 23, 2002].
defining and explaining the term ‘virtual mobility’ in use of this work is therefore important, as it runs the risk of becoming one among numerous vaguely interpreted terms appearing in ICT and Information Society literature.

We can therefore describe the basic idea of virtual mobility as an ICT facilitated opportunity to access an activity that normally would require a person to move physically. A definition that encompasses this idea is given by Kenyon et al. (2002), who define virtual mobility in their work on transport, social exclusion and the Internet:

‘Virtual mobility’ is a shorthand term for the process of accessing activities that traditionally require physical mobility, but which can now be undertaken without recourse to physical travel by the individual undertaking the activity. Thus, virtual mobility creates accessibility opportunities, both substituting for physical mobility and enabling access where previously there was an accessibility deficit.

As the purpose of Kenyon et al. is to outline the concept of mobility-related exclusion, the option of enabling access to activities that were previously inaccessible is stressed. However, as the focus of this dissertation is to examine ICT applications that can substitute travel, the definition applied here is limited to:

Virtual Mobility: Providing access to activities by means of ICT and thereby substituting the need for travel.

This interpretation excludes other forms of mobility such as freight transport, as well as any other form of communication than that mediated by ICT that could provide access to an activity (such as postal mail). Moreover, it excludes situations that would not have taken place without the ICT option (e.g. making it possible for physically disabled people to find employment by working at home). This is an important option, but it does not directly affect the need for travel, or, in the broader sense, mobility (however, it could indirectly lead to situations that in turn would require more or less travel, as discussed in Section 4.1), and is viewed as ‘virtual accessibility’ rather than virtual mobility.

The term is e.g. used to describe students’ access to education in different countries in Europe through e-learning, via the EU project ‘Open To Europe’ within the SOCRATES education programme.
Pragmatic considerations were influential when selecting the term virtual mobility. In the author’s experience, working with the issues surrounding various ICT applications and their potential for transport substitution, the rich flora of expressions employed has caused confusion and uncertainty over what the subject is actually all about. However, the term virtual mobility, together with the terms virtual meetings and virtual communication, has, in the author’s opinion, been the most successful in describing the idea and intention behind the expressions. This terminological confusion has been emphasised by Forsebäck (1998) and Huws (1999), who claim that terms such as ‘virtual’, ‘tele’, ‘cyber’, ‘networked, or simply ‘e-’ can be prefixed interchangeably to an almost infinite number of abstract nouns.

2.1.2 Why Study Virtual Mobility from an Environmental Perspective?

The virtual mobility phenomenon is important to study due to a number of reasons. At first, the environmental and other societal costs of travel, as discussed in Section 3.1, and the potential of virtual mobility applications to substitute a fraction of the travel, makes the virtual mobility phenomenon particularly relevant to study.  

Moreover, the extent and growth of virtual communication, following the fast development of the ICT industry (as described in Section 4.1.1), significantly influences our lives, and it is safe to assume that it will continue to do so to an even higher extent. This will inevitably have a number of important consequences, among which the environmental aspect is highly important.

25 Although it has not been the purpose for conducting this research, the effects of the shocking terrorist attacks in the USA on September 11th, 2001, cannot be ignored. The events have made the virtual mobility option a more topical question than ever. People who are afraid to travel, above all travel by air, are provided with an alternative way of doing their job. Indeed, the short-term effect on organisations in the USA and in Europe is that they, temporarily, have forbidden or recommended their employees not to do business travelling by air. Holden, C. (2001). No Hopping on that Jet Plane. Science Now, and Rechtin, M., Y. Yamagushi, et al. (2001). Busy executives try to adapt to a frightening new world. Automotive News Europe. 6. Virtual mobility provides them with an optional way of still conducting their business. As a result, an increased demand for virtual meetings has been noticed since the attack. James, D. (2001). “Web conferencing, talk eases salesperson’s fears.” Marketing News 35(24): 4-6, and Lövgren, M. (2001). Videokonferens på frammarsch efter terroristattackerna. Computer Sweden. Stockholm.
Policy tools, that are currently being used to steer travel towards a sustainable mode and level, appears to be insufficient. The travel substitution that the virtual mobility applications may lead to, brings our attention to the question – could they constitute an important complement to the pollution prevention toolbox? This is being discussed in Section 2.2.

2.2 Virtual Mobility and Pollution Prevention

In this section, the pollution prevention strategy is presented, and the relationship to virtual mobility is discussed.

2.2.1 Pollution Prevention – an Evolving Concept

Pollution prevention is a strategy for companies and other organisations to reduce their environmental impact. The basic idea is to use materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at source (US EPA 1992). Strategies for dealing with environmental problems in industry have gradually developed during the twentieth century. A number of characteristic approaches can be discerned, in which the main approaches can be referred to as dilution (of emissions into air and water), filtering (capturing pollutants in filters, waste-water treatment plants etc.), recycling (collecting used products and waste to make new products), and prevention (preventing the waste or pollution arising by selection of raw material and/or processes used). Even though these strategies have been, and still are, employed in parallel, we can see a clear trend that industry is moving towards the latter approaches (Lidgren 1993; Kisch 2000).

At the beginning of the 1970s, several international organisations and national governments began to develop preventive strategies to address environmental problems. These strategies were developed under names such as low- and non-waste technologies, cleaner technologies, waste minimisation, and pollution prevention (van Weenen 1990; Lindhqvist 2000). These strategies developed from being largely technology oriented to consider also the aspects of housekeeping, management, and design. In 1989, the United Nations Environment Programme Industry and Environment Office (UNEP/IEO) established a programme based on preventive approaches to industrial environmental problems.

Within the area of pollution prevention, it has today developed a number of different strategies and approaches. One that is of particular relevance in
this context is Cleaner Production. A major difference between pollution control approaches and cleaner production is whether the measures will only stop pollutants from entering the environment, or if they will actually prevent them from being generated at all (Lindhqvist 2000). The definition of Cleaner Production today encompass processes, products and services:

Cleaner Production (CP): is the continuous application of a preventive environmental strategy applied to processes, products and services to increase eco-efficiency and reduce the risks to humans and the environment. Production process: conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity of toxicity of all emissions and wastes at the source. Products: reducing negative impacts along the entire life cycle of a product, from design to ultimate disposal. Services: incorporating environmental concerns into designing and delivering services (UNIDO 1998).

When discussing ICT and preventive environmental strategies, three more terms or concepts should be mentioned, as they are instrumental in describing the effects of the technology applications.

Eco-efficiency: Being the heart of WBCSD26 philosophy, this concept can be explained as creating more goods and services while using ever fewer resources and producing less waste and pollution.

Factor X (Four, Ten or other): The Factor Four report of the Club of Rome shows the necessity and the technological possibility of quadrupling resource productivity (von Weizsäcker, Lovins et al. 1997). Factor Four is defined as a fourfold growth in resource productivity. The amount of wealth extracted from one unit of natural resources is quadrupled. With increasing demands for improved standards of living, reduced consumption of materials and energy is a goal that will be difficult to achieve. If, instead, the same service or product can be offered with equal, or even higher, quality and attractiveness, the goal is more realistic.27

26 The World Business Council for Sustainable Development (WBCSD) is a coalition of 150 international companies united by a shared commitment to sustainable development via the three pillars of economic growth, ecological balance and social progress. Available online: http://www.wbcsd.org/index.htm

27 The Factor 10 Club, launched by the Wuppertal Institute, suggests that Factor Four will not be enough, but rather a tenfold increase in resource productivity is needed to achieve a sustainable development.
Sustainable Consumption has been defined as the use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle of the product or service, so as not to jeopardise the needs of future generations.28

However, to reduce consumption is not a trivial aspiration – not many people from industrialised countries are willing to reduce or abstain from the increase in consumption levels they enjoy today. There is, therefore, a need to bring consumption to a qualitatively new level. Instead of quantities, it is necessary to focus on qualities that, along with fulfilling customers’ needs and wants, improve the environmental quality of what the market offers. This calls for ‘dematerialised’ consumption. The main question is, therefore, how we can obtain a sustainable consumption level without decreasing the standard of living (Mont 2000).

### 2.2.2 Virtual Mobility + Pollution Prevention = True?

How does virtual mobility relate to pollution prevention and the different concepts within this sphere? As pollution prevention is a way for the organisation to reduce its own environmental impact, and use practices to reduce or eliminate environmental impact at source, it can be argued that virtual mobility harmonise with the definition of pollution prevention.

Virtual mobility as a concept can be compared with conceptual pollution prevention measures such as waste minimisation and energy conservation. The virtual mobility applications, such as telework, can accordingly be regarded as applied pollution prevention measures such as substitution of raw material (e.g. shifting from organic to water-based solvents), or changing to a more energy efficient process (e.g. shifting from normal to low-energy light bulbs). However, as implementation of virtual mobility applications is a complex process with implications far beyond the practical aspects, they require a system approach, and are therefore more than just a practical measure. Consequently, virtual mobility is thus considered a conceptual pollution prevention measure, and the applications as applied, system-wide, pollution prevention measures. By recognising them as such

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they can more easily fit in to the established environmental management sphere.

We may now look at the sub-sets of pollution prevention, starting with cleaner production. The idea of fulfilling the need to get access to a certain service or function without having to travel, and thereby preventing the environmental impact from transport ‘at source’, fits well within the cleaner production philosophy. It can be seen as a re-design of a service function, e.g. facilitation of a meeting.

Virtual mobility applications can also be interpreted as being embraced by the eco-efficiency philosophy, as the service of providing access may be achieved using less material and energy (Arnfalk 2000). The resource consumption of virtual mobility applications compared to that of the travel alternatives, can differ in orders of magnitude (von Weizsäcker, Lovins et al. 1997). Therefore, virtual mobility applications may be regarded as a Factor X option.

Virtual mobility applications can relate also to the concept of sustainable consumption, if the virtual mobility options can offer an equal or better/more attractive option to the travel alternative. The virtualisation of travel is, in a way, a dematerialisation of the travel service.

Consequently, it can be argued that virtual mobility fits well with a pollution prevention strategy. Nonetheless, what is the relevance to make such linkage? One issue that is relevant to all industries but has been given limited attention so far is environmental impact from transportation. Few organisations have, for example, taken any steps towards reducing impact from their employees’ business or commute travel. The prevalent policy approach to limit the environmental impact of transportation is through general regulatory policies (e.g. emissions limits) and market-based tools (such as fuel tax). However, governments will have to look for alternative ways of meeting the targets set for reducing greenhouse gas emissions, which inevitably will affect the transport sector. If virtual mobility provides organisation with an alternative way of conducting their business, policymakers will take this into account. Moreover, as transport is accountable for a growing share of many businesses’ total environmental impact, it can be expected that organisations, to a higher extent, will have to
take on the responsibility\footnote{The term ‘responsibility’ should be interpreted in the context of ‘corporate social responsibility’, namely operating a business in a manner that meets or exceeds the ethical, legal, commercial and public expectations that society has of business.} for reducing the environmental impact stemming from their transport activities. One indication of this is that travel is increasingly becoming an issue in environmental managements systems and environmental reporting. However, the extent is yet limited, as discussed in section 5.5.3.

As indicated in the beginning of this chapter, accessibility plays a key role in the virtual mobility concept. This will be elaborated upon in the following section.

\section*{2.3 Accessibility through Mobility and Virtual Mobility}

The increased level of mobility, resulting from the development of vehicles and infrastructure, has made it possible to reach almost every location in the world within a day. At the beginning of the twentieth century, the average person in Sweden travelled half a kilometre per day. Today, the figure is approximately 40 kilometres. In most cases, it is not mobility itself that is the aim, but rather access to a certain function. This leads us to look at the driving forces behind our travel.

We can divide this travelling into structurally enforced and desired (or non-enforced). This separation is used to demonstrate the difference between, on the one hand, potentially ‘avoidable’ travel, if the physical structure was different or by taking advantage of ICT substitution, and, on the other hand, travel that is not necessary for carrying out certain tasks, such as leisure travel (Höjer 1998; Höjer 2000). Thus, in this analysis, we are focusing on the structurally enforced travel. It is important that we plan and construct a society in a way that does not continuously demand increased and enforced mobility. However, such is the de facto structure of our society today, and if we are at all able to plan and build a society with low structurally enforced mobility, it will likely take time before we see the results.

Looking at structurally enforced travel, the demand for accessibility can either be met through physical movement or by virtual communication. A
simple way to illustrate the relationship between these two solutions and how they are interchangeable is shown in Figure 4. This Venn diagram displays the total number of contacts \((C)\) that may be primarily or exclusively facilitated either through physical movement \((C_p)\) or by ICT-based, virtual communication \((C_v)\). Contacts that can be achieved either through physical movement or through virtual communication are found in the overlap field \((C_o)\). Consequently, \(C_o\) represents the substitution potential for virtual mobility.

\[
C = C_p + C_v + C_o
\]

\(C\) = contact of set of individuals
\(C_p\) = contacts achieved through physical movement
\(C_v\) = contacts achieved through ICT
\(C_o\) = the region of overlap: contacts that may be achieved in either way

Figure 4. Venn diagram of physical and virtual contacts and the possibility for substitution (adapted from Concelis (2000)).

What we have experienced, both currently and historically, is the growing demand for contacts overall, \(C_{t2} > C_{t1}\) \((t=\text{time})\), and growing travel demand due to \(C_{p2} > C_{p1}\). Even though \(C_o\) has grown rapidly, the growth of \(C_p\) has swamped any possible effects of a net travel reduction (as argued and empirically supported by for example Mokhtarian and Meenakshisundaram (1998)).

The main advantage of this Venn diagram is that it nicely illustrates where we find virtual mobility, namely in the overlap of the two circles, \(C_o\). Consequently, the objective of this dissertation can be expressed as trying to understand the process of merging the two circles, \(C_p\) and \(C_v\).

### 2.4 Introduction to Selected Applications

Three virtual mobility applications will be reviewed: virtual meetings, telework, and telemedicine. A number of factors have been taken into
account in the selection. The three applications all have the potential to replace travel, each representing different categories: commuter travel, business travel, and travel associated with healthcare. In all three applications, an organisation (e.g. company, municipality, hospital) plays a central role in realising the virtualisation of the traditional way of obtaining access to the service. The following description highlights some main characteristics of the applications relevant in the virtual mobility context.

2.4.1 What are Virtual Meetings?

There is a fast-growing and continuously developing array of interesting virtual communication tools available, many of them supported by the expanding mobile and Internet networks, as presented in Section 4.1.1. However, this dissertation limits its scope to focus mainly on two applications: audioconferencing and videoconferencing. To a more limited extent also web-meetings are discussed. These three applications will be described briefly.

Audioconferencing

If a meeting with three or more persons is to take place, a multi user audio conference call can be used, connecting three or more telephones at the same time. Another option is to connect a conference telephone, a type of telephone with speaker function that allows a group of people gathered in one place to communicate via the phone. These two options are called audioconferencing. Most telephone conversations take place between two people; However, a normal telephone call is generally not regarded an audioconference. Nevertheless, if this communication actually substitutes the need for travel in a professional situation, it can still be considered a virtual meeting.

Videoconferencing and Web-Meetings

The major drawback of audioconferencing is that you cannot see the person or persons you are talking to. This problem is solved by videoconferencing, where two or more places are connected via special equipment that allows the participants both to listen and see each other. Within the concept of videoconferencing, three main types are commercially available:

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30 Both videoconferencing and audioconferencing can be referred to as teleconferencing.
• *Desktop systems* for point-to-point conferences

• *Group systems*:
  A. *Compact or Set-top systems*, and
  B. *Roll-about Systems* for 1 to 6 users
  C. *Room-sized systems* for as many as 25 users\(^{31}\)

A *Group System* is basically a large television (or two) and a camera. In addition, electronic whiteboards, document cameras, and computers can be connected to the equipment to complement and enhance communication. Using this system, several people can participate at either end. Here too, multi-user conferences can be held.

*Desktop or Personal Videoconferencing*\(^{32}\) usually consists of a computer equipped with a small camera, a microphone, a video- and audio circuit board, and special software. With this equipment, one or two persons can communicate at each computer. Multi-user conferences are possible, as several computers can be connected simultaneously. Laptop computers with built-in cameras enable videoconferencing while travelling. In addition, small stand-alone flat screens for executives’ offices and videophones for deaf people are products belonging to this category.

*Web-Meetings* make it possible for a group of people to simultaneously and remotely edit the same document, draw pictures, give oral and visual presentations, etc. Communication via the Internet offers a nearly unlimited range of options, and this technology is developing very quickly. The so far limited professional use, mainly restricted by lack of bandwidth and insufficient possibilities to secure communication, is expected to grow strongly (Eklund and Zetterman 2001).

It is difficult to provide accurate figures on the extent of the technologies, as the growth rate is so high and figures become quickly outdated. Starting with audioconferencing, 5% of all employed in Sweden had participated in audioconferencing in 1999 (SIKA 2001a). The access to telephony is very high. Sweden is one of the countries in the world with the highest

\(^{31}\) This number could be larger, but in such case it is basically a one-way communication, or broadcasting.

\(^{32}\) A term used by e.g. Rosen, E. (1996). Personal Videoconferencing. Greenwich, CT, Manning Publications Co.
percentage of telephone access. The International Telecommunication Union (ITU) estimated in 2001 that there were more than 1 billion subscribers of fixed and mobile telephones, respectively, worldwide (ITU 2001).

The use of videoconferencing is more limited. Only 1% of the employed Swedes had participated in a videoconference during a 30-day period in 1999. On average 9% of companies had access to videoconferencing equipment in 2000, and another 4% planned to acquire equipment during 2001 (SIKA 2001a). It is currently estimated that there are approximately 1 million group videoconferencing systems in the world, and in 1999 about 3000 of these were publicly available studios (Panettieri 1999).

2.4.2 What is Telework?

The term telework has been subject to a wide range of definitions, which has been reviewed by e.g. Lindström et. al (1997). One of the more recent and perhaps also influential definitions is provided by European Telework Development (ETD), which describes the term as follows:

*Telework occurs when ICTs are applied to enable work to be done at a distance from the place where the work results are needed or where the work would conventionally have been done.*

The term encompasses a number of different work forms:

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33 This can be illustrated by that in 1998, 99% of all households have access to a telephone, and in June 2000, there were nearly 6 million private subscriptions of fixed telephone lines in the country (with a population of 8.7 million).


35 The term *tele-* originates from Greek meaning ‘far off’, ‘remote’. The current meaning is ‘operating at a distance’. It does not therefore directly signify that it is work mediated through telecommunications.

36 This can be illustrated by the fact that, in Sweden alone, at least six different organisations have made their own definitions of telework: Distansarbetsutredningen (1998). Distansarbete. Betänkande av Distansarbetsutredningen. SOU 1998:115.

37 The definition can be found at European Telework Online, an information service supported by The European Telework Development, which is an initiative of the European Commission (DGXIII) ACTS programme. Available online: http://www.eto.org.uk/etd.
• **Home-based telework** or **telecommuting**: when an employee or contractor works at home instead of travelling to an employer's or a customer's premises;

• **Mobile telework** or **nomadic worker**: when executives, professionals, or service staff use ICTs to enable them to spend more time with customers and to deliver ‘on the road’ a range of services and capabilities that previously would have involved office-based staff or visits to the company office; and

• **Telecentres**: providing local office facilities for people who prefer not to work at home but wish to avoid the cost, time, and inconvenience of commuting.

Moreover, ETD mentions two telework-related phenomena that usually do not fall within the definition of telework, but that may help or trigger this form of work:

• **Telecottages**, which provide local communities with access to skills development, high performance ICTs, and the networking and socialisation aspects of work that may be missed by a home-based worker; and

• **Functional relocation**, where business functions that previously were located close to the customer are concentrated and delivered at a distance. Examples include both ‘front office’ (selling activities previously done in the High Street, now delivered by phone or computer networks) and ‘back office’ (service and maintenance work previously done ‘on site’, which may now be done anywhere in the world using remote access to systems) (ETD 2000).

The virtual mobility potential applies in particular to telecommuting and telecentres, providing the teleworker with an opportunity to replace a commute to the main office, either by staying at home as in the case of telecommuting, or by going to a nearby telecentre. In the Telia case, as for the rest of Sweden, the dominant mode of telework of these two is

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38 The term telecommuting is commonly used in the US as a subset of, or instead of, the term telework. Telecommuting, in turn, has been defined as “using information technology to work at home, or at a location close to home, during regular work hours, instead of commuting to a conventional workplace at the conventional time. It may be part time or full time, and need not exclusively involve computers”. See: Mokhtarian, P. and I. Salomon (1994). “Modeling the choice of telecommuting: Setting the context.” Environment and Planning A 26(5): 749-766.
telecommuting (see Figure 5), which will thus be the focus for the discussion on virtual mobility.

Besides designating the virtual mobility application, the definition and the different categories of telework as described above also help to point out other important concerns in the contexts of travel and environmental implications. The category ‘mobile telework’, which represents in the Telia case more than a third of all teleworkers (35.4% including the combination with other forms of telework), is a form of work that makes it possible for professionals to spend more time ‘on the road’, which also could lead to a higher demand for travel.

![Figure 5. Modes and combinations of of telework among more than 2000 teleworkers at Telia (Arnfalk 1999).](image)

The relative importance of the telework application naturally depends on how many people telework. This figure also depends on how telework is defined. An Official Swedish Government Report (SOU 1998:115) on Telework in Sweden (Distansarbetesutredningen 1998) suggests that the

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39 Adopted to the ETD nomenclature from Arnfalk (1999): Home – Telecommuting; Local office – Telecentre; and Travelling – Mobile Telework.
number of people who telework at least one day per week is approximately one quarter of a million, corresponding to 6% of the labour market in Sweden. A more recent report suggests that the number of teleworkers has remained approximately the same since the mid-1990s and even declined to some extent (Wallström 2000). It should be observed, however, that a wider definition of telework is used in this report (including occasional telework), which results in the higher estimated percentage (12.5%).

2.4.3 What is Telemedicine?
The third ICT application discussed in this dissertation is telemedicine, a generic term referring to all forms of healthcare that use interactive sound, picture and data communication. It can be used for a number of functions such as diagnosis, consultation, and treatment, as well as education and transfer of clinical data. It provides health providers and patients with the possibility to interact and exchange information without physically meeting each other. Consequently, as it can substitute a trip that one of the parties would have had to make in the conventional healthcare case, it qualifies as a virtual mobility application, and will be discussed from this perspective.

Telemedicine uses videoconferencing in many of its functions, and it also has functions that resemble telework, i.e. specialist and out-of-hour work taking place from home or elsewhere. In this respect, this third virtual mobility application overlaps the other two, but the functions within telemedicine are so specialised that a separate section on telemedicine can be justified.

One of the first uses of telemedicine was already in 1922, when the Sahlgrenska hospital began to give medical advice to ill or injured sailors in the Swedish merchant fleet. Conventional telemedicine was introduced in Sweden in 1968, but the area did not expand substantially until the 1990s. In 1998, the Swedish Institute for Health Services Development (SPRI) conducted a survey of Swedish hospitals regarding the use of telemedicine among them. (Sjögren, Sandberg et al. 1999). Telemedicine is now being used in all regions of Sweden, and nearly 75% of the hospitals used some sort of telemedicine in 1998. It is most common to use telemedicine within radiology, followed by pathology and ear, nose and throat. It is mostly used for consultation, education, and out-of-hours work.
2.5 Summarising the Discussion on Virtual Mobility

This section summarises the main points made in this chapter. The term virtual mobility concept is explained as a way of providing access to an activity by means of ICT, and thereby substituting the need for travel. Virtual mobility was chosen, as it has been most successful, among a rich flora of terms, in describing the idea and intention behind the expression. The concept is of interest from an environmental perspective, as the environmental problems generated by travel are growing, and the current set of tools used to break this trend appears to be insufficient. Moreover, environmental implications of ICT make the issue more interesting, but also more challenging.

The potential role of virtual mobility applications in pollution prevention is discussed. As the characteristics and relative importance of environmental problems are shifting with the development of society, this calls for renewal and expansion of the toolbox used for approaching environmental problems. The increasingly important influence of the Information Society can provide solutions, but may also lead to greater environmental problems. Preventive strategies such as Pollution Prevention or Cleaner Production must therefore be developed with an understanding not only of the environmental potential that dematerialisation or virtualisation of products and services offer, but also the potential problems associated with this development. This understanding is crucial if we which to prevent a growing environmental impact in the Information Society.

Three applications of the virtual mobility concept are presented and characterised: virtual meetings, telework, and telemedicine. The conceptual framework behind the selection of these applications is presented in Figure 6.
Figure 6. Conceptual framework for the selected virtual mobility applications.
3 Travel Implications of Virtual Mobility Applications

In Chapter 2, the virtual mobility concept was connected to the pollution prevention strategy, based on the idea that some travel related to an organisation’s activities, may be replaced by virtual communication. This raises a number of questions regarding travel: What is the environmental impact of travel? In what ways do organisations attempt to reduce this impact today? Moreover, what is the potential impact that virtual mobility applications have to transport, and what do we know of the actual effects up to now? These questions will be approached in this chapter.

3.1 Transport and its Impacts

In discussing virtual mobility as a potential pollution prevention option, it is important to acquaint oneself with the transportation sector and its impacts. The growth of motorised mobility has facilitated and even stimulated much what we regard as progress. It has helped expand our intellectual horizons, allowed efficient production and the ready distribution necessary for widespread consumption. It has facilitated access to products from distant places, and made the comfort of travel commonplace (OECD 2000). It also creates value and employment. In the EU, the value created by the transport sector is estimated to 4% (EUR 320 billion) of total GDP. Moreover, more than 9% of the total EU workforce is employed in the transport service sector, in the transport equipment industry, or in another transport-related industry (European Commission 2001). However, there are costs associated with transport, mostly environmental costs, which are eroding its value.

3.1.1 The Environmental Impact of Transport

The transport sector has become a major contributor to a number of environmental problems, such as climate change, eutrophication, acidification, local air pollution, noise, land use, etc. Climate change is
regarded as perhaps the largest and most difficult environmental challenge we currently face.\textsuperscript{40} The sector’s share of CO\textsubscript{2} emissions (the main greenhouse gas) is in Sweden 35-40\% (SNV 2002),\textsuperscript{41} in the EU as a whole 28\%, and in the US 33\% (DoE 2001; European Commission 2001). The environmental performance of transport has not compared well with other sectors, despite efficiency improvements in engines, and the use of lighter and more aerodynamic vehicles. In the European Union, industrial activities have become relatively uncoupled from energy consumption and CO\textsubscript{2} emissions, i.e. there has been a growth in activity without growth in emissions. This has not been the case for transport (EEA 2000a). The main reason is simply because of the strong growth in transport volume. During the twentieth century, the motorised movement of people increased more than one hundredfold, at the same time as the total human population increased four-fold. During the same period, transport energy use per unit of activity fell between 80\% and 90\%, consistent with energy efficiency changes in other technological processes. Accordingly, the overall impact of transport may have increased by a factor of ‘only’ 10-20, rather than by the factor of more than 100 that has characterised growth in transport activity.

3.1.2 Travel and Freight Transport

Transport can be divided into transport of goods, i.e. freight transport, and passenger transport, i.e. transport of people or travel. By looking at road transportation in the European Union, the dominant mode of transport in the EU and generating 85\% of all transport CO\textsubscript{2} emissions, we get an indication of the proportions in Western Europe.\textsuperscript{42} In 1998, passenger transport (passenger cars and buses) accounted for 62\% of total road transport CO\textsubscript{2} emissions (EEA 2001).\textsuperscript{43}

\textsuperscript{40} As stated by, among others, the Swedish EPA.

\textsuperscript{41} The transport sector’s relatively high share of CO\textsubscript{2} emission in Sweden, is partly explained by that the country’s dominating sources of energy are hydropower and nuclear power.

\textsuperscript{42} Transportation CO\textsubscript{2} emission figures were in 1999 (million ton): EU 872, US 1771, Japan 278, China 219 and Russia 137.

\textsuperscript{43} Passenger transport’s share of the transport sector’s emission were for other air pollutants 51\% for NO\textsubscript{X}; 85\% for CO; 72\% for VOC; and 22\% for PM emissions.
Aviation is the second largest transport CO₂ source in the EU (12%). Travel dominates aviation and the proportion of emissions that can be assigned to freight transport is small.\textsuperscript{44}

Estimated external costs of transport are 8% of GDP in the EU. Travel is estimated to be responsible for 65% of total external costs. The average external costs (as measured per pkm) of cars are the highest, followed by aircraft, bus and train (EEA 2001). Consequently, the environmental implications of travel are significant, and, in many respect, a dominant part of the environmental impacts of transport.

### 3.1.3 Growth of Travel

As for transport in general, the trend of an increasing demand for travel is expected to continue. Globally, passenger air travel is projected to grow by around 5% per year between 1990 and 2015,\textsuperscript{45} whereas total aviation fuel consumption is projected to increase by 3% per year. Scenarios of the emissions from aviation in 2050 predict an increase in CO₂ emissions ranging from 1.6 to 10 times the amount in 1992 (IPCC 1999).

In the last fifty years, the total number of international arrivals\textsuperscript{46} has grown from 25 million to nearly 700 million, according to the World Tourism Organisation. This corresponds to an average annual growth rate of 7%. Business travel accounted for 18% of total arrivals. Not only has it grown in terms of numbers, it has also expanded geographically. Air transport remains a dominant means of international travel (43%), followed by road transport (42%), rail transport (7%), and sea transport (8%) (WTO 2000).\textsuperscript{47}

\textsuperscript{44} Figures for emissions from travel and freight transport have not been found on European or international level. However, the Swedish Civil Aviation Administration approximate the emissions of CO₂ and NOₓ from freight transport in Sweden to about 3-5% of the total aviation emissions.

\textsuperscript{45} Measured in revenue pkm.

\textsuperscript{46} International arrivals refer to international travel by all commercial transportation modes: air, train, road transport and boat.

\textsuperscript{47} Measured in terms of numbers of arrivals.
3.1.4 Reasons for Travel

The main reason for our travel is pleasure. For longer trips exceeding 100 km,\textsuperscript{48} on average 50-60\% of all journeys are made to visit friends or relatives or other forms for leisure. Business travel is the purpose of 25-40\% of all journeys. Shopping and commuting represent between 2 and 10\% each (Weckström-Eno 1999). In Sweden, 45\% of the distance travelled is leisure related, 21\% is commuting, and 10\% business travel, see Figure 7 (Jonsson 2001).

![Figure 7](image)

**Figure 7.** Distribution of distance travelled for different purposes in Sweden 2000. Walking and bicycling (representing 2.7\% of total distance travelled) is excluded (Jonsson 2001).

3.2 The Challenge of Achieving a Sustainable Transport System

Most projections for the next decades predict a strong growth in motorised travel. How does this correspond to the vision of sustainable mobility? Technical advancements in energy efficiency, filters and catalysts, have limited and reduced some emission levels, but pollutants such as NOx, and

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\textsuperscript{48} Measured in seven countries in Europe: Denmark, Spain, France, Italy, Austria, Portugal, and Sweden.
VOC are still emitted at levels that exceed levels what could be regarded as sustainable (EEA 2000a; SIKA 2001c). However, the paramount challenge is the emission of CO₂: more than 95% of all motorised transport is still powered by fossil fuel. Renewable energy sources and fuels are expected to continue to play a minor role in the market for the foreseeable future. Consequently, this calls for a reduced demand for transport. The societal toolbox of, for instance, taxes and command-and-control remedies has, however, not been adapted to such an extent that it has managed to reverse the growing demand for travel.

The problem is far from trivial: if we attempt to cut travel, we run into major conflicts of interests. Mobility is widely considered necessary for society’s growth and welfare, for company sales and competitiveness, and for personal development and success. Indeed, economic growth and transport demand have historically been strongly interconnected. So far, only Austria and Ireland out of the fifteen EU countries have been able to de-link economic activity and travel demand (EEA 2000a). The OECD policy meeting on ‘Sustainable Consumption and Individual Travel Behaviour’ concluded that: “The individual’s right to unlimited, motorised personal mobility has emerged as an important measure of progress in modern, democratic societies. As a result, many governments have been hesitant to expressly seek to change people’s behaviour to achieve less environmentally harmful travel patterns. This has, in the past, lead to a focus on technical measures to reduce negative environmental impacts from transport activity. However, initial progress brought about by more energy efficient and less polluting vehicles has been quickly outstripped by increase in vehicle numbers, travel frequency and trip length. It has become clear that technical solutions alone will not be sufficient to mitigate transport’s negative impacts” (OECD 1997).

3.2.1 The Role of the Organisation

What is the role of the individual organisations in this challenge? How relevant is this for the organisations, and what can they do? We will focus on the challenge of addressing the impact of business travel in the following discussion.

Transport activities, including business travel, constitute a large proportion of environmental impact of many companies, particularly service companies. Examining environmental reports of large Swedish employers like Ericsson and Telia, we find that transport accounts for the majority of
their CO₂ emissions (Ericsson 1998; Telia 2001). What are companies doing to tackle this major source of environmental impact?

3.2.2 Addressing Travel Impacts – Prioritisation of Means

Supposing the aim is to reduce environmental impact from work-related travel, what are the options available, and what priorities should we give to the different alternatives from a pollution prevention perspective? The standard general hierarchy of measures as recognised by for instance OECD governments, seems to be the most reasonable first approach to the problem. In the top priority group of preventing the occurrence of pollution, the following prioritisation is suggested, based on the level of impact by the different categories:

1. **Abstain**: This option could also mean scrutinising the intention of the trip – do I have to go, do all of us have to go, can we get access to something equally good or better with less travel implications? (E.g. – do we have to employ a consultant from the opposite side of the world or can we get equivalent services in-house or within walking distance?)

2. **Substitute**: ICT-assisted measures like video- or audioconferences – virtual meetings.

3. **Minimise**: Selecting an environmentally preferable way of travel. There are several complementary ways of approaching this.50

   a. Logistics in the form of route planning or combining different errands during one trips; locating a rendezvous which generates the least accumulated travel impact from all participants (e.g. not placing the Nordic conference in Hawaii, but choosing a location conveniently available via train)

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49 Nearly three quarters (73%) of the total CO₂ emissions originated from business travel for Ericsson employees working in Sweden in 1997. In the case of Telia, one quarter (25%) of the total CO₂ emissions was generated from business travel, and nearly three quarters (72%) including all transports in 2000.

50 The preference and suitability of the different options listed in the Category 3, depends on the conditions reigning. Nevertheless, the general preference follows the relative order of the listed measures 3 a. to 3 d.
b. Choosing the most appropriate mode of transport for example taking the train for trips shorter than a one-hour flight, public transport instead of taxi, bicycle instead of car

c. Selecting fuel: preferably renewable, non-fossil fuels, but if this option is not feasible, selecting relatively low emission fuels (e.g. natural gas rather than gasoline or diesel)

d. Selecting fuel-efficient vehicles and vehicles with exhaust treatment (e.g. catalytic converters on cars)

Abstain and substitute are the most efficient means of environmental impact reduction, but as these measures can only be used to a certain extent (travelling must still take place), the other measures should also be employed. While the general hierarchy of measures is useful in creating strategies and policies, it should be acknowledged that the relevance of the hierarchy for specific areas of implementation should be tested when possible.

3.2.3 What are the Current Measures Taken?

In a survey carried out for the Swedish Road Administration, companies were asked whether and how their environmental management covered business travel issues (Trivector 2000).\textsuperscript{51} The results indicate that it is primarily service companies that have begun to consider travel as an environmentally relevant issue, and that this is a relatively new phenomenon. Out of the 864 respondents, 14% had taken some action to reduce the impact from business travel. Among these, the three main drivers mentioned are ‘environmental consciousness’ (39%), ‘top management interest in environmental issues’ (22%), and ‘profitability’ (16%). The most common measure taken to reduce environmental impact from business travel was environmental education. Audioconferencing was the second, and videoconferencing the fifth most common measure, see

\textsuperscript{51} In this survey, 1470 company representative of different industries were targeted with an overall 60% response rate. Only 11% of the targeted companies, or 18% of the respondents, answered the questions in the section covering business travel in environmental management. Out of these, 40% had only started to think about the issue. Consequently, only 7% of the companies asked are represented in the results, which also can be interpreted as an indication of lack of interest for relating business travel to its environmental impact and to address the problem.
Figure 8. Out of the total number of respondents, approximately 7% were using audioconferencing and 4% videoconferencing.

The stated three main factors hindering companies from reducing the impact from business travel were: 1) the companies found it difficult and time-consuming to keep track of business travel, 2) poor access to public transport, and 3) difficulties in engaging employees.

Figure 8. Measures taken in Swedish businesses to limit environmental impact from business travel (Trivector 2000).52

52 The percentages presented in the histogram is based on the 124 companies, out of 864 respondents, that had taken some kind of action to reduce environmental impact from business travel.
The positive psychological dimension of business travel discussed in Section 5.1.2 may influence the willingness to address the issue. Those travelling most in an organisation are also usually those making decisions – which makes the issue even more intricate. As a result, the issue of reducing or greening travel has difficulties in reaching the corporate agenda. The problem suffers from a situation that can be illustrated by the public choice theory, as discussed in Paper III.

The organisations making these efforts are influenced by the policy instruments and tools that guide and steer their activities. If organisations are to be encouraged and able to engage effectively in reducing the environmental impact from work-related transport activities, a policy framework that supports such initiatives is essential, bearing in mind the dilemma that companies and others face in this issue. What does the policy framework look like that impacts business travel in Sweden? The dominating steering policy strategy used is economic incentives, in terms of taxes and charges, which are intended to control transport’s societal cost. However, as the business traveller does not pay this bill personally, this incentive might fail to influence the traveller, who is often also the person deciding to make the trip. Other government regulations such as rules for public procurement of transport services, permits for environmentally harmful activities, enforced environmental impact assessments, mandatory environmental reporting, and rules for business trips as bribes, are likely not sufficient to steer towards a more sustainable level of travel in business. Moreover, informative instruments such as environmental management systems, and eco-labelling either fail to address travel at all (e.g. ISO 14_001, the Nordic Swan, and the EU-flower) or stimulate more travel with environmentally unfavourable modes of transport (e.g. frequent flyer programmes). This further explains why organisations are reluctant to tackle the travelling issue and that their chances of success are limited.

In the study by the Swedish Road Administration mentioned above, ways to address commuter travel were also surveyed. Only 8% of the respondents claimed that the employees’ commuting was considered part of their environmental management responsibility, and 3% had taken some sort of action to address the issue. Telework was the most common measure (1%), followed by car sharing and economic incentives to walk or bicycle to work (Trivector 2000).
3.3 Travel Implications of the Studied Virtual Mobility Applications

3.3.1 Typology

Even though the extent of virtual communication is increasing, it is not self-evident that it replaces a physical trip. This type of communication may lead to different outcomes. The relationship between virtual communication and transportation has for long attracted interest of researchers and a number of suggestion on how to categorise this relationship have been made (Salomon 1986; Mokhtarian and Salomon 1994; Niles 1994; Rapp and Skåmedal 1996; Zumkeller 1996). Some important categories that have been identified include:

- **Substitution**: the use of telecommunication may replace or eliminate the need for transport;
- **Neutrality**: the use of telecommunication may have no effect on transport;
- **Modification**: the use of telecommunication may alter transport in terms of transport mode, departure time, etc.;
- **Generation, (Stimulation or Complementarity)**: the use of telecommunication may stimulate or generate more travel;
- **Effectiveness**: the use of telecommunication may make transport more effective or efficient.

These terms have mainly been used to characterise the effects on a macro scale. The typology can also be transferred to micro scale, and in this dissertation, three effect categories have been studied: substitution, supplementation, and generation, interpreted as follows:
1. **Substitution**: travel is substituted totally by the virtual communication;

2. **Supplementation**: the virtual communication supplements the physical trips that take place anyway, and travel remains on the same level;

3. **Generation**: virtual communication leads to more numerous and remote contacts and businesses, stimulating and generating more travel.

All of these three implications will occur, but the question arises, what is the dominant effect? In the following section, the potential and actual impact on travel of virtual meetings, telework, and telemedicine are discussed.

### 3.3.2 Travel Implications of Virtual Meetings

If we assume 100% transport substitution, what would the environmental savings potential be? The author recognises that this is an extensive and complex exercise if more accurate figures are required, including data on modal split for business travel, degree of occupancy, length of trips, type of vehicles and fuels used etc. Moreover, discussing transport and environment, not only CO$_2$ emissions are important but also other pollutants such as NO$_X$, VOC, CO, PM, and issues like noise, land coverage etc. However, as only a rough figure for the substitution potential is needed for the further discussion in this dissertation, and as CO$_2$ emissions are generally considered a critical environmental issue, the focus on CO$_2$ emissions is considered to be relevant.

As the transport sector accounts for 35-40% of all CO$_2$ emissions from fossil fuel, travel accounts for more than 64% of the CO$_2$ emissions from transport, and business travel amounts to approximately 10% of passenger kilometres in Sweden, a rough estimation of the maximum savings potential

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53 Supplementation should not be confused with complementarity, used by for instance Mokhtarian to indicate generation. The Swedish term *komplettera*, used in the surveys, can both be translated into complement and supplement, and has in the surveys been interpreted as that virtual communication has supplemented face-to-face communication, not affecting the volume of travel. This resembles the term neutrality in previously suggested typology. The author has previously used the term ‘complement’ (see for instance Paper I), but in order to distinguish from ‘complementarity’, the term supplementation has been used here.
for CO₂ emissions amounts to about 2-3%.⁵⁴ Considering the Swedish commitment to lower its CO₂ emissions by 4% in the period 1990 to 2008-2012⁵⁵ puts this potential into perspective. However, as 100% transport substitution is not realistic, the question arises – how much business travel does virtual communication replace today, and how much could it substitute if beneficial conditions applied?

Several estimates of the substitution potential are found in the literature. In a review by Rapp and Skåmedal (1996), the estimated substitution potential of total business travel was reported as 30% (Ireland, 1978), 20% (US, 1983) 20% (Canada, 1983), and 35% (Germany and UK, 1985). In more recent studies, figures such as a 25% replacement of business travel by air in the US in 2010 is estimated (Cook and Haver 1994), the latter study basing estimations more on actual development. Furthermore, a study by Arthur D. Little in 1995 predicts a 15% reduction of air travel and up to 40% reduction of business travel as a result of videoconferencing (Burger 1995, cited in (Roy and Filiatrault 1998)). In a Canadian study, Roy and Filiatrault (1998) estimated the current impact of videoconferencing at 1.8% and that the substitution had the potential to affect 3.6-8.6% of business air trips in the year 2000.

In order to examine what the actual impact of videoconferencing is on travel in Swedish organisations, the author studied the relative importance of the three effect categories substitution, supplementation and generation in four different organisations. In two surveys at Telia and SVUG, on the average 46% of the respondents claimed that videoconferencing had replaced business trips they would have made without access to this option. In addition, 19% claimed that their use of videoconferencing had replaced other people’s travel.⁵⁶ The proportion of the respondents answering that videoconferencing had no, or only a minor effect on their business travel was on average 32%, while the ones who experienced a generation effect was on average 3% (see Figure 9).

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⁵⁴ CO₂ emissions per pkm has been assumed to be higher than average for business travel, as the share of air travel, taxi, and single car usage is relatively high and use of train and public transport is low.

⁵⁵ Swedish Governmental Bill 2001/02:55

⁵⁶ This was an effect found, for instance, among managers who normally invited staff to meetings at the head office, and people giving courses to employees (in the case of SVUG also to students) working at different locations.
Figure 9. Respondents’ impression of the effect that their use of videoconferencing has had on their own and others business travel, averaged in the company Telia, and at the Scandinavian Videoconferencing User Group (SVUG).

Two more surveys were made at Skånska Lantmännen and at Tetra Pak. However, due to the limited number of respondents in the Skånska Lantmännen study, and the possibility to check more than one alternative for this question in the Tetra Pak survey, these were not included in the comparison in Figure 9. Nevertheless, the results from these two surveys are well in accordance with the results from the studies at Telia and SVUG, as evident from Table 1.57

57 The results were interpreted one step further in Paper 1, in order to allow a common presentation in one figure.
Table 1. Respondents’ impression of the effect that their use of videoconferencing has had on their own and others business travel. Personnel in four Swedish organisations were surveyed: the company Telia, the Scandinavian Videoconferencing User Group (SVUG), the farmers’ association Skånska Lantmänn, and the company Tetra Pak.

<table>
<thead>
<tr>
<th></th>
<th>Telia</th>
<th>SVUG</th>
<th>Skånska Lantmänn,</th>
<th>Tetra Pak *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replaced my own travel</td>
<td>47%</td>
<td>45%</td>
<td>58%</td>
<td>61%</td>
</tr>
<tr>
<td>Replaced other people’s travel</td>
<td>15%</td>
<td>22%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>Some reduction but only minor effect on my travel</td>
<td>20%</td>
<td>14%</td>
<td>17%</td>
<td>39%</td>
</tr>
<tr>
<td>Participated in meetings that I would not have travelled to otherwise</td>
<td>16%</td>
<td>15%</td>
<td>n.a.</td>
<td>19%</td>
</tr>
<tr>
<td>Increased my travel</td>
<td>1%</td>
<td>4%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>Number of persons answering this question</td>
<td>158</td>
<td>73</td>
<td>12</td>
<td>31</td>
</tr>
</tbody>
</table>

* In the survey at Tetra Pak, the respondents had the possibility to check more than one alternative.

Consequently, in all of the studied organisations, travel substitution was found to be the dominant effect, as about half of the respondents experienced that videoconferencing had replaced their own travel, and approximately another fifth that it had substituted other people’s travel. The results from the Tetra Pak survey also indicate that one person can experience both the effects of replacing both ones own and others travel.

How significant is the actual substitution effect, i.e. how much of the total travel of the organisations does it represent? Due to the lack of reliable figures for the total travel, this kind of comparison could not be made. However, some indications of travel substitution can be found in the companies’ own accounts. Tetra Pak, one of the organisations surveyed, has subsequently estimated its travel savings made possible by

58 However, estimates were made of the substituted travel distance in each of the organisations, based on the respondents’ own figures of how often they attended a videoconference, if it actually replaced a trip, how they would have travelled there, and the average distance to the meeting partners. These figures can be found in the author’s licentiate dissertation.
videoconferencing at about 10% (Miljörapporten 2000). Another of the companies involved, Telia, has for three consecutive years (1997–2000) reduced business travel by air, cutting the volume with more than a third, thereby breaking a long-lasting trend of travel growth. During the same period of time, their use of virtual meetings (mainly audioconferencing) has increased dramatically.

A small-scale example collected from Telia Nära, illustrates how this substitution can look in practice. The top management at the company started using audioconferencing combined with NetMeeting for three out of four quarterly meetings involving 60-70 managers all over the country. For these meetings alone, the company saved 3 million SEK (approximately EUR 330 000) in reduced costs for travel, hotel and loss of working time in two years.

3.3.3 Travel Implications of Telework

Telework is an area that has attracted a great deal of attention from the research community, including its environmental aspects. This environmental interest has almost exclusively been associated with the potential transport implications. Calculations were early made on how many oil barrels that could be saved, for each percent of the workforce that started to telework (Nilles 1976). The connection between telework and transport has since then been the subject of a large number of studies. In the following section, some of the key findings relevant to the transport implications of telework are highlighted and discussed.

In terms of the potential for CO₂ reduction, we could make a similar estimation as for virtual meetings. As commuting represents 21% of the total distance travelled in pkm (see Figure 7), and if we assume that commuting is characterised by the average travel CO₂ emission per pkm, commuter traffic accounts for approximately 4-5% of all CO₂ emissions in Sweden.

Considering that 6-12% of the labour market engages in teleworking, CO₂ savings could in principle be significant on a macro scale. Several estimates of possible travel reduction in a Swedish context have been made, for

example the City of Stockholm (1995) estimated that telework would replace 25-30% of all work-related commuting in the future (corresponding to 4.5% of all travel). Other more moderate estimates include 6% of the commuter traffic for the Stockholm region (or 1.2% of all pkm) (Paavonen 1992).

A hypothetic calculation can illustrate the potential on an individual level. Based on approximate average figures for commuting and telework in Sweden, the teleworker:

- teleworks once a week;
- has a 20 km one-way commute to the employer’s premises;
- makes half of these commute trips by car; and
- works 45 weeks per annum.

This would result in a reduction of 1800 pkm per annum, of which 900 pkm would be travelled by car.

In addition to this wide range of estimates, a number of empirical studies have been made. In the Telia telework survey by Arnfalk (1999) (see also Section 1.5.2 and Appendix II for questionnaire), 45% of the teleworkers (N=1755) claimed that telework had led to an overall reduction of their travel, and 10% responded that they had increased their overall travel as a result of their telework. The remaining 45% did not experience any change or did not know.60 The average distance saved was estimated at between 1230 and 2750 pkm per annum. The range depends on whether long distance commuters (mostly by air) are included or not.61 This can be compared to 42% who claimed a reduction in travel in the SNTW, 20% in a survey by Nordplan in 1995 (Engström and Johansson 1997), and the more than 50% who experienced a travel reduction in a survey by SIKA (1998a).

In addition, a study conducted at two companies within the Ericsson group

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60 Due to the fact that the alternatives offered in the questionnaire did not include a ‘no effect’ alternative, these two groups have to be reported jointly. However, several respondent (3%) added a comment that telework had had no effect on their travel.

61 The respondents estimated their annual saved pkm by selecting distance categories. The respondents in the highest category (above 5000 km) were asked to specify how much they saved. The average was 20 000 pkm and most of these respondents commuted by air. The range of travel savings depends on whether 5000 or 20 000 pkm per annum is used for this category in the total estimations.
indicated that 46% of the respondents reduced their number of commutes, but did not reduce the total distance travelled (Skåmedal 1999).

### 3.3.4 Travel Implications of Telemedicine

The travel volume generated by the health sector in terms of pkm is relatively limited (1%), compared to that of commuting and business travel. However, considering that this sector includes a sizeable share (18%) of the country’s employees, telemedicine will also influence commuting and business travel.

The potential time and cost savings from a reduced need for travel, has been a contributing factor for introducing telemedicine in Sweden. One out of three respondents (33%) mentioned travel savings as a reason for introducing telemedicine, in a survey of Swedish hospitals. Once the telemedicine applications had been implemented, half (50%) of the respondents experienced that it had resulted in reduced travel costs for patients and staff (Sjögren, Sandberg et al. 1999).

Travel reduction has been reported in a number of other studies on telemedicine. A search for travel in a telemedicine bibliographic database resulted in 158 hits, of which 30 article abstracts described empirical findings of travel reduction, and 46 described potential travel savings.

In a study of telemedicine on the island of Gotland by Elander (2000) made with the supervision of the author, the introduction of telemedicine was examined in three case studies. The three medical functions studied were: a) digitising the radiology department at Visby County Hospital (radiology); b) education of physicians at Visby County Hospital (education); and c) treatment of patients with problems related to wisdom teeth on Gotland (dental surgery).

In the radiology case, there was no significant difference in transport between the two options. However, substantially less travelling was needed

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63 The search was conducted in the bibliographic database of Telemedicine Information Exchange, which was created and is maintained by the Telemedicine Research Center with major support from the National Library of Medicine. The database contains more than 10 000 articles about telemedicine. Available online: http://tie.telemed.org/
for the telemedicine option in the education case (reducing lecturers’ flights between Stockholm and Visby), and a 34% transport reduction resulted from using the telemedicine option in the dental surgery case (reduction of patients’ trips to visit the dental clinic by car).64

### 3.4 Summarising the Analysis of Travel Implications

Transport has contributed to growth, prosperity, and well being of society, as for individual organisations. However, transport comes at a high cost, including the environmental impact. Climate change and the emission of CO₂ from combustion of fossil fuels is one of the major environmental concerns of today. Transport is accountable for 35-40% of CO₂ emissions in Sweden, and travel makes up nearly two-thirds of these emissions. Consequently, travel constitutes a major source of environmental problems, and the long-lasting trend of travel growth and its projected continued strong growth the next decades, is not compatible with the goals set up for reduction of greenhouse gases.

By dividing the distance travelled in Sweden by different purposes we find that 21% of the pkm are accountable to commuting, 10% are business travel, and about 1% to healthcare related travel. This corresponds to roughly 7-8% of the total CO₂ emissions in Sweden.

How can the impact from travelling be reduced? The impact per pkm travelled has historically decreased and will likely continue to do so. However, as the demand continues to grow, yet the total impact increases. Consequently, demand side has to be addressed as well. This is made by public policy measures, including command-and-control and market-based measures, for example by taxation of fuels.

But, what can the individual organisation do to reduce its travel impacts? In accordance with pollution prevention strategies, the prioritisation of means should follow the order of abstaining (consider whether travel is necessary), substituting (use other way of fulfilling the task instead of travel) and minimising (selecting an environmentally preferable way of travel). As organisations can cut only a limited part of their travel without damaging

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64 In the dental surgery case, the car alternative was most probable as the public transportation option was poor or not available for most patients.
their activities, substitution in terms of virtual mobility options may play an important role.

Currently, few companies in Sweden have started addressing the environmental implications from business and commute travel: 14% of the companies have taken some sort of action to address the impact from business travel, as compared to 3% for commute travel. For business travel, about 7% were using audioconferencing and 4% videoconferencing. For commute travel, telework was the most common measure used by 1% of the companies.

The actual travel implications of the virtual mobility applications may be divided into substituting, supplementing and generating the organisation’s need to travel. The effects on employees’ business travel and commuter travel have been subject to empirical studies. The predominant effect of videoconferencing in four organisations surveyed was a substitution of the respondents’ travel. On average 64% of the videoconferencing users experienced that the application had replaced business trips that would have taken place without access to this option, either for themselves (45%) or for their meeting partners (19%). The proportion of the respondents answering that videoconferencing had no, or only a minor effect on their business travel, was on average 33%, while the generation effect was limited in all of the organisations, on average 3%. In a study of telework at Telia, 45% of the teleworkers claimed that telework had led to an overall reduction of their travel, and 10% responded that they had increased their overall travel as a result of their telework. In other Swedish studies, the corresponding substitution percentages range between 20 and 50%. For telemedicine, several studies indicate that the application has been able to substitute travel, but the supplementing effect is also significant.
4 Virtual Mobility Beyond Travel
Implications

In the previous chapter, effects of virtual mobility applications on travel were discussed, and the resulting environmental implications. However, approaching the issues from a pollution prevention perspective, the effects from travel only provide a part of the picture. When considering environmental effects of virtual mobility applications, it is necessary to widen the perspective and to take into account other changes that these applications can bring about.

Therefore, in this chapter, a broader approach to ICT and its environmental implications is employed, and a typology for these implications suggested. The typology is subsequently used to discuss environmental effects of the three selected virtual mobility applications. Moreover, a calculation model is used to estimate CO₂ emission from teleconferencing and telework in two scenarios.

4.1 ICT and its Implications

ICT, or Information and Communication Technology, is the basic prerequisite for virtual mobility. If we are to look at virtual mobility from a pollution prevention perspective, it is essential to also analyse the technology behind this wide concept; particularly to the part that supports virtual communication – or Communication in the term ICT. Moreover, it is important to obtain an understanding of the ways this technology can lead to environmental impact.

4.1.1 Size and Growth of the ICT Industry

The ICT industry has become one of the most important in the world. A study of global information technology spending and economic impact found that the industry sector was valued at more than US$ 2 trillion (EUR
2.3 trillion) in 1999 (WITSA 2000), making it the second largest sector after hospitality and tourism. The global economic recession during 2001 has struck the ICT market particularly severely, breaking a decade-long trend of near exponential growth. Despite this, it has been projected that the industry will continue to grow and prosper (Edenholm 2002).

Throughout the twentieth century, but particularly during the 1990s, one of the basic prerequisites for virtual mobility has gradually been materialised, as the technical infrastructure, or Infrasystem was constructed. The growth and development of this system has made it possible for different end users to communicate via computers and modems, telephones, faxes, and videoconferencing equipment. This Infrasystem consists of a number of technical networks that can be divided into telecommunications and computer networks. However, the borderline between these networks and their functions is fading as the integration between the systems increase.

The growth rate of these networks and their use is perhaps one of the fastest, if not the fastest, of any technical system in history. Mobile telephones and the Internet have both experienced an exceptional expansion, not only in terms of numbers of users (see Fig.10) but also in network expansion. Indeed, the number of mobile phones worldwide within soon will surpass the number of fixed telephone connections. While this expansion is beginning to level out among some early adopters due to market saturation, most of the world is occupied with creating or expanding their telecom and computer networks.


66 An expression created by Arne Kaijser (1994). I fädrens spår, Carlssons Bokförlag. Just as the infrastructure provides cars, boats, airplanes etc. with a supporting system for transportation, an Infrasystem is the physical network facilitating virtual communication.

67 For example in the period 1990-1997 the number of fixed telephone lines was constant in Sweden, while in Hungary the number of fixed telephone subscribers increased by 68%.

68 As the progress in doing so varies strongly between different parts of the world, concerns have been raised that this creates a so-called Digital Divide, further widening the gap between more and less technically advanced countries.
This physical network development process creates two basic qualifications for the success of virtual communication. Firstly, it facilitates access to large numbers of end users and services. The network becomes more useful and attractive as more and more people and organisations are connected to it, a process that can be described as a positive feedback loop. This could also be seen as developing a critical mass of user end-points. Secondly, an increase in the network’s capacity to transfer data, or higher bandwidth, is a prerequisite for more advanced forms of virtual communication. For example, until the 1990s the telephone system with its limited bandwidth was the only affordable network available. This constituted a practical limitation to videoconferencing, for example, as real-time video communication demands higher bandwidth than audio. As new broadband networks were established during the 1990s, in parallel with development of more efficient ways of utilising the existing networks, bandwidth-demanding real-time video communication has become increasingly available and affordable.

However, these networks are also associated with an environmental impact. Various studies indicate, for example, that on a national level the Internet’s
electricity demand could increase within 10 years from around 1-2 percent to 5 or even 10 percent of the national electricity consumption (Barthel, Lechtenböhmer et al. 2001; Koomey et al. 1999; Türk 2001). In addition, the impact from all end-user equipment, including computers, telephones, and videoconference apparatus, has to be taken into account.

Consequently, the size and growth of the ICT industry is very significant and its environmental impact cannot be neglected. The growth of the infrasystem creates the prerequisite for virtual communication and improves possibilities for successful virtual mobility applications.

4.1.2 Environmental Impact of ICT

In the previous chapter, it became clear that an organisation actually can substitute some of the travel of employees with virtual communication. However, can and should we promote some ICT applications based on environmental considerations? What are the potential and actual environmental effects of ICT and its use? Which of these effects can an organisation influence, and how can it steer this impact in a preferable direction?

In order to approach the issue in a systemic way, structuring of the question is a necessary step, including defining the unit studied and setting boundaries. This is of vital importance as the area of interest is large, complex, and has countless interwoven effects. A first step in developing a systematised approach is to distinguish between direct or life cycle related effects, and indirect or application related effects (Arnfalk 1999). The direct effects are those related to the product or service, for instance material and energy consumption needed to produce and run a computer. The indirect effects originate from the use of the products or services, for example applications like telework or Internet banking that may substitute commuting or a trip to the bank. However, indirect effects also include subsequent or system effects like changes in lifestyles and consumption patterns, making this category very wide. Therefore, a further division of the indirect effects favours the understanding of the environmental implications.

Fichter (2001) distinguishes between three levels of effects for e-commerce and Internet use: first, second and third order effects. The first order effect, refers to the direct environmental effect of information technology infrastructure, comparable to the direct effect referred to in Figure 12. The
second order effects are those generated by Internet use, for instance effects on distribution logistics and on product use, take-back and recycling. Finally, Fichter categorises subsequent and rebound effects as third order effects, including changes in economic structure, changes in lifestyle and consumption patterns.

This division can be generalised and used to describe all ICT products and services as well as their applications. The concept Fichter’s classification will be adopted in this dissertation. However, for clarity, the terms life cycle effects, application effects and system effects will be used instead of first, second and third order effects, see Figure 11. In the following sections, the three orders of effects will be discussed.

<table>
<thead>
<tr>
<th>Life Cycle Effects</th>
<th>Application effects</th>
<th>System effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects from the entire lifecycle of ICT products or services ‘from cradle to grave’</td>
<td>Effects that can be directly associated to the use of ICT products or services</td>
<td>Effects that only indirectly can be associated to the use of ICT products or services</td>
</tr>
</tbody>
</table>

*Figure 11. A suggested typology for effects of ICT products and services.*

Life Cycle Effects of ICT Products and Services

Life cycle effects encompass the impacts associated with the product or service itself, including those generated during raw material extraction and refining, manufacturing, and end-of-life management of products. With the exception of energy consumption, the impact from use phase is generally excluded. However, health and safety concerns that can be directly related to the products can be categorised as a life cycle effect, such as electromagnetic fields generated by computers and mobile telephones (and

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69 The model can also be applied for products and services beyond the ICT sphere. However, this is outside the scope of this dissertation and will consequently not be discussed here.
by all other EEE, 70 to some extent), emissions of harmful substances such as brominated flame-retardants from computers, and ozone from copying machines.

The first order effects are generally more straightforward to estimate than the second and third order effects, though this does not imply that they are simple to evaluate. For tangible products, life cycle assessment (LCA) may be used to estimate the total environmental impact throughout an entire life cycle – from cradle to grave.71 A range of environmental policy and management tools have also been developed to address the problems that arise throughout the life cycle chain, as illustrated in Figure 12.

![Figure 12. Pollution Prevention tools available to address direct effects throughout the life cycle of ICT products (adapted from Mont (2001)).](image)

The life cycle effects of ICT are highly significant from an environmental point of view. The size of the industry and the large number of products produced every year consumes considerable amounts of material and energy, uses rare and toxic chemicals, and generates growing EEE waste problems. Thus there is an urgent need to develop tools to manage the direct environmental effects of ICT equipment.

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70 Electrical and Electronic Equipment

Application Effects – Using ICT Products and Services

Application effects are consequences of the use of ICT products and services. However, the use of energy to operate the equipment, as well as maintenance during the user phase, are considered to be direct effects. The focus is on the different applications made possible by the technology, such as the virtual mobility applications of interest in this dissertation, i.e. virtual meetings, telework, and telemedicine. The application effects are those that can be directly linked to these applications: transport effects of reduced commuter travel when teleworking, the need for adequate equipment at home or elsewhere, and an increased use of telecommunication. Quantitative estimates of environmental and other effects may be relevant at this level, although uncertainties may limit the usefulness of the results.

System Effects – Societal Implications of ICT

System effects can only be indirectly linked to the application of an ICT product or service. Changing our way of communicating by using more electronic media triggers significant changes in both our social and professional lives, which leads to a whole array of knock-on effects. It could be effects on where we decide to live, how large an apartment we wish to have, the job we look for or are willing to accept, how we socialise with family, fellow employees, neighbours etc. Analogous to the telework example in the previous section, the application effect of a reduced need to commute to the office may lead to system effects such as less congestion on the roads at commuter hours, better fuel efficiency, and less need for maintenance of roads. Moreover, the increased accessibility can influence where companies decide to locate their offices and how offices are designed, and even teleworkers’ changed preferences regarding where and when to shop.

A special category of effects, belonging to the systems level, is termed rebound effects. These effects are discussed in the following section.

With this wide scope for system effects, we have reached effects at the system or society level. The complexity is high, and we run into difficulties when trying to apportion an impact to one specific technology or a particular application of a technology. This leads us to a question of causality: how far in the chain of causal effects should we be concerned? If there is no limit to how far reaching this association is, it leads to a situation where your actions are partly responsible for all things that happen everywhere, and thus inevitably lead to environmentally negative effects. To
illustrate this problem, we may refer to what is often called ‘the butterfly effect’, borrowed from chaos theory,\textsuperscript{72} namely that the flapping of a single butterfly’s wings in the mountains of Venezuela may for instance be the initiator of a chain reaction that results in a tornado that eventually strikes Oklahoma.

A way of approaching the dilemma of what to consider as ‘reasonably linked’, is to use risk as a decisive parameter. ICT applications with high risks for environmental damage and/or good opportunities for environmental gain should accordingly receive greater attention than others. A similar dilemma appears when determining the extent of an LCA, i.e. drawing the life cycle boundary (Lindfors, Christiansen et al. 1995).

Allenby (2001) provides us with an illustrative example of a system effect, revealing a self-experienced, unanticipated side-effect of telework. Working at home during the summer months results in a significant decrease in laundry, due to less ‘public time’ at the office and less clothes worn. The environmental effect of reducing the number of laundry occasions from two per week to one every two weeks, and being able to line-dry the clothes instead of tumble-drying them, leads to a reduced environmental impact.

**Rebound Effects – the Downside**

The accelerated use of virtual mobility has been accompanied by expectations that it could lead to major travel reduction, time and cost savings, and efficiency improvements. As discussed in this dissertation, this may indeed be the case. However, the full picture is more complex. The various virtual mobility applications not only have these sought-after effects, but also other, unintended effects that may limit or even reverse the desirable outcome. In discussing this phenomenon, it is necessary to introduce the term rebound effect, which can be described as (Radenmacher 1999):

\[
\text{the subsequent erosion of the positive potential of technological innovation by increases in overall activities, and the concomitant increase in consumption of material and energy}
\]

The term originated already in 1865, when Stanley Jevons mentioned the rebound effect in his work ‘The Coal Question’, referred to by Herring

\textsuperscript{72} The Chaos Theory was initially presented by James Gleick (1988) when he published “Chaos: Making a New Science”, London: Cardinal.
For more than a hundred years it did not gain much attention, but following the energy crises of the 1970s, energy economists revived the expression (Khazzoom 1980). The rationale can be illustrated by the following example: when products become more energy efficient, for instance light bulbs, the consumer saves money as she or he pays less for the function, in this case illumination. This may lead to the consumer using this savings to keep the light on longer or to buy and use more lamps, and thereby consume more energy – a rebound effect has arisen. When the concept of eco-efficiency is added to the group of tools discussed in terms of resource conservation, again the rebound effects become a topical question when the rate of efficiency improvements is lower than the growth rate of consumption. The same ‘growth effect’ (Radermacher 1997) is found in the ICT sector’s increase in computer performance and reduced price, and the resulting growth in consumption of ICT products and services (Plepys 2001).

Consequently, the term ‘rebound effect’ is used for a less than one-to-one correspondence between efficiency gains and reduced consumption. Different types of rebound effects have been distinguished, and a typology has been suggested. In brief, the major types of effects can be described as:

- **Price effect**: increased efficiency in the use of a resource leads to a lower resource price, leading to increased consumption of the resource;
- **Income effect**: money saved from lower cost for one resource can be spent on consuming more of this resource or other resources;
- **Economy-wide effects**: the rebound effects in one market may affect price and quantity in other markets as well;
- **Transformational effects**: technology changes trigger changes in customers’ preferences, social institutions, and organisation of production (Greening, L. et al. 2000).

The concept of rebound effect can be used to help describe the environmental effects of ICT applications in general and virtual mobility applications in particular, not only those effects that correspond to the definitions found in the literature, but also a number of rebound-like (Plepys 2001) effects. Telework may, for example, not only replace a commute and thereby save money for the commuter, which he or she may use for other activities with associated environmental effects (income effect). It can also lead to effects such as shifting the mode of transport those days the teleworker goes to the office, it may effect decisions on where and how to
live, what job to take, working hours, what day care children go to, where and how to shop, and so on, all of which also have associated environmental effects (transformational effects). Rather than categorising these system effects as yet another type of effects (rebound-like), they will be referred to as rebound effect in those cases where the system effects of an ICT application are considered negative.

Applying this concept to virtual mobility and its applications, we may argue that the function (accessibility) may be achieved in a more eco-efficient way, by using electronic communication instead of physical travel (Arnfalk 2000). Accordingly, the money saved by avoiding costly travel (commuting, business travel, service or shopping trips) may be used for purchasing more ICT-based communication equipment, to engage in more virtual communication, or to buy other travel services. All of these must be regarded as possible rebound effects. Moreover, a ‘scattering of activities’ may be triggered by the technology, as the requirement of being at a specific place at a certain time to perform an activity is lessened. This, in turn, can lead to companies and individuals moving out from cities to suburbs, creating urban sprawl. What is more, this leads to longer distances between physical locations of places for work, housing, shopping, banking, restaurants etc., which may generate more transport. Indeed, Mokhtarian (1998) concludes that it appears unlikely that telecommunications will noticeably reduce travel at a system level, based on the conceptual nature between telecommunications and travel, and that the mounting empirical evidence supports a predominant effect of complementarity.

Time is another important parameter, relevant to all of the virtual mobility applications discussed in this dissertation. A set of critical time-related questions points out the importance: what do we do with the time we ‘save’ by using virtual mobility instead of travelling? Do we allocate this time for work or leisure? Does this lead to more or less stress in our professional and private life? What is the environmental impact of the alternative activity conducted during the released time? Consequently, the issue regarding time saved is a central one in terms of rebound effects and is closely linked to other parameters such as money, efficiency, quality of life, energy and material consumption, and can thus be mirrored to any of these.

Studies Analysing the Effects of ICT

When a manufacturer of a product designs, produces, and sells a product or a service, the application effects and system effects are often considered so
complex and unmanageable that they are disregarded or disconnected from the environmental performance of the products or services. Nevertheless, within the ICT sphere, some attempts to structure and model these effects have been made. Six of these studies are summarised in Appendix VII.

The studies in Appendix VII display the variety in analytical frameworks employed. Consequently, studies of the effects of ICT on transport and the environment vary strongly in design and outcome. Depending on the area of interest, or purpose for studying the effects, different aspects and measures are included. Variations of the studies include:

- Potential effects or actual outcomes;
- Desirable or undesirable effects (e.g. for the environment, health, stress, CO₂ emissions etc.);
- Impact in different specific areas: economy, transport, energy etc.;
- Past, present or future effects;
- Comparative studies of virtual or traditional ways of doing things (e.g. shopping online compared to going to the shop);
- Focus on the effects of a specific product or service (e.g. a computer), or the generic use of this type of products or services (e.g. e-commerce);
- Quantitative or qualitative (and in some case semi-quantitative, making rough estimations based on assumptions and estimations).

Naturally, all of these diverse variables make it very hard to compare the different studies, and to patch them together in order to provide a more full picture. Nevertheless, an attempt was made to extract some common findings from the different studies. These limited common findings identified were: 1) effects on transport, energy consumption, dematerialisation, and CO₂ emissions, are common environmental parameter studied 2) the few results that can be compared differ largely between studies. It becomes evident that the environmental effect of ICT can hardly be studied as such – ICT is a too broad an area. Narrowing the scope down to telecommunications does not make the situation significantly easier; the number of technologies and applications thereof are still very vast. Moreover, looking for environmental effects is also a very wide scope.

Focusing on specific applications used under well-defined conditions is a prerequisite for any relevant outcome of such a study. Accordingly, the
purpose and design of the study must be transparent to be able to set the outcome into a perspective.

As described in Section 1.5.2, a model for estimating the economic and environmental implications of telework and teleconferencing for an organisation has been developed by the author in the licentiate phase of this research. The overall effect on CO₂ emissions and company costs (in SEK) are estimated for the two scenarios, which resemble ‘best case’ and ‘worst case’ scenarios. The outcome of the two scenarios, ‘Business-as-usual’ and ‘Collabication’, are referred to more in detail in Sections 4.2.2 and 4.2.3.

**Relevance of Understanding the Environmental Effects of ICT in Pollution Prevention**

This structuring of different possible effects of ICT products and services supports an analysis of how organisations may be able to address the potential environmental impacts of ICT.

The predominant pollution prevention tools applied by companies are restricted to life cycle effects, and within this category, the focus is still on the production phase (e.g. environmental management systems, waste and energy minimisation schemes). The area of environmental concern and responsibility is gradually expanding to include environmental impact that originates outside the production phase, and as illustrated by Figure 12, a number of tools have been developed to address impact in different stages of a products lifecycle (e.g. eco-design, eco-labelling, end-of-life management). In addition, life cycle assessment is a tool can be used to estimate the environmental impacts throughout the life cycle.

The application effect of ICT products and services can be relevant for the organisation if it directly affects its operations and/or its employees. The effects on business travel and commuting of employees, is for example a application effect of the use of virtual meetings and telework. As discussed in Section 3.2.3, companies are starting to address the environmental impact of travel using these forms of applications. However, it is questionable if a hospital considers the environmental effects from travel of their patients to fall within their sphere of responsibility, and that this would influence their use of telemedicine.

It can be assumed that most organisations do not consider system effects their concern or responsibility, unless the effect significantly influences the
operation or employees of the organisation. It is hard to imagine a situation where for example a company would take on responsibility for what an employee does with money saved by reduced commuting costs. Other possible systems effect of telework could be that recruitment of employees is expanded geographically, or that employees choose to live further away from work. As it is within the interest of the employer to hire skilled personnel and to have satisfied employees, it is unlikely that the organisation would not hire people living further away from the office or try to discourage their employees to live where they want, based on environmental concerns.

Consequently, the environmental effects of ICT and its applications that a company, or other organisations can be expected to consider and take action to influence, are life cycle effects, and application effects if they affects the operations and/or employees of the organisation.

4.2 Environmental Impact of Virtual Mobility Applications

After having discussed effects of ICT in general, the focus is now narrowed to the three virtual mobility applications of interest in this dissertation. As described and defined in Section 4.1, effects may occur at a life cycle, an application, and at a system level. Using this typology, environmental effects of each of the applications will be discussed separately.

Moreover, the calculation model presented in Section 1.5.2 and Appendix VI is used for the sake of illustrating a) the relative importance of various environmental impacts (in terms of CO₂ emissions) generated by telework and teleconferencing, and b) the disparity between different possible outcomes.

4.2.1 Environmental Implications – Virtual Meetings

Life Cycle Effects

A comparative life cycle assessment was made which compared a videoconference with a trip, either by air or by train, between two offices in Gothenburg and Stockholm in Sweden (Östermark and Eriksson 1999). The comparison, including sixteen impact categories, three levels of life cycle boundaries, and two scenarios, generated several interesting results.
Although the study was intentionally designed to be unfavourable to the videoconference alternatives, the trip by air had, by several orders of magnitude, more impact than the videoconference. Travelling by train had a higher or similar impact in comparison with the videoconference, depending on which of the scenarios and conditions were used.

Another finding was that the frequency of use, and whether or not the equipment was left permanently on (in stand-by mode), had considerable effects on the total environmental impact of the videoconference equipment. When, for example, the equipment was poorly used and permanently on, travelling by train was comparable with, or even better than the videoconference from an environmental point of view. A more detailed analysis of the study and its results can be found in Arnfalk (1999).

**Life Cycle and Application Effects**

This comparison takes for granted that the videoconference replaces a physical trip. However, this is not always the case, as illustrated by Figure 15. Moreover, videoconferencing requires more than just equipment: this may be furniture and a designated studio, which may require more energy than the equipment itself (Arnfalk 1999). Correspondingly, a physical trip often includes a transfer (e.g. taxi) and hotel, which further add to the environmental burden of travelling. Taking these factors into account, Arnfalk (1999) presents comparisons of the CO₂ emissions in two scenarios at a fictitious company (briefly described in Section 4.1, Case VII) and illustrated by Figure 2.

In Scenario 1, business-as-usual conditions prevail and virtual meetings are used to a limited extent (based on an aggregate impression of the actual use of teleconferencing in a number of organisations). In Scenario 2, Collabication (Collaboration and Communication), a more extended use of teleconferencing has developed, which has made a significant impact on the company’s business travel (based on ‘best-practice’ cases). The environmental net outcome of the two scenarios, measured in terms of reduced CO₂ emissions, is illustrated in Figure 13.
Figure 13. The reduction of CO₂ from teleconferencing in the two scenarios ‘Business as usual’ and ‘Collabication’ (Arnfalk, 1999).

The scenarios demonstrate the poor utilisation of the savings potential in most companies contacted, resulting in a minute CO₂ emission reduction compared to the potential gains. However, even with the limited use of the application, the effect of substituting business trips outweighs the CO₂ generation from production and use of videoconference equipment, studio and furniture.

How do the different impacts from travel, furniture, and equipment compare? As illustrated by Figures 14 and 15, travel plays a dominating role in terms of CO₂ emissions for both scenarios.
4.2.2 Environmental Implications – Telework

From an environmental point of view, telework does not only have implications for transport, but also a number of other practical effects on teleworkers’ surroundings. Most teleworkers rely heavily on access to an
arsenal of ICT equipment in the home as well as an increased use of telecommunications. This is seldom substituting or reducing the equipment at the main office, and this complementary need for EEE more than likely leads to an increased life cycle effect. The same is true for the utilisation of office space and furniture, which seldom is reduced even if the teleworker spends considerably less time at the main office. However, the teleworker uses a working area in the home, which requires office-like furniture and in some cases a larger living area.

A study by the German Institute for Applied Ecology (Öko-Institut) puts the relative importance of these implications into perspective, comparing the life cycle effect (in terms of energy consumption) from the EEE used by a teleworker and from heating the teleworker’s home-office space, with the travel savings (Griesshammer, Gensch et al. 1997). The results of this study indicate a net increase in energy consumption, mainly due to the extra heating requirements in the home.

Taking the life cycle effect from EEE, telecommunication, home-office space and furniture at home into account, Arnfalk (1999) has estimated the net effect of telework in terms of CO₂ emissions. The estimations are based on a calculation model, for which the results from two scenarios have been generated. The relative importance of the different effects is shown in Figures 16 and 17. The result of the scenario ‘Business-as-usual’, shown in Figure 16, was a net increase of CO₂ mainly due to the limited travel reduction, no decrease in office space, and that two computers were needed. This result agrees with the Öko-Institut energy estimates.

However, as the ‘Business-as-usual’ scenario is not far from the environmentally ‘worst-case’ scenario, it is equally interesting to see what the potential ‘best-case’ outcome could be, based on the same basic conditions, but with a different telework design. The outcome of this ‘best-case’ scenario, entitled ‘Collabication’, can be seen in Figure 17. In this scenario, a net decrease of CO₂ emissions is achieved, mainly due to the increased travel reduction and the use of one computer.

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73 The study assumes a 1700 pkm saving in commuting per annum, and that the teleworker has to heat an extra 10 m² home-office area.

scenario, telework led to a net decrease of CO\textsubscript{2} emissions. The Collabication scenario differs from the Business-as-usual scenario in the following ways:

- A larger share of the employees telework (50\% compared to 6\%);
- In both scenarios, the telework frequency is two times per week, but in the Collabication scenario telework take place over whole days (and not mainly half days, evenings and/or weekends as in the Business-as-usual case), which results in a larger commuting reduction (3840 km compared to 480 km);
- One laptop computer is used for both workplaces instead of two stationary computers;
- A flexible office solution is used instead of fixed private offices, reducing the office area per employee required with 20\%;
- With a more serious telework commitment, part of the home is calculated as an extra home-office space (10 m\textsuperscript{2}) in the Collabication scenario, which was not the case in the Business-as-usual scenario; and
- Special furniture is acquired in the Collabication scenario, which was not the case in the Business-as-usual scenario.

![Environmental impact category](image)

**Figure 16.** The net CO\textsubscript{2} saving from teleworking in the ‘Business-as-usual’ scenario. The negative total result indicates a net increase of CO\textsubscript{2} emissions (Arnfalk 1999).
The two scenarios illustrate that the net environmental outcome of telework is not fixed; on the contrary, it is very much dependent on how the telework situation is designed and managed. Moreover, it is not only the effect on transport that is of environmental concern, but also EEE and the use of space in the home and at the office have significant implications. With this knowledge, it is possible to consciously shape telework in a way that is environmentally beneficial, as well as economically and socially preferable.

4.2.3 Environmental Implications – Telemedicine

In a Master’s thesis by Maria Elander (2000), supervised by the author, the environmental implications of three different telemedicine functions were analysed. As they differ in character and extent, different approaches have been used to evaluate the environmental effects.

Radiology

The impact of the traditional X-ray development process was studied in the radiology case, including use of chemicals for development of film, the X-
Ray film itself, and use of rinse water. Through digitalising, the use of 6400 litres of development liquid, 8000 litres of fixation liquid, three tons on X-ray film, and the disposal of 800 m³ rinse water became redundant. The relevance of this shift becomes even more evident on the macro scale. If this was carried through at all the hospitals in Sweden, it could result in an annual reduction of 1 million litres of development liquid, 1.3 million litres of fixation liquid, 500 tons of X-ray film, and the emission of 125 000 m³ of rinse water.

In addition, the digital option reduced the need for storage space for X-ray film, previously taking up 100 m², which can be compared to the 3 m² digital library area. No comparison was made of the environmental impact of the traditional and the digitalised equipment. This case does not have any direct effects on travel, but is interesting from an environmental viewpoint due to its large dematerialisation effect.

Education

Educational seminars are held for physicians (MDs) during their internship or residency about 60-70 times per year at Visby general hospital. These seminars are held at Huddinge general hospital in Stockholm, and mediated via videoconference to Visby. No such seminars were given in Visby before this option became available. Two scenarios were used, comparing a ‘traditional’ scenario, in which the lecturer would fly from Stockholm to Visby, with the scenario using videoconferencing. Using CO₂ emission as the common unit for environmental impact comparison, and including the impact from travel, hotel, and energy use for studio and videoconferencing equipment, a comparison between the two scenarios was made. The total CO₂ emission was 2000 kg per annum in the ‘traditional’ scenario, and 1100 kg using telemedicine, i.e. 45% less CO₂ emission in the second scenario.

As these seminars did not take place before the telemedicine option became available, this is a typical supplementing travel case, in which the travel volume is unchanged, but the use of the virtual medium has been added. It could, however, be seen as a way of meeting demands for these kind of lectures and thus substituting a growing transport demand.

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75 In absence of any available LCA studies on the X-ray process, Elander based her selection of the most significant environmental aspects on interviews with persons working with the X-ray development process, representatives from the industry recycling spent developing fluids, and producers of film and development chemicals.
**Dental surgery**

In Elander's third case, the remittance procedure for dental surgery of wisdom teeth was targeted. The telemedicinal function was in this case a transfer from paper to electronically based remittances, which can make it possible to reduce the number of visits by a patient to a dental surgery specialist. Also here, CO₂ emissions for two scenarios, ‘traditional’ and ‘electronic’ were compared, including impact from travel, electronic equipment, postal mail delivery, and the use of practice space. The total CO₂ emission was 1700 kg per annum in the ‘traditional’ scenario, and 1400 kg using electronic remittances, i.e. 18% less CO₂ emission in the latter scenario.

This is a fictitious case, used to illustrate more generally the effect of changing from a traditional paper-based medical information system to electronic information management. As in the education case, the importance of the travel effect is made evident, yielding the major difference between the two scenarios.

Consequently, the telemedicine functions studied could lead to an overall reduction of CO₂ emissions, provided they reduce travel and not only supplements the traditional health care. However, the effects in these studies must be regarded as more potential than actual, and more supplementing than substituting. In addition to travel implications, dematerialisation was environmentally relevant.

### 4.3 Summarising the Analysis of Environmental Implications

When studying virtual mobility applications and their impact on travel from a pollution prevention perspective, the environmental effects from travel only provide us with one part of the picture. The expanding computer and telecom networks give more people and organisations access to virtual mobility applications, and increase in bandwidth makes them also more useful and attractive. However, these applications are also associated with environmental impacts, as are ICT equipment such as computers, telephones and videoconferencing apparatus. Considering the vast size and fast growth of the ICT industry, the impacts of ICT, the prerequisite for virtual mobility, cannot be ignored.
A typology has been suggested for implications of ICT at different levels. Three types of effects have been categorised: Life cycle effects refer to effects that stem from the entire lifecycle of ICT products and services. Application effects are effects that can be directly associated to the use of an ICT product or service, and finally system effects are those effects that only indirectly can be associated to the use of ICT products or services. In addition, rebound effects are discussed, a term used for a less than one-to-one correspondence between efficiency gains and reduced consumption. Virtual mobility applications may suffer from rebound effects in economic, environmental or temporal terms.

A literature review of relevant studies of the use of ICT and its environmental effects reveals very scattered findings, and it is hard to draw any distinct conclusions from these studies. One of the major problems is the large uncertainty of the system effects. However, the environmental effects of ICT and its applications that a company, or other organisations can be expected to consider and take action to influence, are life cycle effects, and application effects if they affect the organisations’ operations and/or employees.

Environmental effects of telework and teleconferencing are discussed and put into perspective, using a calculation model to roughly estimate CO₂ emissions from two scenarios. In addition to direct travel implications, the impact from ICT equipment and networks; use of space in the home, office or in a hotel; and other equipment needed such as furniture, are taken into account. For teleconferencing, the travel substituting effect outsized all other effects in both scenarios. However, for telework, the CO₂ reduction from the limited travel reduction in the ‘worst-case’ scenario, was smaller than the increase in CO₂ accounted by extra equipment and home area needed. For both applications, the outcome of the two scenarios differed widely, which can be interpreted as that the ‘worst-case’ scenario, which resembles the conditions in many organisations, is environmentally sub-optimised.

The telemedicine studies covered, revealed that for example distance education of medical personnel could give potential travel savings, although the current use is mainly supplementing existing routines. In addition, dematerialisation of for instance X-ray equipment may yield substantial environmental gains.
5 Virtual Mobility Applied – Virtual Meetings

By 1975 we will no longer need to spend time in face-to-face meetings. Thanks to computer terminals and picture telephony, we will be able to meet electronically from our office chairs – at least that is what engineers have predicted.

1975 as predicted in 1969

In this chapter, the possibility for an organisation to shift towards an increased ‘virtualisation’ of business meetings will be discussed. At first, a brief introduction to and description of business travel and virtual meetings is given, followed by an analysis of how the two may be interchanged. In this analysis, travel implications of virtual meetings are addressed, but also economic and social aspects are taken into account, as well as a discussion on the role of policy. The chapter ends with a discussion on how to realise a shift towards a higher share of virtual meetings.

5.1 Basic Characteristics of Business Travel

The relevance for the concept of virtual meetings to be brought up as a virtual mobility application and discussed in a pollution prevention context is its potential effect on business travel. It is therefore important to understand a number of basic characteristics relevant to this type of mobility.

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5.1.1 Extent and Growth of Business Travel

At first, some basic statistics of business travel is justified. In conformity with the general travel trend discussed in Section 3.1, business travel has been growing strongly over a long period. On the macro scale, business travel now accounts for about 5% of all travel trips in Sweden (SIKA 2001b), and 10% of passenger km (pkm) travelled (Jonsson 2001). Most business trips are made by car (77%), which corresponds to 57% of the total distance travelled on business. For trips exceeding 10 km, aviation is the second most common mode of transport (SIKA 2001b). In aviation, 41% of all passengers (53% domestic, 33% international) are business travellers (LFV 2000). Aviation sector is the fastest-growing mode of transport: its growth in passenger numbers over the last four decades is shown in Figure 18.

![Figure 18. Number of arriving and departing passengers in Sweden, international traffic at all publicly-owned civilian airports. Source: Civil Aviation Administration airport statistics, referred to in (SIKA 1998b).](image)

In the aftermaths of the terrorist attacks on September 11th, 2001, air traffic has declined considerably, leading to dramatic cutbacks in the aviation industry. Swedish records for November 2001 reveal a large drop in passenger number compared to November 2000: 8% fewer domestic passengers, 13% fewer in traffic to Europe and 57% fewer to the rest of the world. LFV (2001). Trafik och statistik - November 2001 i siffror. Swedish Civil Aviation Administration, [December 28, 2001] Internet: http://www.lfv.se/site/library/statistics/index.asp

Tourism in general has declined by 12 to 15% worldwide WTO (2001). Tourism after 11 September 2001: Analysis, remedial actions and prospects., World Tourist Organisation.Special Report 18. In a survey of 5600 US companies, one third said that they would curtail their business travel as a result of the terrorist attacks Coolidge, S. D. (2001). “Attacks curtail the era of the ‘road warrior’”. Christian Science Monitor: 1. The immediate effects from this event have been dramatic, but the long-term effects are more difficult to predict.
5.1.2 Character and Purposes of Business Travel

Providing access can be viewed as a principal reason why we travel in business. This accessibility should be valued by the organisation as sufficiently beneficial ($B_{ORG}$) to justify the cost ($C_{ORG}$) in terms of time, money and the employees’ efforts, i.e. $B_{ORG} > C_{ORG}$. The trip can provide the traveller access to for example customers, suppliers, partners, colleagues, or to places, products, instruments, etc. This in turn should yield values such as revenue, information, knowledge, skills, collaboration, services, maintenance, and so on. The value added could also be intended for the party visited by the traveller, or for both. Moreover, business travel often involves a dimension of more intangible values such as trust, confidence, interest, pleasure, fear, and gratitude.

The distribution of purposes of business trips vary, of course, between different organisations, depending on their type of business, number of employees, geographical distribution, organisational culture etc. On average, the most common reason for business travel in Swedish organisations is to attend a business meeting. In a survey at Telia Nära, the author found that two-thirds (66%) of the respondents were travelling to meetings about company projects or some other kind of cooperation. The term ‘meetings’ includes start-up meetings (or kick-off), project meetings, meetings with suppliers, recruitment, and so-called ‘visible leadership’. The second most common purpose was for training or conferences, to which nearly half of the respondents were travelling (45%), followed by network meetings (29%), and customer contacts and marketing (12%) (Arnfalk and Kogg 2001). In the US, the national survey of business travellers reveals a similar pattern, in which nearly half of business travellers (47%) report that their last trip was to attend a meeting, trade show, or convention. A general finding is that in large organisations with extensive geographic distribution, the majority of business trips are triggered by collaboration with partners within the company or company group. At Skanska, more than 80% of domestic travel was due to intraorganisational collaboration (Nilsson 2001).

A tendency found in the geographically distributed organisations surveyed, such as Telia, Lantmännen, and Skanska, was that intraorganisational meetings often took place at the main or head office or in its vicinity. The meeting was normally initiated by someone at the head office, requesting

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78 Personal communication with Cathrine Wickerts, chairman of Swedish Business Travel Association, September 13, 2001.
employees at other locations to travel to the meeting. In some cases, this triggered annoyance at a local office level, where the requested number of participants was considered unnecessary, or respondents believed that the meeting could easily taken place virtually. In the Telia Nära case, this was referred to as the ‘Stockholm-syndrome’, and was reflected in the travel frequency per employee and year: Stockholm (8.8), Gothenburg (13.5) and rest of the country, on average (13.3) (Arnfalk and Kogg 2001). In the Lantmännen case, a similar pattern was found, with the regional offices regularly travelling to meetings in and around the location of the head office in Stockholm. In both these cases, interest in conducting meetings virtually was much greater among the parties outside the main office than among personnel at the main office.

**Who is Travelling on Business?**

The occupational groups that travel most frequently in the organisations studied were generally upper management, project leaders, and sales and purchasing personnel. Here too we find a large variation between different individuals and organisations. The demographic profile of the business traveller is in Sweden overwhelmingly male (69%) (SIKA 2000b). This can be compared to business travellers in the US, where 60% of business travellers are male (TIA 1999).

**Benefits of Business Travel**

*Societal Perspective*

As discussed in Section 3.1, transport in general has historically constituted a major economic driver. It has facilitated and stimulated society’s development and progress, and has made efficient production and consumption system possible. Comfortable travel to distant places has become commonplace (OECD 2000). It also creates value and employment.

Consequently, as the societal benefits (B_{SOC}) of transport have been highly valued, investment in transport infrastructure has for a long time been a standard solution for supporting and strengthening economic growth (Andersson and Strömquist, 1988). The historic coupling of transport

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79 The expression used should *not* be confused with another ‘Stockholm-syndrome’ referring to the phenomenon when hostages start to sympathise with their kidnappers.
Virtual Mobility and Pollution Prevention

volumes and GNP is hard to dismiss. The establishment of the World Trade Organisation (WTO) is a major manifestation of the globalisation trend. Within the framework of the WTO, a number of agreements have been made that will facilitate international trade. This naturally generates the need for more contacts and communication between remote parties, and thus, in turn, calls for more business travel.

Organisational Perspective

Paper I discusses the perspective of the organisation, where travel has been important to a company’s survival, by attaining and maintaining customers, suppliers, retailers, partners, and other business contacts (BORG). These parties need to communicate. This generates a large number of meetings, many of which require people to travel long distances to attend. Meetings are also a way of exchanging information and generating new ideas. Furthermore, the industry category also includes a large group of companies that benefit from business travel in general, for instance petrochemical companies, vehicle manufacturers, travel service providers, and construction companies.80

Individual Perspective

Paper III highlights the perspective of the individual employee, who often view travel very positively, as a personal benefit (BIND). Many organisations even use business travel as a selling point when trying to attract new recruits. Business travel is still surrounded by an aura of status and glamour, even though it has become increasingly commonplace and is no longer the privilege of top management. The feeling of importance when a company considers you and your work so vital that it is willing to spend thousands of dollars for you to travel to some remote part of the world is enough to boost most people’s ego, and signals professional success to one’s surroundings. In addition, the possibility of combining a business trip with a vacation is gaining acceptance and popularity, and bringing the family along

80 Outside industry, politicians can be cited as an example of another group that is strongly dependent on meeting people in different places, attending various events, seeing things and being seen. In addition, along with becoming a member of the EU, Swedish politicians are increasingly expanding their focus outside the country. This generates a need for travel, and some even claim that ‘the more travel, the better the politician’ (Lindberg 2001). Politicians naturally have a strong influence on travel, both as policy makers and as role models.
is becoming more common (Chanen 2000; Shifflet and Gillice 2000). In the US, one in five (21%) business travellers combines business and vacation in one trip (TIA 1999). However, in companies where most staff travel, the motivation for business travel is less, and travel is considered hard work that you would happily reduce (Halme, Fadeeva et al. 2001).  

Other personal drivers that help make business travel attractive are frequent flyer programmes, tax-free goods, and travel allowances. When asked whether they are influenced by these factors, very few admit that this is the case. However, a majority insists that these factors have significant impact on others’ frequency and mode of transport (Arnfalk 1999). An illustrative anecdote reveals the importance of frequent flyer programmes. Given a choice between immediate departure with an airline that did not provide any bonus points, or waiting an extra hour for an airline that did, eighteen out of twenty employees at a major Swedish company, flying between Oslo and Stockholm, chose the later flight (and doubled the time duration before they got home) (Kogg 2000).  

A managing director at a company plays an important role as a source of inspiration and role model for employees. A survey of Swedish managing directors by Boson (1999) revealed that their top three interests were to ‘meet new people’ (77%), ‘leisure travel abroad’ (75%), and ‘travel’ (74%). These results indicate an above-average interest in travel in this group, and contradict the hypothesis that busy top executives are weary of business travel. The likelihood that these decision makers will promote travel substitution based on environmental considerations is limited, taking into account that the one area (of 22) attaining least interest among managing directors was ‘environmental protection’ (41%).  

In addition to being role models, the top management can influence business travel by calling employees to physically attend meetings (compare with the ‘Stockholm-syndrome’), and also address an aura of status and success when travelling in business.

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81 Discussions with representatives from the studied organisations indicated a clear difference in attractiveness between domestic and international business travel. In general, international trips were considered more attractive than domestic. A commonly stated reason was that domestic trips are often routine trips, with little or no social arrangements associated to them.
Business Travel Costs
As for the benefits of business travel, the concerns in terms of costs can be viewed from a societal (C_{SOC}), organisational (C_{ORG}), or individual perspective (C_{IND}).

Societal Perspective
Looking at the issue from a societal perspective, transport has societal costs that stem both from building and maintaining infrastructure, and from the use of this infrastructure. Externalities from the use of the infrastructure include environmental impact, casualties and accidents, and noise. For an efficient transport volume and modal split (between car, train, aviation etc.), all costs, i.e. private costs and external costs, should be balanced with the benefits of the transport. Those benefits are in most situations internalised costs, i.e. they are already considered in the decision-making by individuals and organisations. However, many studies have shown that road transport is subsidised, as current road user taxes do not cover the external costs (see for example Hansson (1997)). As prices do not reflect the full social cost of transport, the European Commission claims that the demand for (road) transport is ‘artificially high’ (EC 1992).

If preserving the quality of the environment is preferred by society, the state must intervene by setting limits or prices. In Sweden, among other countries, there is a commitment to reduce CO$_2$ and other emissions in a number of sectors, including the transport sector.$^{82}$ More than $\frac{3}{4}$ of the external costs of transport accountable to environmental emissions can be allocated to CO$_2$. This will most likely lead to higher transport prices in the future, yielding higher transport costs for companies and other organisations, and thus, increasing the incentives to moderate these costs.

Organisational Perspective
In Paper I, the organisational costs for business travel, C_{ORG}, are discussed. The average annual travel cost per US business traveller is about US$ 9000 (EUR 10 200) (NBTA 2001). The cost of ‘business travel related activities’, including both travel and entertainment, in year 2000 amounted to more than

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$^{82}$ Swedish environmental quality objectives, includes limited climate change (Governmental Bill 2000/01:130)
US$ 450 billion\textsuperscript{83} (EUR 510 billion) worldwide (WTTC 2001). The scale of the issue may be emphasised by the fact that in US and Canadian companies, business travel has soared to become on average the second or third largest controllable cost (Gibbs 2000).\textsuperscript{84}

Productive work time is undoubtedly a key asset for any organisation. This is critical in a competitive market environment where productivity, efficiency and time-to-market are important success factors. Much of this time we spend in meetings. According to the US National Statistics Council, 37\% of (US) employee time is spent in meetings (InfoCom 1999). Time is also a main reason why companies are seeking options to rationalise their meeting culture, as many of their key personnel are constantly tied up by meetings.

Another aspect of time is the frustration many experience when trying to schedule a meeting at a time that is suitable to all invitees. In this sense, synchronous virtual communication may be instrumental, as it often requires less time for travelling. However, asynchronous virtual communication, such as e-mail and webcasting, provides a powerful alternative as the scheduling exercise is no longer necessary (Lewis 1998).

However, not all travelling time is wasted from a professional point of view. Travelling time can partly be used for work. The possibilities differ depending on for instance the type of work, mode of transport, length of trip, and personal preferences. A model for evaluating to what extent travel time can be used to do different work tasks is presented in Arnfalk (1999). Moreover, many useful contacts are established during travel as people are ‘forced’ to meet at random in a plane, train, bus, etc. Travel may also ‘free’ useful, undisturbed, time for reflection and gathering of thoughts.

\textit{Individual Perspective}

Far from all business travel is as glamorous as commonly pictured in advertisements. Most business trips are of routine character, without

\textsuperscript{83} This could, for example, be compared to the Swedish GNP that amounts to approx. US$ 200 billion – or less than half of the business travel spending in the world.

\textsuperscript{84} The term ‘controllable costs’ originates from the \textit{controllability principle} within accounting. It refers to that it is appropriate to charge an area of responsibility only those costs that are significantly influenced by the manager of that ‘responsibility centre’. Drury, C. (2001). \textit{Management Accounting for Business Decisions}. Huddersfield, Thomson Learning.
extravagant social arrangements and other incentives. Therefore, in this case, travelling is considered burdensome and boring.

The travelling takes its toll, at a cost \( (C_{\text{IND}}) \) on the individual travellers, particularly those who travel very frequently. How is this related to the increasing problem of work-related stress? High stress levels are common — according to a recent Swedish survey, \(^{85}\) more than 40% of the respondents claimed to have felt mentally exhausted, or ‘burnt out’ (Jankell 2001). One of the stress factors is probably extensive business travelling. In the US, the average business traveller goes ‘on the road’ five times per year, while the average ‘frequent traveller’\(^{86}\) makes 23 trips per year. Four out of five frequent travellers finds the trips stressful (Fingar 2000). In a US survey of 1300 ‘heavy meeting goers’ in 1998, 24% of the respondents felt more stress when travelling for business, while 14% felt less stress. The most predominant areas of stress include spending time away from one’s family and worrying about work accumulating at the office (InfoCom 1999). A daunting indication of the travel-stress relationship was found in health insurance records of 10 800 employees of the World Bank, revealing that employees who routinely travelled on business accounted for 80% more medical claims than employees who did not travel (Korn 2000).

Frequent absence from home may have implications for the quality of private life, such as loss of contact with family and friends, divorce, and problems finding a steady relationship. In a survey at Telia, it was found that when employees for whom business travel originally was a positive factor started a family, frequent travelling often became a negative aspect of the job (Arnfalk 1999).

**Weighing Benefits and Costs of Business Travel**

A systematic approach to relate the different costs and benefits of business travel to each other facilitates the discussion and improves the understanding of the different implications. Transport costs \( (C) \) and

\(^{85}\) The survey was conducted by asking the question “Have you ever felt burnt out?” 24% replied, ‘Yes, several times’, 17% ‘Yes, one time’, and 58% ‘No, never’. The survey included 1000 Swedes aged 18-84 years in year 2000. It should be mentioned that the number of persons who are clinically diagnosed as ‘burnt out’, constitute only a fraction of the percentages presented here.

\(^{86}\) The US National Business Travel Association defines ‘frequent traveller’ as a person making more than 10 trips per year.
benefits \((B)\) can be identified at three levels: individual, organisational, and societal. Travelling on business is undertaken because it is (expected to be) profitable for the organisation. As business travel does take place, this would indicate that:

\[ i) \quad B_{\text{ORG}} > C_{\text{ORG}} \]

In addition, it cannot be ruled out that individuals also consider personal aspects (benefits) of travelling in business. Normally, the cost of travel (time and effort for the employee) is compensated by the organisation (e.g. travel allowance). If that is the case, the trade-off can be explained as:

\[ ii) \quad B_{\text{ORG}} + B_{\text{IND}} > C_{\text{ORG}} \]

If the travelling affects the traveller’s private life (being away from family, friends etc.), and the organisation does not fully compensate this sacrifice, it might also be the case that the following trade-off is valid:

\[ iii) \quad B_{\text{ORG}} + B_{\text{IND}} > C_{\text{ORG}} + C_{\text{IND}} \]

The individual has private interest in making the trip, if:

\[ iv) \quad B_{\text{IND}} > C_{\text{IND}} \]

As business travellers do not bear the economic cost of the business trip personally, their judgement of whether to make the trip or not may be skewed, and they may exaggerate the organisation’s benefit from the business trip:

\[ v) \quad B_{\text{ORG}}^* > B_{\text{ORG}} \]

\(B_{\text{ORG}}^*\) = the ‘exaggerated’ benefit

This may lead to a situation where the individual’s private values, expressed in Equation (iv), distorts the rational decision of the organisation:

\[ vi) \quad B_{\text{ORG}} + B_{\text{IND}} < C_{\text{ORG}} + C_{\text{IND}} \]

and \(B_{\text{ORG}} < C_{\text{ORG}}, B_{\text{IND}} > C_{\text{IND}}\)
If, the trip despite this is undertaken, we have a situation that we may denote as ‘excessive travel’ from the organisation’s perspective. Moreover, if transport’s externalities are not fully internalised, travelling is also associated with a societal, external cost, $C_{\text{EXT}}$. This can lead to a situation that can be expressed as:

$$vii) \quad B_{\text{ORG}} + B_{\text{IND}} < C_{\text{ORG}} + C_{\text{IND}} + C_{\text{EXT}}$$

and

$$B_{\text{ORG}} < C_{\text{ORG}}, \quad B_{\text{IND}} > C_{\text{IND}}$$

or

$$B_{\text{ORG}} > C_{\text{ORG}}, \quad B_{\text{IND}} > C_{\text{IND}}$$

Correspondingly, we may call this ‘excessive travel’ from a societal perspective. Thus, this is a situation that can be unfavourable both for the employing organisation and for society as whole, or just for the society.

### 5.2 Virtual Meetings – Possibilities and Limitations of the Technology

Before considering a shift from physical to virtual forms of business meetings, two important questions must be addressed: what possibilities do the technologies offer? and: what are the limitations and drawbacks associated with the virtual communication tools?

A number of important features will be highlighted here. However, commonly referred to advantages is that virtual meetings can save money by reducing travel, and reduce stress by saving time. These potential advantages will be discussed in Section 5.4.

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87 It is an accepted fact among transport economists that the positive effects of transportation are huge, but also that these effects are considered by industry and individuals in their transport decisions and trade-offs. This means that the benefits are included in the market demand and not external, i.e. there are no resource efficiency reasons for subsidization of transportation. Whatever positive external benefits there might be, they are only a very small fraction compared to the negative external effects of transportation. IWF/INFRAS (1994). *External Effects of Transport*. IUC.
5.2.1 The Virtual Meetings Concept

Briefly recapitulating the concept of virtual meetings as presented in Section 2.4.1, we may describe virtual meetings as synchronous communication mediated by ICT, making it possible for two or more spatially remote people to interact. In other words, the technology enables people to meet and to communicate without having to be at the same location. In practice, virtual meetings include audioconferences, videoconferences, and web-meetings. These applications can be used both for private and professional purposes, although only the latter will be examined in this dissertation.

5.2.2 What are the Advantages of the Technologies?

Virtual meetings are often described as more effective than physical meetings, as participants tend to concentrate and focus, and meetings can be shortened considerably (Lipnack and Stamps 2000; Duarte and Snyder 2001). In web-meetings, the advantage of having much of the communication written down and documented provides a convenient possibility to recapitulate and analyse the discussion afterwards. Audio- and videoconferencing can also easily be recorded for the same purpose. In this way, the outcome of the meeting can afterward conveniently be analysed, clarified, confirmed, or rejected, and it may also enable others with the possibility to (passively) participate in the meeting.

As the preparation time is relatively short for these types of meetings, ad-hoc meetings become possible for geographically distributed teams. This has proven particularly useful in dealing with urgent problems, when input is required from a group of people.

Another feature that can be advantageous for an organisation is that virtual meetings can allow more people to attend a meeting than otherwise would be possible, due to time or budget constraints. This is particularly valuable if it can allow key persons to participate such as top managers/decision makers, specialists/people with critical information, knowledge, experiences, and so on.

The ability to hold meetings more frequently is also often mentioned as one of the main advantages. This is particularly relevant to geographically

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88 The term physical meeting is used to distinguish between the option of being physically present in a meeting or not. It does not refer to any more intimate form of interaction.
dispersed project groups that otherwise would meet perhaps a few times a year, but with the help of ICT can collaborate more efficiently and be better informed throughout a project.

5.2.3 What are the Limitations of the Technologies?
The most fundamental requirement in virtual communication is that the technology is accessible and functional – to be able to connect people, people need something to connect with. This accessibility is still a serious limitation for videoconferencing, as only a fraction of companies have direct access to it (see Section 2.4.1) The virtual communications market is growing rapidly, but it has still not reached a 'critical mass', where it is taken for granted that a meeting partner has access to the equipment, as is the case for telephone, radio, fax, television, etc. in the ‘developed’ world. However, with the recent dramatic increase in demand for teleconferencing, this critical mass may be reached more rapidly.

This should be compared with audioconferencing, which has the advantage of very high accessibility. A limitation still exists in terms of the number of good, high-performance conference telephones. An audioconference using poor equipment (such as normal telephones with a speaker function) has limited chances of producing a successful outcome.

Even though the telephone has been with us for more than a century, teleconferencing is still a relatively immature technology. This is also true of both videoconferencing and audioconferencing, but is an especially relevant limitation for videoconferencing. In a study by Arnfalk (1999) of four different organisations in Sweden, videoconference users listed their problems with the medium, as shown in Figure 20.89 However, the reliability of the equipment and the network has improved in recent years, and many people’s reluctance towards videoconferencing is based on an experience they may have had five to ten years ago. It is also noteworthy that people have very little forgiveness for a 15-minute delay in connecting a videoconference, while the frequent hour-long delays in air traffic seem to be more easily forgiven.

89 These figures are given as average percentages based on the figures for the four organisations surveyed, and are not weighted according to the number of respondents in the different organisations.
Technology should not receive all the blame, however, as most breakdowns are due to a lack of skill in how to use the equipment, and an inappropriate environment (acoustics, lighting etc.).

For web-meetings, novelty is perhaps the main limitation today, even more so than for teleconferencing, which has been used for decades. Early company adopters started using the technology at the beginning of 1990s, but it is particularly since the end of the 1990s that web-meetings have enjoyed a strong development and growth. In Sweden, the infrasystem is becoming less of a limiting factor, as computerisation and Internet connectivity is very high (see Section 4.1.1) and software products facilitating these meetings are readily available.

For videoconferencing and web-meetings, a practical limitation is, however, bandwidth. When videoconferencing was ‘born’ in the 1960s, the innovation did not take off due to a lack of commercially available networks with sufficient bandwidth (see Figure 19). Today, videoconferencing relies mainly on ISDN-based communication, and the most commonly used transmission speed is 6 * 64 or 384 kbps, which delivers good, but still not television-like quality. The industry is now providing equipment that is prepared for IP-based communication (at the moment mainly as a complement to ISDN), but bandwidth, connection reliability, and security are important concerns that need to be resolved before the bulk of videoconferencing shifts from ISDN to IP.

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90 One example of this is a recent analysis of the problems that had occurred in Telia’s Multi-meetings, where 80% of the problems could be traced to misuse of the equipment. Source: Rolf Laggar, Falun, Sweden; personal communication, January 18, 2002.

91 ISDN: a fixed digital telecommunications network, and IP (Internet Protocol): a commonly used protocol (addressing mechanism) for communication via the Internet.
Figure 19. A landmark in the development of teleconferencing was when Bell Labs introduced the Picturephone at the World Expo in 1964: the world's first interactive video-enabled telephone.

Web-meetings are already using the Internet as their main network connection, and bandwidth is thus of crucial importance also here, as are the questions regarding security and reliability. Web-meetings are, however, less dependent on a large bandwidth compared with videoconferencing, and are more tolerant of network disturbances.

Figure 20. Problems experienced with videoconferencing, averaged in four Swedish organisations: Scandinavian Videoconferencing User Group (N=72), Telia AB (N=158), Skånska Lantmännen (N=10), and Tetra Pak (N=30) (Arnfalk 1999).
5.3 Communicating Virtually

Virtual communication differs considerably from face-to-face communication. Anyone who fails to recognise and accept this fact will encounter problems in using virtual media. When people meet face-to-face, they are able to exchange large amounts of information carried by sound (speech), light (gaze, facial expression, gestures, posture, physical appearance), chemicals (smell), or by direct contact (touch). In virtual meetings, this information flow is more or less limited. In the field of Communication Theory, we find a number of theories and concepts that may help us better understand how communication takes place in a virtual environment.

5.3.1 Social Presence

One helpful concept is Social Presence, which can be described as the degree to which the technology facilitates personal connection with others (Duarte and Snyder 2001). A more elaborate explanation of social presence is given by Werkhoven, Schraagen et al. (2001):

Social presence [is] ... a quality of a communication medium that depends on its capacity to transmit verbal or non-verbal cues as well as aspects such as the apparent “realness” of the participant. Hence, social presence refers to the tangibility and proximity of other people that one perceives in a communication situation.

Interactions with high social presence have been described as more lively, social, and intimate. Synchronous communication channels (e.g. face-to-face meetings, audio- and videoconferences) generally have higher social presence than asynchronous communication (e.g. e-mail, voicemail). Situations when greater social presence is considered better include first-time meetings, solving a new problem, and handling of sensitive or interpersonal issues. However, it cannot always be assumed that more social presence is better. Its usefulness depends on what the communicating parties are trying to accomplish in a given situation. Routine situations may benefit from less social presence, such as regular information exchange between members of a team.

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92 The term face-to-face is, in a sense, misleading, as for instance videoconferencing and web-meetings can provide a virtual version of a face-to-face meeting.
A related term is *telepresence*, which can be described as ‘the illusion of being there’ and is used for example to express how well a virtual reality environment manages to simulate a real situation. The term has also been used in the context of teleconferencing.

### 5.3.2 Media Richness Theory

An important theory commonly cited and used to help explaining different modes of virtual communication is *Media Richness Theory* (see Paper I). Media Richness refers to the amount of information that can be conveyed through a communication medium (Poole, Shannon et al. 1992). According to the theory, the choice of communication channel should be based on the character of the information to be communicated. Different communication channels can be rated according to its *density* – a measure of each channel’s potential for the effective transfer of complex and ambiguous information, or requiring high social presence. The density of the channel is said to correspond to its bandwidth. For effective communication, the bandwidth, or density, should thus correspond to the character of the message. The following two points summarise the message of Media Richness Theory (Rice 1992):

- Send non-routine, complex information through a dense medium;
- Send routine, clear information through a less dense medium.

### 5.3.3 Channel Expansion Theory

Media Richness Theory has been criticised for being too simplistic, not considering for example situational and social factors, and new theories have been designed to attempts to explain better why a certain medium is used for a communication task. One of these theories is *Channel Expansion Theory*, which adds a temporal variable to Media Richness Theory. Channel Expansion Theory argues that the bandwidth of a medium expands over time as the user learns how to use it better. This means that a less dense medium could develop into a denser medium providing that the parties using it are at the same level on the learning curve (Carlson and Zmud 1994). One example of this is that people with considerable computer

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93 Encyclopaedia Britannica; see entry on Virtual Reality.
experience rate e-mails much higher on the Media Richness Theory density scale than people with less experience.

5.3.4 Some Practical Aspects of Communication Theory

Communication in virtual meetings is a well-researched area, and the theories brought forward here only highlight a few important issues. In addition to presenting the basic theories, reference is made to a number of practical aspects of video- and audioconferencing collected from the literature.

Managing a meeting: We tend to change the way we interact in virtual meetings compared to face-to-face conversation. Focusing on the interaction process between speakers, such as speaker turns and interruptions, Sellen (1995) found that during face-to-face conditions, people produce significantly more interruptions and fewer formal handovers of the floor than during audio- or videoconferencing. This calls for training in the way we manage virtual meetings, in order not to create confusion and frustration in these situations.

Video or not: The importance of the visual part of the communication is dependent on the situation and the social cues between the participants. The presence of a video channel in addition to an audio channel has no effect on the performance of tasks that are highly independent of social cues. In situations where social cues become relevant, such as bargaining and conflict, the visual part of the communication may become important (Mortlock, Sheppard et al. 1997). This underlines the importance of considering the communication needs in an organisation when selecting appropriate equipment.

Promoting virtual meetings: The usefulness of the theory in the context of promoting virtual meetings in an organisation is underlined by Kogg (2000):

…the most interesting aspect of channel expansion theory is not that it can help to explain the current meeting behaviour. The theory is particularly relevant because it sends a clear message as to what is important when managing communication behaviour within an organization with the intent to promote a specific type of communication channel. It tells us that it is important to have uniform meeting behaviour so that everyone is on the same level on the learning curve for the types of media that are used, and it also tells us that, by promoting the use of Virtual Communication channels, it is possible to expand the bandwidth of these types of media, thus, increasing their range of use, and the potential for an increased substitution of physical meetings with Virtual Meetings.
5.4 Implications of Replacing a Business Trip with Virtual Communication

5.4.1 The Untouchable Face-to-face Meeting?

A rudimentary question implied by the heading is: can virtual communication really replace a physical meeting? The question is triggered by two statements that, in the authors experience, commonly arise when discussing virtual meetings: “Virtual Communications can never replace a real meeting”, and “but you know, we have to meet [physically] so we don’t lose valuable personal contact”. These statements can, in a sense, be seen as both correct and incorrect, depending on the context in which the issue is discussed. In order to avoid any misunderstanding, two points must be clarified.

First of all, we must recognise that it is not a matter of extremes: the question is not whether we will cease having meetings in person or not. Virtual meetings provide an alternative to some types of meetings, but by no means all. What is essential is to know when virtual meetings are an appropriate means of interaction, and in such case, what means of communication to use.

The second point is to acknowledge that the earlier statement is correct: that nothing replaces a ‘real’ meeting. However, this is irrelevant as the intention is not a perfect substitution of a physical meeting, but to satisfy the need to obtain access to a certain function. These two issues are discussed in Section 5.6.1.

5.4.2 Economic Implications

In line with the discussion in Section 5.1.2, it can be argued that a comparison of costs and benefits in relative terms decides the type of meeting that is most cost-efficient in a certain situation. As a result, even in situations where virtual meetings cannot give the same benefits as a face-to-face meeting, their comparatively low costs could make the virtual alternative more attractive for the organisation.

As the cost of business travel is very high, which can be illustrated by the fact that in Sweden, the total costs of business travel amounted in 1998 to 70 billion SEK (EUR 6.5 billion) (Askeberg 1998), which means that even if only a fraction of travelling is replaced, the economic consequences can be significant for an organisation. A review of studies on the economic
consequences from such shift can be found in Arnfalk (1999). In addition to reduced travel expenses, the use of virtual communication may improve the overall efficiency of the organisation, which also has significant economic implications.

Parallel to the scenario comparison of CO2 emissions for the fictitious company using videoconferencing in two different ways, an evaluation of the economic implications was made (Arnfalk 1999). In accordance with the approach for the CO2 calculations, the total costs associated with videoconferencing are subtracted from the reduced total costs from substituted business trips. The outcomes of the two scenarios are illustrated in Figure 21.

![Figure 21. Economic savings from teleconferencing in the two scenarios 'Business as usual' and 'Collabication'.](image)

94 Videoconferencing total costs include direct expenses for equipment, telecommunications, studio, furniture, support, and hosting.

95 Business trip total costs include direct expenses such as the cost of travelling, hotel, transfer, travel allowance, but also loss of work time and administration of pre- and post travel arrangements.
This figure illustrates clearly that savings can be made both in the Business-as-usual case, but that the savings potential is substantially greater in the Collabication scenario.

If we limit the comparison to a single occasion (a single business meeting), the dimension of economic implications from substituting a trip by video- or audioconferencing can be illustrated by comparing the total costs for travelling with those of the two teleconferencing applications. In Figure 22, this cost comparison is made for three modes of transport (by car, train and air) and three destination categories (to a destination in Scandinavia, in Europe and the rest of the world).

![Figure 22. A comparison of travel costs for different modes of transport and destinations with the equivalent costs for teleconferencing.](image)

### 5.4.3 Social Implications

The social dimension is enormously important. Even though the emphasis of this research has not been to investigate these aspects, a number of collected findings are considered as still worth mentioning.

The hardware and software vendors, telecom companies, and other promoters of virtual meetings often put forward a number of intangible or ‘soft’ benefits of their use. These include better communication, as people can meet more often and share knowledge more easily, and improved employee moral, as less time, energy and stress is spent on travel and staying in hotels. This has practically become a truism within the field, but is this really true? The arguments are often supported by examples of companies
that have successfully implemented virtual meetings in their organisation (and often conveyed by a person involved in implementing these meetings). The following reflections are based on the author’s own experience with both more and less successful implementations of virtual meetings.

Saving time is the prime motive for increased use of virtual meetings. It is also an argument for the individual employee to ‘release’ time for other activities. What this timesaving actually means is seldom specified. The interest from the organisation lies in improved efficiency, which implies that the employee should do productive work during the time ‘saved’ from not travelling. Instead of having one or two meetings in a day, the employee may be able to fit in four or five, or to engage in some other work activities. Potential quality-of-life improvements gained when tiring business trips are avoided, are cancelled out by even more meetings at the office. The anticipated stress reduction is consequently limited by the increase in other professional engagements. This can be considered a time-rebound effect on a personal level. Hörning et. al (1999) refers to this phenomenon by questioning: “Do we not suffer from the paradox that although we constantly save time by using better and speedier technology, in the end we do not have more time than before, even less perhaps?”.

So-called ‘small talk’ or informal discussions is an important part of business communication that will be affected by an increased use of virtual meetings. A relevant point is that this type of communication might be lost, and that both business output and personal relations will suffer. However, it appears that a number of factors counterbalance this risk. We are developing skills in how to compensate for this ‘loss’ – one is to spend more time and emphasis on the social and informal dimension during the (fewer) physical meetings. During virtual meetings, as participants are improving in using the technology as a communication tool, more of the informal discussion values seems to be incorporated (compare Channel Expansion Theory in Section 5.3). Moreover, particularly in web-meetings, technology (software) provides solutions to meet this need for informal or side-discussions: through chat-boards and private (hidden) messages between certain participants, but also by complementing the virtual meeting with individual telephone calls or e-mails.

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96 The ‘small-talk’ in for example videoconferencing develops along with the users’ experience and depends on how comfortable they feel in front of the camera.
A problem that can arise when a teleconference is used to connect one or a small number of individuals virtually to a physical meeting of a group of people, is that these individuals may feel awkward and alienated. In audioconferencing, the ‘outsiders’ lose out on side conversations, gazes and other non-verbal communication between those in the physical entity. The extent of this problem depends on how well the meeting is managed, if the person(s) calling in knows the other persons or not, the type of meeting, and form of communication (sensitive issues, disagreement and negotiations are particularly difficult).

Another problematic issue is how to express appreciation, importance, interest and other values in virtual business communication. A prevalent impression is that if a company representative does not come in person, the project or other form of cooperation is not highly prioritised or not of interest. Thus, suggesting a form of virtual meeting can be detrimental to a valuable business relationship, unless both parties see the advantages of this form of meetings. This is particularly important between organisations in different social or business cultures, but can cause problems also between different units in a company group. On the other hand, if the virtual communication channels are established, it enhances the possibilities to exchange fast, continuous, and constructive feedback in cooperation.

Last but not least is the fun factor: how enjoyable do people think it is to cooperate with others via ICT? Naturally, this varies between individuals and depends to large extent on their receptivity to technology and new ideas. However, beyond the enthusiasts, a large group remains sceptical to the pleasures of virtual communication. This can be illustrated by a quote from an employee at the telecom operator Telia (author’s translation):

> It is exciting to travel to new exotic places. It is fun to meet new, exciting people. Virtual media is about sitting alone in dark rooms filled with technology. And really, how much fun is that?

### 5.4.4 System and Rebound effects

As discussed in Section 4.1.2, although they are highly relevant and clearly present, system effects cannot be expected to be of any direct concern for an organisation, unless it influences its operations or employees significantly. In this respect, public policy plays a key role. If an organisation should engage any pollution prevention measures to reduce systems effects,
regulations or incentives have to be provided to address these issues. Consequently, these effects will not be included in the following discussion.

5.5 Barriers for an Extended Use of Virtual Meetings

From now on, the quest begins to discover why the potential benefits of these promising virtual meetings have not been fully realised. In Arnfalk (1999), barriers inhibiting the use of teleconferencing were presented and divided into four categories:

1. Organisational, bound to the way the individual organisations manage the application.

2. Personal, related to an individual person’s use of the application (the division between personal and individual becomes less distinct the smaller the organisations).

3. Institutional, linked to laws, policies and norms controlling the application.97

4. Practical, including for example technical hindrances and building limitations.

In subsequent empirical studies, (Kogg 2000; Arnfalk and Kogg 2001; Nilsson 2001) these barriers have either been confirmed, rejected, or revised. In addition, other barriers have been identified. The following discussion on barriers for virtual meetings is a synthesis of the findings from these studies.

97 In the field of Institutional Theory, it is claimed that an organisation rarely ever acts independently of the world around it or is ‘free to do as it likes’, as it is influenced by a number of so-called institutions: rules, norms, and beliefs that describe the reality of the organisation. These institutions can be categorised as regulatory or legal, normative, and cognitive (see for example: Hoffman, A. J. (1999). “Institutional Evolution and Change: Environmentalism and the U.S. Chemical Industry.” Academy of Management Journal 42(4): 351-371). In this dissertation, the term Institutions is generally referred to as legal and normative influence on the organisation. For an overview of Institutional Theory, see Tolbert, P. S. and L. G. Zucker (1996). The Institutionalization of Institutional Theory. Handbook of Organization Studies. C. Hardy and S. W. Clegg. London, SAGE: 175-190.
5.5.1 Organisational Barriers

Some of the organisational obstacles are linked to the deeply rooted corporate business travel culture. It has become routine to solve the need for remote access by travelling, and many organisational functions are directed towards promoting business travel. A project budget commonly has money allocated for ‘travel’, but rarely for virtual communication. Travellers are compensated for their additional burden in the form of travel allowances, but no such compensation exists for the virtual alternative. Moreover, most mid-sized and larger organisations have some kind of travel policy, which rarely includes non-travelling alternatives.

Travel agencies (still) play an important role as mediators of the business trips. These travel agencies commonly work in close cooperation with an organisation (and in large organisations even in-house), and earn their living from providing travel facilities for the organisation’s employees. With a few exceptions, such travel agencies do not offer alternative means of business meetings and have no interest in reducing their livelihood, i.e. travel. On the company side, travel managers are the closest link to the travel agencies; they see their job as providing good, cheap travel services to their company, sometimes in a symbiosis-like relationship with the travel agency. Reducing travel would mean reducing the importance of the manager’s area of responsibility, which, for some travel managers, seems to pose a threat to their position.

The organisational structure can be an obstacle in less formalised organisations. Virtual meetings require a certain degree of formalisation to ensure that organisational members learn to use the same applications sufficiently well. In an organisation with very heterogeneous meeting behaviour, it can be hard to capitalise the full potential of a good virtual communications infrastructure. Similarly, lack of a common communications platform hinders interorganisational communication (Kogg 2000).

Another drawback for virtual meetings is that the distribution of responsibility for virtual communication is often unclear and informal. This becomes particularly apparent when compared with the professional organisation surrounding the travel industry. Lack of priority leads to poor coordination between booking, support during meetings, start-up and close-down, service, telephone directories, and so on. Sometimes the responsibility is delegated to a nearby secretary who has neither knowledge
of how to run the equipment nor any interest in doing so. This may result in virtual meetings alternatives being perceived more as hassle than help.

Organisations also have a tendency to overlook a number of factors and thus make poorly informed decisions when investing in equipment. Many companies invest in poor equipment, low bandwidth, and little or no support, even though the payback time for group-sized videoconference equipment for a large organisation is typically 20-30 days.\footnote{One example is the telecom company Ericsson, which has invested in more than 800 videoconferencing facilities worldwide. Their estimated payback time of the equipment is 22 days.}

As discussed in \textit{Paper III}, an EMS rarely acts as an incentive for an organisation to lessen the environmental impact from business travel, and even less so for travel substitution.

\subsection*{5.5.2 Personal Barriers}

Perhaps the most important barrier to virtual meetings is the positive output and attractiveness of the travelling alternative, as discussed in Section 5.1.2. Some of the drawbacks of \textit{not} travelling are summarised by (Arnfalk 1999):

\begin{itemize}
\item Reduced professional output (as the teleconference does not fully compensate meeting in person), loss of personal contact and informal discussions;
\item Lack of the status and feeling of importance associated with travel;
\item Loss of the valuable educational contact and experience value that many business trips have;
\item Economic losses (travel allowance);
\item Loss of a pleasant experience (business trip to Italy in May?) – Many people are anxious that virtual meetings will replace physical meetings altogether, and are eager to point out that it is also important to meet in person;\footnote{An indication that business trips are increasingly combined with a leisure activity is the increasing number of (male) business travellers staying at high-end resorts, accompanied by their families. \textit{Shifflet, D. K. and A. Gilllice} (2000). “High-end resorts not just for leisure purposes.” \textit{Hotel & Motel Management}: 64.}
\end{itemize}
• Loss of frequent flyer points, often used for private holiday trips at a later date. Nearly one third (32%) of all business travellers participate in at least one frequent flyer program (TIA 1999);
• Loss of the possibility to buy duty-free goods.

The resistance to learn new things does constitute for some a barrier, which may be expressed by the proverb *it is hard to teach an old dog new tricks*. What is more is that people have practiced their entire life how to manage physical meeting situations and have developed non-formalised meeting skills. The professional skills of many employees lies in their way of handling these meetings (e.g. negotiators, sales staff). Communicating by virtual media means that some of these skills become less important, new rules apply, and the comfort and advantage of professional experience is reset. The uneasiness a manager may feel in a situation where he or she no longer has control due to a lack of skills in how to handle the technology, or the risk of losing face if something goes wrong, should not be underestimated.

A closely related barrier, and a direct consequence of the resistance to learn about the new technology, is the lack of knowledge about, and lack of skills in managing virtual meetings. Employees are often unaware that equipment exists, where it is located, and how to use it. It is taken for granted that the employees should teach themselves how to handle the equipment, and how to manage a virtual meeting. Even though great improvements have been made in making the technology more user friendly, training in how to handle it is necessary, and this applies even to audioconferencing. In a stressed organisation, this will constitute an obstacle unless time and resources are planned for and set aside for this purpose. Considerable annoyance and concern may be avoided if users are presented with some of the ‘new rules’ that apply to virtual meetings. Perhaps, for younger employees who have grown up with computer, web cams, video cameras, Internet chat, and so on, this will become less of a problem.

There seems to be some reluctance to engage in virtual meetings among those who call for meetings at the main office and do not have to travel so often themselves.

Even though travel constitutes a major part of an organisation’s environmental impact, and a majority of the surveyed employees regard environmental issues as important or very important, they do not seem to relate their own travelling to its environmental consequences. No
correlation was found between concern for environmental issues and willingness to use virtual meetings (Kogg 2000; Arnfalk and Kogg 2001).

5.5.3 Institutional Barriers

The foremost policy measures employed are market-based instruments such as taxation of and fees on vehicles and fuels, and command-and-control measures. These instruments are based on the assumption that users’ willingness to pay for a certain transport service is limited, and by appropriate pricing and a regulatory framework, the transport volume as well as the preferred mode of transport can be steered. However, these instruments are to some extent ineffective in the case of business travellers, as those who make decisions about travel often do not pay for the trips themselves. It is therefore of interest to investigate what other policy measures influence business travel, and to analyse to what extent they promote a reduced environmental impact from business travel. A number of such policy measures are discussed in Paper III. The following list briefly summarises these policy issues:

Legal, mandatory

- Permits and Environmental Impact Assessment (EIA). The permit required for establishing or changing an activity (factory, power plant, etc) according to the Environmental Code does not cover travel. If for example a company needs to make an EIA, travel is rarely (if ever) included.

- Environmental Report. The mandatory environmental report, which must be filed by companies ‘with a significant environmental impact’, does not have to include travel.

- Public Procurement. EU guidelines make it very difficult in practice to include environmental requirements in public procurement in a comparison between two or more alternatives or suppliers.

Normative, voluntary

- EMS. The most common EMS, ISO 14 001, does not explicitly mention transport in general or travelling in particular. EMAS II lists transport of employees as one of the aspects that should be covered.

- Eco-labelling: The major eco-labelling scheme in Sweden, the Nordic Swan, does not include transport, nor is transport included in the
criteria for labelling of products. The European Union Flower does not include transport issues either. However, the eco-labelling scheme of the Swedish Society for Nature Conservation’s (Good Environmental Choice, or Falken) does include criteria for travel.

- **Voluntary Environmental Reporting.** The vast majority of organisations do not report on their environmental impact from travel.

In addition, *Frequent Flyer Programmes* could be seen as an external institutional influence. This system may stimulate more business travel (by air), as the bonus points generated from professional travel, and paid by the employer, are given to the traveller in person. The likely consequence of these programmes is that the attractiveness of receiving free private trips that can be used for leisure travel may influence a decision of when and how to travel in business, towards more travelling and a greater proportion of air travel.

Consequently, policy measures that influence, or potentially could influence business travel, have a very limited steering effect towards more environmentally favourable business communication. Any specific promotion of the non-travelling alternative is negligible.

### 5.5.4 Practical Barriers

Communication based on technology is, of course, strongly dependent on this very technology: that it is available, reliable and fulfils the requirements of the users. Many of these aspects are discussed in Section 5.2. In addition, a number of examples of specific practical barriers found in the organisations surveyed will be given.

*Limited availability.* For videoconferencing and web-meetings, the general practical limitation to an increased use of virtual meetings is simply the lack of the facilitating technology, or meeting infrastructure. However, in an organisation such as Telia Nära, where this infrastructure has been put in place, a new level of practical limitation arises. As the use of virtual meetings has become an established form of communication within the organisation (mainly audioconferencing, and a combination of audioconference and web-meeting) the demand for the limited number of conference telephones, and for conference room suitable for virtual meetings (preferably with access to the intranet) quickly exceeded the supply at the offices. Buying additional conference telephones is not a major investment; However, the need for
more rooms designated for virtual meetings provided a larger challenge (Arnfalk and Kogg 2001).

Two other organisations (Ericsson and Lantmännen) expressed concern that the rooms equipped for videoconferencing were frequently used (or ‘hijacked’) for regular, physical meetings, further limiting availability.

**Insufficient telepresence.** At Telia Nära, once the organisation members became more dependent on the technology, two sorts of reactions could be distinguished. One was that the users felt more comfortable using virtual meetings for collaboration and promoted an increased use of this form of meeting, which is in accordance with the Channel Expansion Theory (see Section 5.3). However, some who worked remotely from the main office and participated in meetings with several people gathered in one conference room expressed concern that they felt alienated and that audioconferencing did not yield sufficient social presence. A virtual medium with higher social presence such as videoconferencing could lessen this drawback, but practical possibilities to facilitate this today are limited.

**Poor reliability.** For videoconferencing, at an organisation with very good access to the technology (Telia Research), approximately 60% of the respondents claimed that they would use this form of virtual meeting if the technology was more reliable (Kogg 2000). At Telia Nära, the use of videoconferencing had almost completely ceased, partly due to poor reliability.

**Infrastructure.** It is not only the technical equipment that is important if an audio- or videoconference is to be successful. A number of very down-to-earth aspects can cause irritation during meetings, such as rooms that are too bright or too dark or echo-prone, loud fans in overhead projectors, and squeaking or scraping chairs. This is often a process in stages – after testing the equipment, and becoming accustomed to using it, the requirement for a more suitable virtual meeting environment grew.

### 5.6 Creating Change – a Shift Towards Virtual Meetings

If an organisation wishes to start using virtual meetings or increase its use of this form of communication, how should they proceed? A number of barriers have been identified, but what can be done to remove or overcome
them? This section will cite a number of factors that have influenced the success of virtual meeting implementation in various organisations.

The process of change taking place in an organisation implementing virtual meetings is a fascinating transformation, with numerous implications, some of which have already been discussed in this chapter. Even though they may not be relevant to all organisations, examples of successful and failed attempts to communicate virtually provide a useful insight into the mechanisms that steer the outcome of such implementation process. For further guidance on how to initiate and successfully manage change in an organisation, useful support may be provided by for instance Organisational Change Theory. However, the organisational implementation process is not within the scope of this dissertation.

A number of factors influence the choice of communication channel, whether it should be virtual or not, and, if virtual, the type of technology that should be used. These factors can be categorised as either contextual or situational (Kogg 2000). The influence of situational factors is illustrated in Figure 23 (see also Paper II).

![Figure 23. A model of situational factors that may influence the choice of communication channel (Kogg 2000).](image-url)
5.6.1 Identifying when to use Virtual Meetings or Not

Virtual meetings can be more or less appropriate for different applications. This can be illustrated by two extreme cases: after years of negotiation, the final meeting for signing a contract worth EUR 10 billion would, without doubt, require the physical presence of the signatories. On the other hand, if one were to ask a long-known colleague where to find blank diskettes, as he is currently on a business trip to Italy, one would definitely not take a flight and ask him or her in person, but rather try to reach that person via telephone, mail, fax, etc. In these two cases, the choice is simple and indisputable, but there are situations where there are several possible ways of satisfying the need for access. A simple illustration of this range of choices is presented in Figure 24.

![RANGE OF MEETING PREFERENCE](image)

Figure 24. Illustration of the range of choices between situations where physical meetings are preferred and those where virtual meetings are most suitable.

Purpose and Type of Meeting Decides if Virtual or Not

It is of vital importance that virtual meetings are used for the appropriate types of communication and interactions. For meetings that are short, ad-hoc or at short notice, and of low to medium importance, virtual meetings are generally recommended.

The preference for which meetings should be physical and which should be virtual was surveyed in the Telia Nära organisation. Meetings are labelled in a large variety of ways, and in order to interpret the results, the terms used have been categorised and the number of replies in a certain category listed in Table 2. Correspondingly, the meetings that should preferably be physical are listed in Table 3.
Table 2. Type of meetings when virtual alternatives are preferred. The table lists the number of respondents that stated a certain type of meeting in a survey at Telia Nära.

<table>
<thead>
<tr>
<th>Form of meeting, categories of words</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up, check-up meetings</td>
<td>56</td>
</tr>
<tr>
<td>Informing, information meetings</td>
<td>51</td>
</tr>
<tr>
<td>Time: short meetings, maximum number of hours</td>
<td>37</td>
</tr>
<tr>
<td>Regular, repeated, consecutive meetings</td>
<td>29</td>
</tr>
<tr>
<td>Monthly-, weekly meetings</td>
<td>11</td>
</tr>
<tr>
<td>‘Working’ meetings</td>
<td>10</td>
</tr>
<tr>
<td>Decision making</td>
<td>8</td>
</tr>
<tr>
<td>[when people] know [each other]</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3. Type of meetings when the physical alternative is preferred. The table lists the number of respondents that stated a certain type of meeting in a survey at Telia Nära.

<table>
<thead>
<tr>
<th>Form of meeting, categories of words</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kick-off, kick-out</td>
<td>79</td>
</tr>
<tr>
<td>Discussion</td>
<td>11</td>
</tr>
<tr>
<td>Long meetings</td>
<td>10</td>
</tr>
<tr>
<td>Customers, external [contacts]</td>
<td>9</td>
</tr>
<tr>
<td>Important meetings, issues</td>
<td>8</td>
</tr>
<tr>
<td>Information meetings</td>
<td>6</td>
</tr>
<tr>
<td>‘Working’ meetings</td>
<td>6</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>5</td>
</tr>
<tr>
<td>[situations requiring] Creativity</td>
<td>4</td>
</tr>
<tr>
<td>Many participants</td>
<td>3</td>
</tr>
</tbody>
</table>

Tables 1 and 2 clearly show that there are some types of meetings that can be placed far right or far left on the range ‘definitely virtual’ and ‘definitely physical’ in Figure 24. Kick-off and kick-out meetings (at the start and end of projects) were the most common answer for the type of meeting where it was important to meet in person. Virtual meetings were considered best for
follow-up and check-up meetings, information meetings, short meetings, and regular, repeated, or consecutive meetings.

If the preference is known for the type of meetings that are suitable for the virtual alternatives, it is possible to plan and select the type of meeting most appropriate for each occasion. At Telia Närä, this type of planning was carried out for communication within the line organisation (see Figure 25).

In addition to using suitability as a criterion for selecting the meetings that can be held virtually, the determinants – forces initiating change – have to be recognised. The most common determinants are improvement of organisational efficiency in terms of time and money. Meetings that require long and expensive travel time are naturally more favourably held with the aid of virtual media than meetings where colleagues are in the next office. However, this does not imply that organisations do not see advantages in using the technology for more local communication, such as videoconferences between different business units in the same city. Ericsson uses its videoconferencing facilities extensively for meetings.

Figure 25. Conceptual plan for type, frequency, and form of meetings selected in the line organisation at Telia Närä (Source: Claes Larsson, Telia).
Virtual Mobility and Pollution Prevention

between subsidiaries located in the south and north of Stockholm, saving hours of travelling time through the congested city core.100

In the case of Telia Research, the environmental policy makers of the company group were very keen to ‘walk the talk’ – using the telecom company’s own services. The determinants behind this high ambition were in addition to time and money also a market opportunity (better research and an opportunity to sell an ‘Optimal Meetings strategy’) and environmental performance (green image, less environmental impact) (Kogg 2000). For the construction company Skanska, the motivation for using more videoconferencing is to create ‘quality-time’, and virtual meetings that can free such time are promoted (Nilsson 2001).

What Type of Virtual Meeting Technology Should be Used?
After deciding whether the meeting should be virtual or not, the most suitable type technology should be selected. At Telia Nära, this selection was almost exclusively in favour of audioconferencing (much preferred to videoconferencing, although they had good access to the equipment). What decides what type of technology to use? Duarte and Snyder (2001) have, in the context of mastering virtual teams, compiled an extensive list of recommendations for when to use different types of virtual meeting technologies (asynchronous and synchronous), depending on the purpose of meetings.101 They highlight two prime factors that can help us evaluate the effectiveness of one technology over another in different situations: the amount of social presence and media richness required (as discussed in Section 5.3). Moreover, the authors make two statements: (a) the ideal technology will differ according to type of task, and (b) that more social presence and information richness in not always better.

Interpretation of the Findings – A Comment
It should be pointed out that this is not an attempt to provide a general checklist or guide on how to succeed with all virtual meetings. Varying conditions in and around different organisations make it difficult to


101 The authors have experience from working with a large number of organisations, including the UN, NASA, the GAP, NORTEL, Johnson & Johnson, and Whirlpool Corporation.
generalise – what is suitable for one organisation may not be so for another. The various virtual communication applications also have specific success factors associated with the particular technology – what is true for videoconferencing may be unsuitable in web-meetings. As web-meetings themselves consist of a large group of different computer-based applications (e.g. desktop and real-time data conferencing, electronic meeting systems, and electronic display), one must be cautious in generalising how to implement these applications successfully. Moreover, the empirical material that this analysis is based on is limited to a few companies, and it would be unwise to draw too far-reaching conclusions on this basis.

The risk associated with generalisation can be illustrated by the contradictory attitudes among Telia Nära employees, where for same type of meeting (‘working’ meetings) some preferred as a virtual meeting (10) and other preferred a physical meeting (6). Nevertheless, an organisation that is developing its virtual communication structure can use such generalised findings as a starting point and initial guidance, but must develop its own guidelines and ‘truths’ based on their own circumstances and experience with the technology, in order to reap fully the benefit of virtual collaboration. This could also include an environmental dimension, which will be discussed further in the following section.

### 5.6.2 Influencing Meeting Behaviour – Organisational Factors

A number of organisational barriers were identified in Section 5.5, and implementation of virtual meetings is to a large extent dependent on how well an organisation succeeds in overcoming these obstacles. The chances of succeeding in doing so depend on many things being to a varying extent within the organisation’s control. As discussed in Paper II, situational factors affecting meeting behaviour, such as the character of the message to be communicated (see Figure 23), can be very difficult, or even risky, to

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102 The implementation process has been studied more closely in the two Telia subsidiaries, Telia Nära and Telia Research, and follow-up studies have been conducted at Tetra Pak and (Skånska) Lantmännen. In addition to these primary sources of information, secondary sources have been used.
However, many contextual factors influencing meeting behaviour in an organisation are (theoretically) possible to manipulate for the purpose of introducing, or reinforcing, drivers and removing barriers for virtual meetings. These factors were found within the areas of human resource management, organisational culture, management control system, organisational structure, meeting infrastructure, and policies for travel, the environment and information.

In addition to internal organisational factors, the organisation may also have a limited possibility to influence external factors such as travel agencies, and external meeting participants. The employees themselves can also be manipulated by improving their skills in handling virtual meetings, and influencing their values, attitudes, and preferences to a more positive outlook on virtual communication alternatives. (Paper II)

Identifying these potential target areas is an important first step, but the critical move remains: how to change meeting behaviour within the organisation. A number of suggested approaches for how to promote implementation of virtual communication were put forward by Arnfalk (1999). These include:

- Expanding and renaming the organisation surrounding business travel. This would entail (a) also including the virtual communication alternatives in the organisational framework, and (b) focusing on the accessibility sought instead of on solely travelling, which for business travel primarily would mean business meetings. This could materialise in a travel policy becoming a meeting policy, a travel manager is transformed into a meetings manager, the travel bureau becomes a meetings facilitator, etc.

- Allowing the individual user to benefit directly from the savings that the substitution of business trips can yield. As contradictory incentives may influence the choice of communication channel, and that business travel context can be described with the public choice theory. In conformity with the previous suggestion, this could entail some sort of ‘meetings allowance’, or ‘infrequent flyer points’.

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103 The term manipulation has a negative connotation, but should in this context be interpreted as a combined term for efforts to create the necessary conditions, to inform, stimulate, and inspire.
• Identifying the tasks and types of meetings most suitable for the virtual alternatives, as discussed in Section 5.6.1.

• Making savings visible, in terms of money, time, and the environment.

• Creating a smooth system for booking, support, service etc., making the use of virtual meetings comparatively easy and uncomplicated.

• Let the travel agent also arrange virtual meetings, and make it equally, or more rewarding for them to arrange the virtual alternative.

The subsequent surveys, interviews, and workshops that were part of the action research studies conducted at Telia Research, Telia Nära, and to some extent Skanska have provided an opportunity to gain feedback from and to revise these suggestions, as well as to suggest new measures.

One point that has been reinforced is that virtual meetings are as much about ‘people-issues’ as technical issues. Consequently, the development and implementation of a more comprehensive strategy for virtual meetings should not be the responsibility of an IT department exclusively, but rather built on the joint efforts from different areas of expertise. Such groups would benefit by also including representatives from the financial, human resource, information, and environmental areas, a corporate controller, and someone who could represent users.

Involving top management is essential, particularly in a project with a wide-ranging nature, in several respects. Top management commitment is crucial in order to free resources for technical equipment, training, information, policy changes, and so on. By using virtual meetings themselves, top managers can also constitute good examples and thereby give virtual alternatives status and promotion. Moreover, if top management uses virtual meetings in line management and projects they participate in, middle management will have had to test the meeting form, and the use may, in this way, diffuse further through the organisation.

In addition to the managers in the line organisation, project leaders may also play a key role. The organisations studied worked, to a large extent, in the form of projects, resulting in numerous project meetings. Commonly, it is the role of the project leader to call upon the participants to join these meetings, and the use of this medium in project meetings thus depends on this person’s attitude to, knowledge of, and skills in managing virtual meetings.
Management Control Systems

As suggested by Kogg (2000), one approach to monitoring travel expenses and making savings from virtual alternatives visible may be to include indicators related to virtual meetings and business travel into the organisation’s version of a Balanced Scorecard (BSC). This idea was further developed and tested by Nilsson (2001), in a project supervised by the author. In her thesis, Nilsson analysed two companies, Telia Nära and Skanska Facilities Management.

A BSC that is designed and used as intended by its creators Kaplan and Norton (Kaplan 1992) tracks the key elements of a company’s strategy, from continuous improvement and partnerships to teamwork and global scale. It should convey what is important for everybody within the organisation to focus on, i.e. what is strategically important. Therefore, any aspect incorporated into the BSC should enjoy high attention and priority. Introducing measures into the BSC related to the organisation’s use of virtual meetings and their effects must therefore be highly important for the organisation’s strategic goals. Nilsson suggested that in the case of Telia Nära, being a telecom company and benefiting from an extensive and well functioning use of virtual meetings in several aspects (as explained in Section 5.6.1), introducing virtual meetings-related measures in the BSC could be justified as its success holds a high strategic importance. However, in the case of Skanska Facilities Management the virtual meetings issue weighed more lightly, and to bring in such measures in the company’s BSC could not be justified (Nilsson 2001).

The potentially significant environmental implications of virtual meetings point towards a role for EMS in promoting virtual meetings. Collection of data to evaluate the environmental impact from travelling could be steered and managed through an EMS, as well as estimations of savings from travel substitution. In case that organisation produces an environmental report (or an environmental section of the annual report), it can favourably report on these collected and estimated figures. However, as environmental consequences are most often ranked lower than others (time, cost, effectiveness, etc.), and the EMS generally has limited possibilities to make far-reaching changes in an organisation, it would be unwise to rely solely on the EMS for promotion of virtual meetings.

Travel Management is another corporate function that is heavily associated with virtual meetings. The success of the idea to focus on the function – meetings, instead of the means – travel – relies much on travel
management’s willingness to redefine its role. Discussions with a number of travel managers have triggered different reactions. Some have seen virtual meetings as a threat to their professional area (as discussed in Section 5.5), while others, including the president of the Swedish Business Travel Association (SBTA), have embraced the concept fully and promote it actively for travel managers in Sweden and abroad. Conditions for travel management and travel agents are rapidly changing, with increased Internet booking, and travel restrictions since the terrorist attacks on September 11th, 2001, which forces this professional group to rethink. As for environmental management, travel management should not be the single actor managing the virtual meetings issue, but has an important role to play in a multidisciplinary group.

Organisational Culture

In several organisations, virtual meetings have become embedded in the culture of the company. Organisational, or corporate culture can be described as a system of shared meaning, i.e. values, beliefs, assumptions, and understandings shared by members in the organisation (Robbins 1990), which will influence work behaviour. A shift in these aspects is a gradual and time-consuming process, but this process is clearly of interest for any organisation wishing to obtain any significant travel substitution. Some factors identified as barriers to the implementation of virtual meetings were closely associated with the prevailing corporate or organisational culture, both at Telia Research and Telia Nära. Barriers include for example the non-formalised meetings structure at Telia Research, and the common scepticism about technologies beyond audioconferencing at Telia Nära. However, the culture also includes drivers. A clear difference was found between the two companies in respect of employees’ consciousness of travel-related cost. Reducing cost was clearly a significant driver at Telia Nära, while at Telia Research, cost restraints were less and therefore also the incentive to find less expensive alternatives.104 Employees’ initial curiosity about ICT at Telia Research could also be seen as a driver for virtual meetings.

104 The ‘rich’ organisation situation was also found at other companies within the Telia group, as well as at Ericsson.
Forcing a change of corporate culture is not a trivial task, but if other measures suggested in this analysis are undertaken, it is likely that a change in organisational culture would also follow.

Policies and Strategies
The hypothesised importance of making changes at a policy level was supported, particularly during the action research process at Telia. The symbolic value and message signalled by converting a travel policy into a meeting policy is a powerful manifestation from top management and an important step in changing the corporate culture. Changes in policies are also necessary if the strategies and routines controlled by these policies are to be supported and make sense.

5.6.3 Influencing Meeting Behaviour – Meeting Infrastructure
Providing a good meeting infrastructure is essential for virtual meetings. As stated in Section 5.2, this involves networks with sufficient security and bandwidth. In addition, readily accessible,\textsuperscript{105} and reliable end-user equipment is required, which has adequate capacity and quality. Moreover, this equipment needs to be compatible with those you wish to communicate with. Ease of use is also critical – the easier the equipment is to use, the more inclined the attendees are to use it. In order to ensure that the organisation’s communication needs are met, it is advisable to investigate the extent and character of this communication. Priority should be given to company nodes between where communication is intense and/or strategically important.

External communication provides more of a challenge, as the organisation’s control of the external parties’ technical infrastructure is limited. Audioconferencing seldom constitutes any major problems in this respect. However, interorganisational communication using videoconferencing and web-meetings can be more difficult. In addition to the social and cultural barriers this type of communication may face, availability, security, accessibility does not seem to be simply a technical issue, but also a matter of information and awareness. When asked whether they had access to videoconferencing equipment, many employees were unaware that this possibility existed at their specific location. Arnfalk, P. and B. Kogg (2001). Nära Målet - en undersökning av möten, resande och attityder på Telia Närå. Resultat, analys och rekommendationer. IIIEE, Lund University: 29
bandwidth, and compatibility are practical concerns that must be solved. For videoconferencing, publicly available studios could be a short-term solution, but hardly ideal for a longer time of collaboration. The growth and development of these applications will without doubt lessen these practical obstacles. Normal telephony (POTS) illustrates how a virtual form of interorganisational communication has become accepted, commonly available, reliable, and highly compatible.

To establish an attractive virtual meetings environment, efforts must go beyond connecting the equipment into the network socket. Allocating funds for making premises suitable for these types of meetings, for bookings systems, hosting, service and technical support are commonly neglected, but essential factors for success.

5.6.4 Influencing Meeting Behaviour – Personal Factors
The paramount challenge of virtualisation of business communication is to convince sceptics that this is a good idea, not only for the company, but also for them. The focus for overcoming the personal barriers identified in Section 5.5 can be oriented towards two main areas: changing attitudes and improving skills.

Attitudes
Recognising that some people feel unease using what they might consider complicated, ‘Star Trek like’ technology, this uneasiness often diminishes after they have tested the application themselves. The challenge is thus linked to how to attract these sceptics to test a virtual meeting under more informal conditions. This could be tackled by introducing mandatory tests during introduction of new employees, training of project leaders, management training, etc. Efforts such as offering free tests or open days at videoconferencing studios, giving seminars on ‘dos and don’ts’ in virtual meetings, will most likely not succeed in attracting the sceptics.106

As discussed in Section 5.2, the sceptics’ attitude to videoconferencing was sometimes based on an unsatisfactory experience dating five or ten years earlier. This group must be persuaded into reconsidering the application, by testing it again and experiencing the improved performance of today’s

106 Based on experiences at Lund University, Telia, and Tetra Pak.
networks and equipment. This may have more far-reaching effects than simply convincing one person to use using videoconferencing more frequently, as it also eliminates a potential source of bad will to virtual meetings. On the other hand, those who have a strong positive attitude to virtual meetings could act as important sources of inspiration for others, and act as catalysts in trying new technologies.

The *public choice* concept discussed earlier may also inhibit many employees from giving up the perceived benefits of travelling, see Paper III. The introduction of a meeting allowance has been considered by the Swedish EPA\(^{107}\) and at Telia. However, the idea has been rejected due to the difficulties in finding a form that is just, easily administrated, and difficult to abuse. Distributing a share of saved travel expenses in the form of a bonus at a group or department level could be a practicable way of creating incentives also at the individual level. The fact that Telia Nära has highlighted the savings made by using virtual meetings and linked this to a performance-based salary bonus has probably been instrumental in creating a very positive attitude towards this meeting form (98% of the respondents used audioconferencing, on average around 100 times per year).

**Skills**

Several barriers identified were directly linked to lack of skills in how to manage meetings in general and virtual meetings in particular. Therefore, the two main strategies for improving the skills suggested are *Information* – visualising virtual meetings can be an alternative to business travel, and *education* – improving ‘meetings professionalism’ in general, as well as how and when to use virtual meetings (Arnfalk and Kogg 2001).

Informing key persons about the available alternatives to physical meetings seems to be necessary, even within a telecommunications company. In addition to informing about the possibility and where to access the technology, the information could include good illustrative examples, estimates of possible savings, and the positive gains on a personal level.

Educating personnel in basic skills in how to manage and act in a successful meeting should be of interest for most organisations. This would also benefit the virtual alternatives, but specific, additional training is useful for

\(^{107}\) Personal communication with Joanna Dickinsson, Swedish EPA February 23, 2000.
those meeting forms. Many take for granted that it is commonly known how to behave, for example, in an audioconference, as most of us have long and thorough experience of using the telephone. However, for most people participating in a multi-point conference call, or simply using a conference telephone, is not routine.

5.6.5 Influencing Meeting Behaviour – Key Actors

The company, municipality, state agency, university, NGO, or other organisation with employees who travel in their line of work holds the key role in realising the potential of virtual meetings as a substitute for travel. The organisation’s chances of succeeding depend on numerous factors and other players, but ultimately it is for the employing organisation to decide if, and then, how, it wishes to implement a system that enables and supports virtual meetings.

Within the organisation, top management and project leaders are central for implementation, but also the role of representatives from the areas of ICT, finance, human resources, travel and transport, and environment should be emphasised. In addition to the organisation itself, two influential actors will be mentioned.

Policy makers have both a direct and an indirect possibility to influence the development of virtual meetings. The general way to adjust this situation is by taxation of fuels and vehicles, influencing the demand for travel by raised prices. As discussed in Section 5.1.2, situations may arise when ‘excessive travel’ is generated because of personal incentives, but the costs exceed the benefits for both the employing organisation and for society as a whole. Apart from the cost, organisations are offered few incentives from other policy instruments and tools to move towards a reduced environmental impact from travel (as discussed in Section 5.5 and developed in Paper III). Nevertheless, both at a national and international level (EU), politicians developing transport policy, as well as persons who control the design of EMS, eco-labelling, and environmental reporting schemes, have a possibility to influence the use of virtual meetings. Another influential role they may have is to be a good example, and use the technology themselves.

Producers and suppliers of equipment and network solutions are well suited to take on the role of informing and educating users of their products and services. This engagement should not (as is currently the situation) only be about communicating possible savings, but also informing the customer
how to obtain such savings, and to successfully implement a virtual meetings culture in an organisation.

### 5.7 Summarising the Analysis of Virtual Meetings

This section will briefly summarise the ideas and findings regarding business travel and virtual meetings presented in this chapter.

*Business travel* constitutes 10% of all pkm travelled in Sweden, and a major source of CO₂ and other emissions for many organisations. It can add value both for the organisation as well as for the traveller. Most people travel on business to attend meetings. Other common reasons for business travel are to attend conferences and training. In large organisations with extensive geographical distribution, a majority of business trips are triggered by internal collaboration. Upper management, project leaders, and sales and purchasing personnel are the groups travelling most frequent.

*Benefits and costs* for business travel can be identified at three levels: societal, organisational and individual, as summarised by Table 4.

#### Table 4. Summarising costs and benefits of business travel on a societal, organisational and individual level.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society</td>
<td>Stimulating growth and progress</td>
</tr>
<tr>
<td>Organisation</td>
<td>Access to established and generating new contacts, exchange of ideas and information, supporting an expanding business</td>
</tr>
<tr>
<td>Individual</td>
<td>Nice experience, developing personal and professional contacts, knowledge, skills, experiences, travel allowance and travel bonus</td>
</tr>
</tbody>
</table>
We may denote ‘excessive travel’ to a situation when the costs exceed the benefits. This could apply on a societal as well as on an organisational level. Excessive travel may arise in an organisation, if the individual benefits for a business trip exceed the individual costs, and that this skew his or her decision making to ignore that the organisations’ costs exceeds the benefits.

*Virtual meetings* offer a number of *advantages* as compared to physical meetings, but are at the same time associated with some *limitations*. In addition to cutting travel costs, advantages include more focused, effective meetings, supporting documentation and offering more people that chance to participate and take part of the information. More frequent, ad hoc meetings are made possible, as well as the chance to involve key persons. Limitations include limited technical access to networks and equipment, immature technology, and limited bandwidth.

Communicating virtually differs considerably from face-to-face communication. *Communication theory* improves the understanding of virtual communication, and highlights what should be considered in a shift from face-to-face communication. The concept of *Social Presence*, and the theories of *Media Richness* and *Channels Expansion* are explored.

Replacing a physical meeting with a virtual one has a number of implications, including *economic* and *social implications*. Even if only a fraction of business travel is replaced in an organisation, the economic consequences can be significant, as the costs associated with travel are very high. However, the potentially large savings are seldom fully realised. The social dimension of virtual meetings attracts great concern. Important aspects include the ‘time-rebound’ effect – less time per meeting but more meetings, the risk of losing out on ‘small-talk’, social and professional isolation of remote participants in meetings, and finally the ‘fun-factor’ – the fact that many people simply do not enjoy virtual meetings.

The *system and rebound effects* of virtual meetings can be discussed in terms of transport consequences, as well as environmental, social and economic terms. However, these effects are predominantly beyond the control and reasonable concern of the organisation. As this dissertation takes on a practical pollution prevention approach, these effects will consequently not be elaborated upon.

Four categories of *barriers* for an extended use of virtual meetings have been identified: *organisational, personal, intuitional and practical*. Among the
organisational barriers, we find a well-established business travel culture with the focus on travel – not for meetings. This is expressed in terms of many function and routines, such as travel budget, travel allowance, travel manager, travel agency, and travel policy. These functions seldom include or promote the non-travel alternatives. A heterogeneous meeting behaviour complicates adoption of virtual meeting routines and skills. Lack of responsibility and support for the virtual meetings infrasystem discourages its use, as well as a sub-optimisation of investments. Personal barriers include some drawbacks from not travelling: reduced professional output; loss of status, personal development, nice experience, travel allowance, travel bonus points, and even tax-free goods. Moreover, the lack of skills in how to manage a virtual meeting and the resistance to learn new things, also constitute barriers. The lack of institutional pressure can also be interpreted as a barrier for a shift towards shift towards virtual meetings, particularly as legal and normative pressure on an organisation, in the form of environmental policies, largely fail to address the impact of travel. Practical barriers in the organisation include limited availability to equipment and facilities for virtual meetings, poor reliability of existing equipment and unsuitable premises for this kind of communication.

How can an organisation support this change and reap the maximum benefits from technology’s virtues? A first step is to recognise when to use virtual meetings and when not to. The preferred form of meeting is decided by a number of situational and contextual factors. Among the situational factors, we find critical parameters such as the purpose and type of meeting, but also considerations of costs and benefits for the meeting, influence the decision. A second step is to decide what type of virtual meeting technology that should be used, which is partly determined by the amount of social presence and media richness required.

However, the organisation can influence the meeting behaviour, by manipulating contextual factors such as the organisation, meeting infrastructure, and also personal factors. The organisational factors that the organisation can influence, closely relates to organisational barriers, are found within the areas of human resource management, organisational culture, management control system, organisational structure, meeting infrastructure, and policies for travel, the environment and information. The meeting infrastructure aspects correlate to how to overcome the practical barriers, such as providing access to good equipment at strategically important nodes in an organisation, and allocating funds for support and service. Finally, personal factors that can be influenced include attitudes, by information, education and practical tests,
and by providing incentives not only for business travel, but also for virtual meetings.

The company, municipality, state agency, university, NGO or other organisation is the key change agent in this process. Within the organisation, top management and project leaders are central for implementation, but also the areas of ICT, finance, human resources, travel and transport, and environment should be emphasised. In addition, policy makers have both a direct and an indirect possibility to influence the development of virtual meetings. Furthermore, producers and suppliers of equipment and network solutions can play a role in informing and educating users of their products and services.

5.7.1 Further Discussion

From an organisation’s perspective, virtual communication is closely associated with the creation of so-called virtual teams. These can be described as groups of people who work together across distance, time, and/or organisational boundaries using technology to facilitate communication and collaboration. The growing literature in this field, see for example (Cooper and Rousseau 1999; Lipnack and Stamps 2000; Duarte and Snyder 2001), describes the challenges and opportunities of this form of work. The globalisation of markets creates a growing demand for virtual teams, and the possibility to work in this way itself shapes the way organisations are designed, managed, and offices located geographically. The emergence of virtual organisations or virtual companies can be seen as a direct result of ICT’s possibilities. The implications discussed here are very dependent on the design of these virtual organisations and virtual teams.
6 Virtual Mobility Applied – Telework

In this chapter, the virtual mobility application telework will be analysed and discussed, based on the virtual mobility framework presented in Chapter 2, transport effects discussed in Chapter 3, and environmental implications discussed in Chapter 4. The analysis of telework is less detailed than for virtual meetings as the area of telework has been covered by much more extensive research. The focus in this chapter is directed towards the possibility for an organisation to influence the environmental implications resulting from the application.

6.1 Basic Characteristics of Commuting

As for virtual meetings, the relevance for telework to be addressed as a virtual mobility application and discussed in a pollution prevention context, is justified by its potential effect on travel. For telework, the targeted travel is commuting. Therefore, some basic characteristics of commuting in Sweden will be highlighted.

In Sweden, the share of all employed that commute\(^{108}\) to work increased from 21.8% to 27% in the period 1985-1998 (Distansarbetesutredningen 1998). Commuting between the home and work or study represents 21% of all pkm travelled. In terms of number of trips undertaken, work and study commuting is the second most common purpose (26%) of all trips after leisure travel (SIKA 2000b). Most commuting to work takes place by car (60%) followed by public transport (35%) (Distansarbetesutredningen 1998).

\(^{108}\) Commuters are defined as persons who cross a municipality border on their way to work.
The average one-way work commute distance is approximately 18 km.\textsuperscript{109}

### 6.2 Factors Influencing the Environmental Outcome of Telework

In Chapter 2, a fundamental question for this dissertation was raised: why should an organisation be concerned about virtual mobility applications from a pollution prevention perspective? Based on the findings in Chapters 3 and 4, we may now re-approach the question for the telework case.

#### 6.2.1 Limited Travel Substitution

As five surveys report that 50-80\% of teleworkers do not experience any reduction in travel (see Section 3.3.3), it is not unreasonable to assume that much of the telework does not reduce travel. Moreover, most of the reported travel savings were considerably less than the theoretically expected average of 1800 pkm. A number of possible explanations for this have been suggested and researched. An important factor limiting the actual travel saving is that most people have a complex travel pattern, in which commuter travel is combined with other errands such as leaving and picking up children, shopping, making leisure trips, etc. (Engström and Johansson 1995; Skåmedal 1999). If the commute is omitted, these other trips may have to be made anyway. Other possible, but relatively limited, effects include a shift in commute times, moving further away from the office to more desirable residential areas, and effects on household members’ travel patterns.

However, the major factor hindering the potential travel saving is the simple fact that most telework does not take place during a whole working day, and thus does not substitute for the commute (Arnfalk 1999; Skåmedal 1999). In the Telia telework study, 34\% of the respondents teleworked whole days,\textsuperscript{110} 20\% part days, 35\% evenings and weekends, and 11\% in ‘other’

\textsuperscript{109} Personal communication with Anna Johansson at the Swedish Institute for Transportation and Communication Analysis, April 5, 2002. This figure exclude persons that walk or bicycle to work. The average ‘commuter’ (defining a commuter as a person who passes a municipality border on the way to work) travels on average 27 km to work.

\textsuperscript{110} Telework during ‘whole days’ refers to a situation when the teleworker spends the entire workday in a place other than the (main)office.
ways. In Skåmedal’s Ericsson study, only 20% regularly worked whole days. Not surprisingly, the commute distance plays a role in how inclined teleworkers are to telework whole days: 29% of those who have 1-10 km to work telework regularly whole days, as compared to 50% of those who commute more than 35 km one way (Distansarbetesutredningen 1998).

Viewing this finding from a pollution prevention point of view, the question arise: is it possible for the organisation to facilitate a shift towards telework during whole days? The three most common general barriers identified for telework in Sweden are the character of work tasks (85%), need for contact with colleagues (60%) and the employer’s unwillingness (20%) (Distansarbetesutredningen 1998). Consequently, organisations can play a key role in promoting telework, for example by designing work tasks so that telework is made possible, and to allow their employees to telework when it is possible and suitable.¹¹¹

However, this is not an attempt to add to the extensive literature on how to facilitate telework in general, on common barriers, facilitators, drivers, etc. The focus is rather on the possibilities of reaping the possible environmental benefits of telework for those who actually do telework or will start to do so.

There are a number of factors that may contribute to teleworkers not teleworking whole days. These can (as for virtual meetings) be categorised as organisational, personal, institutional, and practical.

**Organisational**

- The employer does not pay for commuter travel nor for commuting time and hence has no (strong) incentive to reduce employees’ commuting;

- The environmental impact from employees’ commuting is not considered the employer’s concern (although in some instances, such as in the Netherlands and the USA, this has become the case, see Section 6.3.2); and

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¹¹¹ By ‘designing work tasks’ implies that for the same type of work, necessary technical and administrative conditions are provided to facilitate telework. It does not imply changing the work task into something else.
• As teleworkers are in a minority in most organisations, the routines of the organisations have not changed to adapt to the teleworkers’ situation. Scheduling of meetings, information dissemination, and management style (‘management by walking around’ as opposed to ‘management by objectives’) are factors that influence the possibility for teleworkers to be away from the office a whole day.

Personal

• Sharing the home with the rest of the family may create a problem, as teleworkers might be expected to take on a larger share of the household duties, or may be disturbed by other household members;

• Many teleworkers feel stressed being away from the office full days as they are not able to ‘show’ what they have accomplished due to the lack of setting clear targets; and

• Teleworkers can experience negative reactions such as jealousy and irritation from non-teleworking colleagues due to their absence.

Institutional

• Taxation: commuting expenses exceeding SEK 7000 (EUR 770) per annum can be deducted from gross income when calculating taxation levels (in this way the Swedish state annually subsidises long distance commuters by more than SEK 3 billion (EUR 330 million)). Teleworkers are also able to deduct the rent for the part of the apartment or house used for work. However, this option only applies if telework exceeds 800 hours per annum, which effectively excludes more than 90% of Swedish teleworkers;

• The use of company cars partly shifts the variable cost burden from the employee to the organisation providing the employee with the car. This could constitute a disincentive to reduce travelling by car, and consequently also for telework, as the variable cost for commuting is transformed to fixed costs; and

112 There are two main company car agreements possible. In the first option, the teleworker pays for all private fuel for private use, in the second, the company pays for the fuel, and the employee using the car is taxed for the benefit of driving a standard distance of 15 000 km per year. The latter alternative strongly decreases the economic incentives to reduce travel by car.
• The most common EMS, ISO 14 001, does not explicitly mention transport in general or travelling in particular. Thus, most companies and other organisations managing their environmental impact based on this system, do not consider their employees’ commuting as part of their environmental responsibility.

Practical
• Insufficient technology in respect of insufficient equipment and inadequate network connection to the organisation’s server can constitute a hindrance, and force the teleworker to go to the office to perform certain tasks;
• Poor technical support when working at home; and
• Poor availability of material electronically restricts more extensive telework. The more material that can be reached remotely, the less the need to go to the workplace to pick it up (manuals, drawings etc.).

Consequently, the barriers for whole day telework are multidimensional, and are influenced by several stakeholders. Most of these barriers hinder telework in general, while a few particularly hinder the full day telework option.

6.2.2 Environmental Impact Beyond Travel
As discussed in Section 4.2.2, the environmental implications of telework are not only associated with travel implications, but the work form also has a number of other environmentally significant effects. These are triggered by changes in the teleworker’s need for ICT equipment, network connections, office space, working space in the home, and furniture. What is the relative environmental significance of these factors (in terms of CO₂ emissions)?

ICT equipment. The teleworker often surrounds him/herself with a large amount of electronic equipment in the home. As compared to commuter travel, office and home space the environmental life cycle effect from the equipment has a comparatively moderate impact. The largest impact stems from the computer. An increase in the amount of equipment at home is seldom accompanied by a reduction at the office.

Network Connections. The impact from this category is comparatively small.
Office space. A reduction in office space made possible by flexible work arrangements brings about comparatively large effects. However, it seems like most teleworkers in Sweden still work in traditional offices, resulting in unused office space during telework days.

Working space in the home. Different arrangements are possible. If telework triggers moving to a larger house, constructing or renting a separate building, heating and lighting of space in the home that otherwise would have been cold(er) and dark(er), this will lead to a comparatively large extra impact. However, if the work at home takes place in the regular dwelling area, that is usually heated during office hours as well, the impact is less.

Furniture. As for ICT equipment, the increased need for furniture in the home is seldom accompanied by a reduction in furniture at the office. The comparative impact from furniture is very small.

6.3 Realising the Virtual Mobility Potential of Telework

Clearly, the potential travel saving offered by the virtual mobility application telework is not fully realised. Moreover, as telework is commonly designed and managed today, the net environmental impact may even be negative. However, as this form of work is not one fixed solution, but rather one of a wide array of flexible possibilities, suggestions for approaches that could lead to a higher degree of travel substitution and an environmentally preferable overall outcome will be presented.

6.3.1 The Role of the Organisation

Reducing the Environmental Impact of Commuting

The organisation can enhance the environmental outcome of telework in basically three different ways: a) increasing the number of telework occasions (number of teleworkers and the frequency of telework), b) increasing the share of telework that takes place during whole days, and c) providing a possibility of teleworking during rush hours to avoid traffic jams and thereby facilitate a more effective commute (relevant for commuting by car). In this section, only b) is considered, even though the suggestions given probably influence a) in a positive way as well.
Consequently, the issue of concern is limited to the level of travel substitution. A rudimentary solution to this problem is that telework should be arranged over whole days, instead of evenings, weekends, and fragments of days. The barriers lie to a large extent in the way the organisation supports the teleworkers, or more often does not support them. A first step would be to acknowledge that telework does actually takes place in the organisation, which is not always the case. Considering that 6% to 12% of the Swedish labour force teleworks, it is startling that only a few companies and other organisations have developed policies, guidelines, agreements, and other forms of administrative support tools for this form of work. In a survey among commuters, although 35% teleworked at least occasionally, only 14% responded that they worked in an organisation that had a policy for telework (Distansarbetesutredningen 1998).

Therefore, it is recommended that organisations should establish a policy for telework and set out written individual agreements between the employer and the teleworker. In this way, concerns such as when, how much, and where the teleworker should work can be settled, possibly avoiding excessive overtime, allaying fears from both the employer’s and employee’s perspective, and paving the way for more structured support for this group of workers.

Other practical issues that promote telework in general and can help facilitate telework during whole days, include routines for scheduling meetings to avoid forcing people to go to the office during telework days, and managing information in a way that also provides easy access to those working remotely.

From an environmental management point of view, the main challenge is that organisations will have to begin to consider commuting as part of their environmental agenda. This is currently not the case, with a few exceptions. In this way, reporting of the environmental impact, and the means of reducing the environmental impact from commuting, could be more strongly supported.

113 This has been repeatedly stressed in literature, and numerous examples can be found online: e.g. http://www.telecommute.org/incentiveprogrammes.htm., and http://www.energy.state.or.us/telework/services.htm. Suggested examples of agreements in Sweden can be found in e.g. TCO (1996). Med jobbet på distans. The Swedish Confederation of Professional Employees (TCO): 16.
Reducing the Overall Environmental Impact of Telework

Some ways that an organisation may be able to influence the environmental impact of telework, other than travel effects are:

- **ICT-equipment**: using one lap-top computer instead of two stationary computers (sometimes plus a laptop as well!), offer support, service, and upgrading of equipment to increase life-span, promoting Energy Star and/or eco-labelled equipment, and to offer take-back support.

- **Working space in the home**: This is hard for the organisation to control, however, it may offer the employee space-saving furniture, advice and consulting, making it possible to facilitate a workplace within the existing dwelling area.

- **Office space**: The organisation can reorganise the office and create a flexible workplace, without fixed workplaces. This is closely associated with office furniture. However, this does not suit all organisations, as brought up in the discussion section.

- **Network communication**: It is hard to justify the little savings possible for this category, considering the importance it has for successful telework.

- **Furniture (in the home)**: As for network communication, it is hard to justify the little savings possible for this category, considering the importance it has for a successful telework (good furniture and lighting have repeatedly proved important success factors for telework).

### 6.3.2 Public Policy Influence on Telework

Swedish public policy does not include any specific means to stimulate a form of telework that could lead to a reduction in the environmental impact from commuter traffic. However, it is likely that Swedish organisations will experience a policy development towards an extension of the employer’s responsibility in terms of the environmental impact of commuting. This may be one of the outcomes of Europe’s and Sweden’s efforts to mitigate CO₂ emissions.

General measures, such as supporting large investment in a broadband network, and economically favourable conditions for employees to buy ‘home-computers’, have helped to boost computerisation of homes and connections to the Internet. However, a number of policies also act in the opposite direction, as indicated by (SOU 1998:115). General policy obstacles that connect the lessening of environmental impact of commuting
are found, for instance, in the areas such as taxation on benefits and public procurement (Feychting, Karlsson et al. 2001).

On an external policy level, taxation could favour a reduction in commuting rather than the reverse. Environmental management schemes could guide the organisations to take measures to reduce the impact from commuting. However, as in the case of virtual meetings, the employing organisation plays a key role in making this change, and without their support in this process, public policy measures are likely to fail. Thus, the main challenge for such efforts should be to create policies that can stimulate and support organisations to provide their employees with teleworking schemes that do result in overall travel reduction, and at the same time are economically and socially viable.

Two countries that use policy measures to actively promote telework as a means for commuter traffic reduction are the Netherlands and the USA. Some policy initiatives taken in these countries will be highlighted below.

The Netherlands
Dutch policy makers have recognised the country’s severe traffic congestion and environmental problems and have developed a number of policy measures in response. The basic approach to transport policy in the Netherlands is that the state provides the infrastructure, and that individuals and organisations are responsible for its use. The state’s role in terms of use is to facilitate the users’ shift towards transport modes and patterns with less negative impact.

Telework is promoted in that an employer can give an employee EUR 1800 to equip a home office for telework. This contribution is exempt from tax for the employee, and deductible for the employer (Feychting, Karlsson et al. 2001).

The USA
In the USA, the birthplace of telework (or telecommuting), telework has for a long time been considered a tool to mitigate urban traffic congestion and improve air quality. Initiatives to stimulate telework have included both federal telecommuting programmes as well as programmes by individual states within the USA (Distansarbetesutredningen 1998; Arnfalk 1999). The positive attitude towards telework has also been successful: a recent survey
found that there are 29 million teleworkers (21% of the labour force) in the USA, which is an increase of almost 17% since last year. Most of the telework takes place ‘on the road’ (24%) or from home (22%). A smaller percentage work at telework centres (7.5%) or at satellite offices (4.2%). The typical teleworker works at least one full day per week away from the traditional office environment (Davis and Polonko 2001).

Telework is legally supported at the federal level. A public law instructs federal agencies (1) to review telework barriers, act to remove them, and increase actual participation, (2) to establish eligibility criteria, and (3) that subject to any applicable agency policies or bargaining obligations, employees who meet the criteria and want to participate must be allowed that opportunity if they are satisfactory performers. The law provides that its requirements must be applied, within four years, to 100% of the federal workforce. Other existing or proposed telework laws cover funding for federal telework centres, federal agency procurement of telecommunications equipment for use in employee homes, telework tax breaks, and pilot-testing of telework environmental credit incentives (GSA 2001).

One example of an interesting federal initiative that promotes telework from an environmental point of view is the eCommute programme (the logo depicted in Figure 26). This pilot programme was debuted by the US EPA in April 2001 and is offered to companies in five major metropolitan areas: Denver, Houston, Philadelphia, Los Angeles, and Washington DC. The aim of the initiative is to create market economic incentives, such as emissions credits and credit trading, to encourage employers to promote telework at their companies. It is administered by the non-profit National Environmental Policy Institute (NEPI), which has developed an emissions credit and exchange system to test the effectiveness of incentives that would be offered to employers. Another goal of the eCommute programme is to help identify regulatory and statutory issues that need to be addressed to

114 The residual share of teleworkers is made up by a combination of different modes of telework.
115 Public Law 106-346, Section 359, 2000, as interpreted by OPM memorandum to agencies, 2001.
116 The National Telecommuting and Air Quality Act (S. 1521) was signed into law in October 1999.
117 The ‘credits’ are calculated with the help of Internet-based software provided by the company Teletrips. Available online: http://www.teletrips.com/
promote air emissions trading incentives. In January 2002, about 40 organisations had signed up for the programme.\textsuperscript{118}

![e-Commute Logo](image.png)

**Figure 26.** The logo for the e-Commute programme, administrated by the National Environmental Policy Institute in the USA.

One of the more far-reaching initiatives at US state level is Virginia’s ‘telework!va’ programme, which provides economic incentives for businesses to establish or expand telework programmes for employees. This two-year pilot programme reimburses lease costs, consultant, and technical assistance expenses connected with telework up to US$ 35 000 per organisation or US$ 3500 per employee (EUR 40 000 and 4000 respectively).

Other State supported telework programmes are found in for example Arizona, Colorado, Connecticut, Maryland, Michigan, Minnesota, North Carolina, Oregon, and Utah.\textsuperscript{119}

### 6.4 Discussion

#### 6.4.1 Socio-Economic Considerations

Repeatedly throughout this dissertation, it has been emphasised that the environmental concerns regarding virtual mobility applications may be important, but hardly constitute significant drivers compared to the economic and social implications. If telework proves economically disadvantageous for the employee and/or for the employing organisation,

\begin{itemize}
\item \textsuperscript{118} Personal communication: Ms Taryn Holowka, NEPI, Washington DC, January 25, 2002.
\item \textsuperscript{119} A list of Government programmes that support telework in the USA is available via the Canadian Telework Organisations online: http://www.ivc.ca/part33b.html.
\end{itemize}
or if the work form is socially unacceptable, it is unlikely to happen. Thus, it is important that telework is a voluntary form of work.

The business economic consequences of telework were estimated in the two scenarios ‘Business-as-usual’ and ‘Collabication’ (Arnfalk 1999). The result was economically favourable in both cases; however, the positive effect was considerably greater in the ‘Collabication’ scenario. This indicates that moving towards the more environmentally favourable scenario also leads to positive economic consequences, a so-called ‘win-win’ situation.

In the author’s experience, the social aspect of telework is, by far, the area attracting the most attention when this form of work is under discussion. In particular, people who are not teleworking are concerned that being away from the office will lead to social isolation, loss of job opportunities, frustration, and other negative effects. However, this commonly refers to an extreme form of telework, i.e., full-time work at home (or elsewhere). The sense of social isolation has also been reported in several studies, e.g. (Huws 1995; Wikström, Palm Lindén et al. 1997), and is a serious problem for sufferers. But, as only a minor proportion of the teleworkers in Sweden telework full time, and the average telework frequency is one day per week, this concern is in most cases misdirected. Telework is a voluntary initiative by the employee, and if he or she feels too socially isolated by working in this way, the employee will likely stop doing so. Furthermore, some of the most common reasons why people telework or want to start to telework is that they ‘want time to concentrate’, have ‘peace and quiet’, or have ‘undisturbed time’ for writing or reading (see e.g. Bergum (2000)), also confirmed by comments from Telia Telework survey and a report by Petterssson and Arnfalk (2001)). This could be interpreted as avoiding social interaction, i.e., when telework is employed to a limited extent, it is actually something sought rather than a problem for most teleworkers. Moreover, a large number of the teleworkers surveyed would like to telework more than they did at the time of the survey.

Another very important social aspect of telework is related to the way it is commonly distributed in time. As many people who work at home work evenings and weekends, this type of work could be considered a form of ‘hidden’ overtime, and not actually a form of telework. However, many are using the opportunity provided by the ICT to continue working from home. This could create problems of stress and difficulties in separating work and leisure time, which may lead to work-related stress in this group. Therefore, many negative aspects of telework for the employee derive from
this type of work that is actually not a form of telework. In the short term, it may be beneficial for an employer, but it is not unlikely to be so in the long term, as the employer ends up with stressed and unsatisfied employees.

The stress issue is also important in other respects: there is a risk that the employee feels stressed if he or she cannot show, to a (superior) manager or to other employees, that he or she is actually working and producing results. Correspondingly, managers may be anxious that they ‘lose control’ of teleworkers and that they are not working as intended.

Finally, a brief comment on the possibility of making savings on reduced office space by creating open, flexible offices. Many of the employees working in such flexible offices were not pleased with the change from individual rooms to open office space, complaining about being constantly disturbed and not being able to concentrate. On the other hand, some were also in favour of the shift. Nevertheless, the willingness to reduce costs for office space could be in conflict with employees’ well-being, and such a move should be carefully considered before being implemented.

6.4.2 But – Do We Really Want to Cut Travel?

The emphasis of this section on telework has been to analyse possible ways of enhancing the whole day telework mode. This is in order to obtain the desired transport substitution, from an environmental point of view. One thing must not be ignored when we are considering changing people’s travel behaviour. What if people who work half days, evenings and weekend, simply do not wish to telework full days? It is possible that they would not consider this option even if the appropriate organisation, technical infrasystem, and public policy framework were in place. The ‘flexible’ form of work that telework is often associated with and described as implies a non-routine, non-controlled, non-regulated form of work. A policy regulated, home-based telecommuting is far from the type of work promoted by slogans such as ‘work where you want’ and pictures of a man and his laptop in a hammock strung between two palm trees. Mokhtarian and Salomon (2001) challenge the assumption that the demand for travel is completely derived from the demand for spatially separated activities. They argue that travelling has an intrinsic value, and that structurally enforced travel such as commuting has other benefits than simply getting to and from work. These arguments are supported by the results from a survey in the San Francisco Bay Area. However, it should be noted that the terms ‘commute trip’ and ‘travel’ are not directly interchangeable, and that
different forms of travel, e.g. leisure travel, commuting and business travel, probably do not have the same value.

In a survey conducted among non-teleworking employees in the City of Lund (see Appendix IV), about three quarters of the non-teleworking respondents were willing to start teleworking. Of these, 51% would like to telework whole days, and 43%, part days (Pettersson and Arnfolk 2001).

Consequently, employees’ willingness to reduce commuting cannot be taken for granted. Removing practical and organisational barriers to whole day telework will likely increase this temporal distribution of the work form, but will not attract all teleworkers. The willingness to travel, as in the case of business travel, is strong, even in the case of routine commuting. In order to influence this, market-based policy instruments such as taxation of fuel and road-tolls can be employed. In order to use telework as a tool for alleviating the environmental impact from commuting, there is a need to combine both organisational and public policy measures.

6.5 Summarising the Analysis of Telework

The type of travel that telework may replace is work commuting, which represents 21% of all pkm travelled in Sweden, and is the second most common reason to travel after leisure travel. The average commute distance was 21 km in year 2001.

We may divide the factors that influence the environmental outcome of telework into two categories: travel implications, and other environmental impacts beyond travel. Starting with the travel implications, the fact that less than half of all teleworkers actually leads to travel savings (because the work is allocated parts of days, evenings and weekends), raises the question of whether the work form could be designed in such a way that a larger percentage of teleworkers would experience a travel saving effect. Organisational, personal, institutional and practical factors acting as barriers against that more telework take place during whole days.

However, environmental implications of telework are not only associated with travel implications, but the work form has also number of other environmentally significant effects. These are triggered by changes in the teleworker’s need for ICT equipment, network connections, office space, working space in the home, and furniture. Out of these, in terms of CO2 emissions, office and home space are the most significant, followed by ICT
equipment. Network communication has a small, and furniture a very small impact in this respect.

The environmental outcome is all but fixed, but varies strongly depending on a wide array of flexible possibilities, suggestions for approaches that could lead to a higher degree of travel substitution and an environmentally preferable overall outcome.

The organisation can enhance the environmental outcome of telework in basically three different ways: a) increasing the number of telework occasions (number of teleworkers and the frequency of telework), b) increasing the share of telework that takes place during whole days, and c) providing a possibility to telework during rush hours to avoid traffic jams and thereby facilitate a more effective commute (relevant for commuting by car). In this section, only b) is considered, even though the suggestions given probably influence a) in a positive way as well.

A common barrier lies in the lack of support of teleworkers. A way to address this is to acknowledge that telework does take place in the organisation, establish a policy for telework, and set out written individual agreements between the employer and the teleworker. Other practical issues that promote telework in general and can help facilitate telework during whole days, include routines for scheduling meetings to avoid forcing people to go to the office during telework days, and managing information in a way that those working remotely can also access it easily. A challenge is also to begin to consider commuting as part of the environmental agenda.

Some ways that an organisation may be able to influence the environmental impact of telework, other than travel effects include avoiding double ICT equipment, support, maintenance and upgrading of the technology, and promoting Energy Star and eco-labelled equipment. The employer may offer teleworkers space-saving furniture and equipment, as well as consulting on how to design the home workplace. Moreover, office space (as well as office ICT equipment and furniture) may be reduced by flexible work arrangements. However, these do not suit all workplaces nor employees and this step should be carefully considered. The small environmental savings on network and furniture are hard to justify, considering the importance it has for a successful telework.

The Netherlands and the USA have initiated a number of policy measures to stimulate telework in general and transport savings in particular.
Swedish public policy does not include any specific means to stimulate a form of telework. The main challenge is to create policies that can stimulate and support organisations to provide their employees with teleworking schemes that actually do result in overall travel reduction.
7 Concluding Discussion

This chapter presents the main conclusions drawn from the studies of virtual meetings and telework discussed in Chapters 3 to 6. The conclusions are structured as summary answers to the research questions. In addition, the generalisation of lessons learned from these two applications for other virtual mobility applications are discussed, using telemedicine as an illustrative case. Moreover, the main contribution of this dissertation is discussed, and suggestions for further research are given.

At first, the research questions will be approached and discussed in light of the research findings.

7.1 Lessons Learned from Virtual Meetings and Telework Findings

The main findings and conclusions drawn from the studies of virtual meetings and telework are presented in line with the structure of the research questions given in Chapter 1.

1. Can virtual mobility applications lead to travel substitution in an organisation?

The dominant effect of videoconferencing on business travel was substitution. In the two largest surveys, on average 64% of videoconferencing users experienced that the application substituted either their own business travel (45%) or travel for someone else (19%), while 33% of respondents experienced little or no change, and on average 3% found that videoconferencing had generated more business travel. Two smaller surveys had similar results. At for instance Tetra Pak, the company’s use of videoconferencing resulted in an estimated 10% reduction of total travel costs in 1998.
Audioconferencing combined with NetMeeting at Telia Nära was found to replace specific types of regular meetings in the line organisation. Since 1997, the Telia group has experienced a three-fold increase in the use of audioconferencing, in parallel with a substantial decrease in air travel. Other studies in the area also support the findings that organisations using virtual meetings experience a substitution of business travel.

A telework survey at Telia showed that 45% of the teleworkers reduced their overall travel, 3% experienced no difference and 10% had an increase in travel. In a smaller study at Scandinavian Network for Telework (SNTW), 42% experienced a travel reduction due to their telework. This can be compared with other Swedish studies in which the share of respondents who actually reduced their commute travelling ranged from 40-50% (except one study stating 20%).

In empirical studies within this research and in other studies, people who telework and participate in virtual meetings, predominantly report a substitution effect that exceeds the generation effect on their commuting and business travel. Indications of travel reduction on an organisational level were found as well. These travel savings appear on an application level, i.e. savings that can be directly associated to the organisation’s activities.

2. Can promoting virtual mobility applications be justifiable from a pollution prevention perspective?

Transport comes at a high cost, including its environmental impact. Climate change and the emission of CO₂ from combustion of fossil fuels is one of the major environmental concerns of today. Transport is accountable for 35-40% of the CO₂ emissions in Sweden, and travel makes up nearly two-thirds of these emissions. Business travel and commuting make up nearly one third of all travel in Sweden: 21% of the total pkm are accountable to commuting and 10% to business travel, thus representing 7-8% of all CO₂ emissions. However, most Swedish companies do not take any action to address environmental impacts from commuting or business travel.

Virtual meetings and telework do not only have travel implications that are environmentally relevant, but the applications change the need for ICT and other equipment, network communication, and space. By making approximate estimations the CO₂ emissions in different scenarios: a) the relative importance of these impact categories could be compared, and b) also the total outcome in different scenarios could be compared.
The results illustrate that for telework, the total CO₂ emissions are largely dependent on the effects of commuting, but also significantly influenced by the need for extra ICT equipment, and changes in area required in the home and at the office. Depending on the telework arrangements, telework can lead to a reduction or an increase of CO₂ emissions.

Applying the approach for virtual meetings, we find that even a very limited substitution of business travel (in the scenario once per month) leads to an overall reduction of CO₂ for an organisation. In comparison to the impact from travel, video- and audioconferencing equipment and virtual meeting premises has a limited impact.

In conclusion, the significant environmental impact of work related travel, and the possibility that the studied applications offer a prevention of this impact at source by substituting travel, makes it relevant to consider the applications from a pollution prevention perspective. Moreover, it seems reasonable to promote the applications as means for reducing the environmental impact from travel. However, it has to be recognised that the overall environmental impact largely depends on the way the technology is used, set up and applied. Consequently, pollution prevention efforts cannot be limited to promoting the applications, but must also influence the way they are set up.

3. **What are the main drivers and barriers for an organisation to obtain environmental gains by using virtual mobility applications?**

Enhancing environmental gains from the use of *virtual meetings* means foremost to substitute more business travel with virtual communication. This may be accomplished by replacing a share of the existing travel volume or to fulfil a growing demand for meetings with virtual alternatives. In general, the use of virtual meetings is economically favourable for the organisation as compared to its travel alternative. Although the initial investments in equipment may seem high, the possible savings in travel expenses, including substantial timesavings, can result in a very short payback time. Thus, this constitutes a driver for virtual meetings from an organisational perspective. However, the individual user has hardly any economic incentive to use the virtual meetings alternative. Rather the opposite is true as travelling is often compensated with a travel allowance, which commonly exceeds the standard cost of the trip.
Included in the many social effects of virtual meetings, we find that time plays an important role. On the one hand, these meetings offer large timesavings, and less time away from family and friends. However, a ‘time-rebound’ effect emerges as more meetings are scheduled, and complaints have been raised that people do not have time for reflection between all the meetings. Additionally, users of virtual meetings often express a concern that they miss the small-talk common in physical meetings. In audioconferencing, non-verbal cues are lost, which reduces social presence and can give a feeling of isolation.

Some of the main barriers towards a more extensive use of virtual meetings and substitution of business travel are related to the profound type of change required. Today, the travel paradigm prevails, and the whole organisational system is geared to support this forms of physical business meetings.

Factors that influence virtual meetings can be divided into situational factors (type of meeting, issues to be discussed, persons involved etc.) and contextual factors (organisation, technical infrastructure, training, policies, etc.).

In terms of situational factors, it is important to identify the situations when it is cost effective to use virtual meetings. Moreover, if a virtual meeting is chosen, selecting the most suitable technology is critical.

Among the contextual barriers we find four categories: organisational, personal, practical and institutional. Organisational barriers towards an increased use of virtual meetings are embedded in the corporate culture. In addition, well-established routines and organisational functions (e.g. travel policy) seldom consider virtual alternatives.

Personal barriers for virtual meetings are strongly associated to a reversed incentive – the attractiveness of travel. Most people like to travel, and business travel is surrounded by an aura of success and prestige. Travel allowances, frequent flyer programmes, tax-free shopping, and the possibility to combine the trip with a holiday, further enhances the business trip’s magnetism. A critical detail is that the persons who travel the most are often also the most influential in the organisation.

As a virtual meeting is a new way of interacting, it takes time for the innovations to diffuse into the mainstream way of working. Fear of approaching new technology (and the risk of making a fool of oneself), lack
of interest, knowledge, training, and skills are barriers that cannot be ignored.

Among the many practical barriers that can be mentioned, availability is a crucial point in two respects; the extent to which virtual meeting equipment is available at the organisation, and availability of equipment at other organisations. When the availability of equipment is solved, other barriers commonly include poor reliability (particularly videoconferencing) and an insufficient support environment (assisting technology, booking systems, rooms and furniture, support functions, etc.).

From an institutional perspective, the policies in place that could control and limit the business travel are mainly relying on market-based incentives. In the case of business travel, this disincentive is less effective, as the individual traveller is not paying the ticket her/himself. Consequently, a transport policy solely relying on increasing costs as means to steer business travel to a sustainable level, may not be sufficient in reaching targets set.

Telework has repeatedly been reported to yield large economic savings both for the employer and for the employee. Moreover, the fact that a growing number of people voluntary decide to telework indicates that it is also considered socially acceptable or preferable. These major drivers promote telework in general, but not necessarily a transport substitution. The fact that less than half of all teleworking actually leads to travel savings, due to the fact that work is allocated to parts of days, evenings and weekends, raises the question if the work form could be designed in a way that a larger percentage of teleworkers would experience a travel saving effect. A number of factors have been identified that act as barriers to more telework taking place during whole days. These factors can be divided into organisational, personal, institutional and practical.

An important factor is that the commuting of employees is presently not regarded as being within the realm of the responsibility of the organisation. Therefore, the organisation has no direct economic and environmental incentive to facilitate the teleworking actually leading to a travel substitution. This can be of vital importance as the employer is highly influential in creating conditions that can promote whole telework days. Conditions that may act as barriers against telework during whole days include a lack of policies and written agreements regulating telework, managers’ lack of acceptance, no consideration for teleworkers when scheduling meetings at
the office, poor/insufficient equipment and network connection, and limited availability of information electronically.

Consequently, the employee often considers it as a privilege to telework. There is a tendency that s/he also works evenings and weekends, particularly if the work environment makes it difficult for the person to work whole days remotely. In this way, the employer (in the short run) ‘gets more work out of the employee’, while the benefits for the teleworker are less, due to the risk for over-work and problems of making a distinction between work and free time.

We find that economic incentives play an important role as a driver for the applications. However, lack of economic incentives for the organisation to reduce commute travel, and a lack of economic incentives for the employee to reduce business travel, can constitute barriers for virtualisation of mobility. Lack of supporting policies and norms promoting the non-travel alternatives can also be seen as a barrier. The utility and attractiveness of travelling itself must not be disregarded in the overall equation of how virtual mobility may succeed in replacing certain travel activities. The fear of the extreme scenarios: never meet business contacts, never go to work to socialise and collaborate, are negative images that make many people instinctively recoil from the virtual options.

4. In what ways can an organisation influence the environmental outcome of a virtual mobility application?

A prerequisite for virtual meetings is to provide the technical infrastructure, but the realisation of a functional and a well-used virtual communication system relies heavily on non-technical issues as well. In order to obtain a system that better supports and utilises the advantages of virtual meetings, the organisation will have to fundamentally rethink, and adapt a system that supports both physical and virtual forms of meetings. The focus must be on the desired outputs from the meetings, as well as access to and the communication of values like information, contact, and trust.

Tackling these problems may involve expanding the scope of these functions to also involve the virtual alternatives, i.e. as a meeting policy, allocation of money for meetings in projects, a meetings manager, and a meetings agency (with emphasis on communication instead of meetings). It is important that the incentive structure is designed so that it stimulates
actors in the system to find the most suitable form of meeting from a cost-efficiency perspective, including social and environmental concerns.

Investing in good and appropriate technology is the foundation of success, but the too-often neglected auxiliary services must not be forgotten. Time and money set aside for these systems often prove to be well invested. Moreover, suppliers of solution for virtual meetings have plenty to learn from the travel and hospitality industry, and are facing a true challenge in making the virtual alternatives more attractive.

The different forms of virtual meetings offer a varying degree of social presence. However, this is depending not only on the technology but also, to a large extent on how used and skilled users are in managing the communication tools. Remedies may include testing of available technologies for all employees, training of new employees, routines and planning for regular meetings, and training in meeting management particularly for managers and project leaders.

As for virtual meetings, the two basic criteria determining the usefulness of telework as a means to tackle emissions from, in this case, work commute trips, is a) the number of teleworking occasions, and b) when teleworking, how it is designed. Realising the potential for telework in practical terms means making it possible for those who can and are willing to telework to do so, and designing the telework setting in a way that telework during full days are made possible and stimulated.

By extending the environmental responsibility of the organisations to incorporate commuting of its employees, an incentive to reduce this impact would be created for the stakeholder, who is central in making this possible. Arrangements that give the employer economic incentives to take on this responsibility would naturally further enhance this effect.

A well-working telework is beneficial both for the employee and for the organisation, and thus it should be of interest for the organisation to create the necessary prerequisites. Critical issues in this respect are to adapt the organisational policies and routines in a way that it supports telework: for instance scheduling of meetings, information handling, work planning and agreements for telework. Providing good equipment and office furniture, fast and secure access to the server of the central workplace are other success factors. Moreover, as telework represents a different type of work
and also affects the private sphere considerably, some consulting in how to set up and manage the telework situation may be a well-spent resource.

The strong role of the organisations is key to its success. However, the willingness of the organisation to engage in reducing travel impacts can be influenced by policy measures, and the willingness of individual to travel can be influenced both by the organisation and by public policy. Consequently, the effect of virtual mobility relies on a combination of efforts from individuals, organisations and policymakers. The formation and distribution of incentives to organisations and individuals are essential.

In summary, the organisation must recognise that virtual mobility can play a role in substituting travel, but also that the environmental outcome depends on a number of factors. Providing sufficient technology is a prerequisite, but most of the success factors involve issues beyond provision of technology. As this dissertation shows, realising the potential of virtual mobility is not a matter of one ‘quick fix’, but rather a combination of more far-reaching changes on several different levels. Some of this adaptation is likely to spontaneously happen, but it may take a long time if the challenges are unknown and every organisation has to find out how to handle them ‘the hard way’. To speed up the process in a desirable direction, is to see to that the right incentives are directed to the parties that can affect the situation.

### 7.2 A Parallel to Other Virtual Mobility Applications

#### 7.2.1 The case of Telemedicine

Throughout this thesis, telemedicine has been discussed in parallel with virtual meetings and telework, and the impact of telemedicine on travel and its overall environmental impact has been analysed. However, the limited extent and depth of the analysis, and the lack of primary data and own experiences within this field, leaves us mainly with the option of speculating in how telemedicine can play a role as a virtual mobility application and pollution prevention tool.

Nevertheless, the findings from virtual meetings and telework provides us with an insight into what possibilities and challenges that telemedicine will face in this respect.
Telemedicine appears to follow the economic pattern of both virtual meetings and telework, with substantial savings possible for the organisation, which is welcomed in a sector pressured by a tightening economic situation and cut-downs. This, however, also restricts the willingness to make large initial investments. For many of the telemedicinal functions, the savings benefit the patients, which does not directly appear in the balance sheet of the investing department. The missing incentive to lessen patients’ travel, and other similar barriers found for virtual meetings has been previously reported (Håkansson and Gavelin 2000).

The organisation, in this case a hospital, plays, like in the two other applications, a key role in shaping the effect of what impact the equipment will have, including transport reduction and environmental effects. Also here, it is likely that the issues surrounding the technology are equally or more important than the equipment itself.

As for the two other applications, the social aspect of telemedicine is important for its extent and design. The risk that technology would induce some kind of alienation between patients and healthcare personnel must be avoided. However, if the application can be used to help sort out the suitable occasions, and to distribute the scarce resource of direct interaction with physicians, the result would be the opposite effect instead.

What potential impact does the technology have for the health care sector? Naturally, the most important benefits of introducing telemedicine is undoubtedly the possibility to provide more people a better quality healthcare. Nevertheless, the following estimated figures indicate that telemedicine also could have an important virtual mobility role:

- 50-80% of people entering the healthcare system don’t really need a doctors care; and
- 70-80% of the health problems can be cared for by the patients themselves if provided the right information (Spradley 1998).

As telemedicine offers possibilities to provide diagnose at a distance (e.g. via medical information teleservice), the number of people entering the medical system in vain could be reduced. At the same time, by helping to provide patients with the right information at the right time, time, costs and suffering could be limited.
Consequently, a number of parallels can be drawn to the findings from virtual meetings and telework. The experiences from these areas can enhance the understanding of how to succeed with obtaining positive effects of telemedicine.

### 7.2.2 Other Virtual Mobility Applications

In addition to the three virtual mobility applications discussed, a travel substitution potential exists in a number of other areas. Limiting the range to those that can influence structurally enforced, non-leisure travel, and areas where an organisation can play an important role in influencing the travel implications, a number of areas can be mentioned:

- **B2C, local e-commerce**: could substitute a trip to the supermarket with a truck delivery of the commodities. The key player is the shop;
- **E-learning**: could substitute a trip to the school, university etc., The key player is the educating body;
- **Tele-surveillance**: trips to different facilities could be replaced by remote monitoring. Both guarded organisations and the guarding companies are influential;
- **E-banking**: substituting a trip to the bank. The bank, and the company designing the alternative – the Internet based services, are key players.

The applicability of the virtual mobility framework, and the lessons learned from virtual meetings and telework, appears to be relevant for telemedicine. However, the applicability for these other areas will not be further discussed here, but left for further research.

### 7.2.3 Usefulness of the Virtual Mobility Concept

With the findings from this research in hindsight, what can be said about the usefulness of this concept and its applicability in terms of an addition to the pollution prevention toolbox?

One advantage of introducing this concept is that it brings down a new and difficult issue to a manageable and practical level, compatible with existing ways of handling things, e.g. policy measures, management systems, guidelines, educational courses, material etc. This in turn can make it easier and less insurmountable for managers, politicians, and individuals to identify and take action towards realising potential gains. Moreover, the applications may have several problems in common and lessons learned
from one could benefit others as well, e.g. experience sharing between areas like virtual meetings, telemedicine, and e-learning.

Is it relevant to bother about these applications – do they make a difference? The question has to be answered in two ways. From a macro perspective, looking at the current overall impact they generate today, previous research finds that the effects are very limited. However, from an organisational perspective, and in a longer perspective also on a macro scale, the applications do have an environmental relevance. The environmental impact of the travel these applications have the potential to replace, often constitutes a significant share of the total impact of the organisations. Empirical research indicates a reduction of travel from the use of the applications. The concern of the environmental impact of transport is increasing (EEA 2000a; OECD 2000), which is being expressed as more stringent policy measures, including a larger degree of internalisation of the costs of transport. This, in turn, leads to higher prices, and demands that organisations should take action to lower their impact. However, the potential net travel substitution is considerably larger than the actual ‘business-as-usual’ gain experienced today. Thus, a conscientious design of the applications to safeguard the potential is the prime challenge when considering virtual mobility within pollution prevention.

7.3 Main Contribution of this Dissertation

In the author’s opinion, the ways that this research has contributed to a further understanding of the area are by:

- developing the virtual mobility concept and its relevance for organisations;
- exploring the role of virtual mobility in a pollution prevention context;
- developing an approach to analyse environmental impacts of virtual mobility applications;
- identifying facilitators and barriers towards enhanced transport substitution and reduced overall environmental impacts of the applications;
- suggesting new design for teleworking and virtual meetings that can lead to enhanced transport substitution and overall environmental impacts.
7.4 Questions for Further Research

A number of important questions have had to be left outside the scope of this work, but could be the starting point for further research.

What are the effects of virtual meetings on business travel in the long term? What impact do they have on travel in absolute and relative terms (e.g. compared to turnover, number of employees, and output of services or products)?

Theories of innovation diffusion and structural inertia will no doubt support the understanding of how these technology applications become accepted, implemented, and integrated in an organisation’s activities. What can these theories tell us about the barriers identified in this research and how to overcome them?

What are the current and potential travel and environmental implications of other virtual mobility applications such as e-commerce, e-learning, and e-banking? What can be done to utilise the virtual mobility potential of these applications as well?

What policy adjustments are necessary in order to make organisations willing to give a higher priority to travel-related environmental issues? How could the design of EMS and other environmental policy tools be changed to better take the potential of virtual mobility into account?

The short-term effect of the terrorist attacks on the September 11th, 2001 has been a decline in the business travel market, but the businesses are recovering. To what extent has this event lead to policy changes within different organisations? Is there generally a greater acceptance to use virtual communication in inter-organisational communication? Does this constitute a tipping point?

The importance of mobile communication services is likely to grow, despite the industry sectors’ current recession. Via mobile phones and palmtop computers, employees can access functions such as e-mail, company intranet, address books and calendars etc. In a recent survey of Nordic companies,\textsuperscript{120} 40% had already invested in remote access for their

employees (including fixed access via a computer in their home), and 69% were planning to invest in mobile access for employees, within the next year. Most US teleworkers are people who work ‘on the road’. What are the social, economic and environmental effects of the increasing ‘mobilisation’ of the workforce? Is this development sustainable, and if not, what can be done to steer it in a more sustainable direction, and who should do it?

The economic discussions have been mainly limited to the organisational perspective. What are the current and potential socio-economic implications of these applications? A question of particular interest is what role virtual mobility application may have in greenhouse gas emissions trading schemes.

This research has focused solely on a western perspective in general, and Swedish one in particular. What are the current and potential implications in other countries, and particularly interesting is to investigate what is the potential in developing countries? How can this development be steered in order to get the best results down the triple bottom line?
8 Epilogue – the Research in Hindsight

In this chapter, some more personal reflections will be made on the research approach, the research process, how it has been received, and what it has lead to.

8.1 Proactivity

In my role as an environmental researcher, I have clearly stated my opinion that a lessening of the environmental impact from transport is desirable. I also believe that measures preventing pollution are more preferable than remedial solutions. Virtual mobility applications offer such preventive pollution reduction from travel.

The vast majority of all studies made within this field are describing the current situation of ICT and its inter-linkage to transport. They make more or less well-substantiated predictions of how the ICT will affect transport patterns in the future. From an environmental perspective, it is discouraging to find that many trustworthy studies of both the current and future situation, projects a picture of a continued fast growth of the travel sector’s impact, with only a minimal substitution effect from ICT applications and more significant travel generation from rebound-like effects. The findings of this research also underpin the currently limited travel effects on a macro scale. Here we could stop and comfortably resign to the conclusion that this probably wasn’t a good idea after all.

However, this research does not only point out the current limited effects but also the potential for organisations and individuals to make significant economic and environmental savings on a micro scale. It also reveals some of the major hindrances that limit the current savings and suggests ways to overcome these hindrances.
If companies and other organisation become more aware of the savings potential, policymakers provide incentives for the organisations, and the organisations provide incentives for their employees, we can reap more of the benefits from the virtual mobility phenomenon.

8.2 Creating Change

This research journey has resulted in a number of research journal articles, reports, book chapters, and two dissertations. It has also involved designing university courses and supervising nine Masters’ theses within the field, as well as numerous presentations at conferences and other events. Moreover, the topical question has attracted much interest from different media including daily newspapers and magazines (more than 20 articles), homepages and even television. This has been fun and rewarding, and well worth the time and effort required. However, the most rewarding experience was, beyond all, the Royal prize I was given for my research in May 2001.121

The research approach has involved a large number of organisations, including private companies, state agencies, municipalities, NGOs, universities, large project organisations. I have gained a lot of experience from these interactions, but the contact has also to some extent succeeded to influence the organisations to considering and managing these issues more actively.

I will mention one practical result of the research process. In the absolute final stages of submitting the manuscript of this dissertation, Telia, the most thoroughly studied company, announced that they will adopt a corporate meeting policy, which will guide and steer how business communication is managed within the organisation. The basic message of the policy is that employees must consider the question that the CLASH posted: Should I stay or should I go? This is a direct result of a long research process that started in 1996. I’m very glad and proud of this little ‘achievement’ – persevere and never fear!

121 King Carl XVI Gustaf’s 50th Birthday Foundation for Science, Technology and the Environment.
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**Personal Communication**


Anna Johansson at the Swedish Institute for Transportation and Communication Analysis, April 5, 2002.


Appendix I a

Questionnaire: Videoconferencing surveys

Videoconferencing at the Scanian Farmers Association (Skånska Lantmännen)

1. Woman/Man?
   A) Woman
   B) Man

2. Age?
   A) Below 25:
   B) 25-30:
   C) 31-35:
   D) 36-40
   E) 41-50:
   F) 51-60:
   G) Above 60

3. Main Professional Role?

4. Have you ever participated in a Videoconference?
   A) Yes, go to question 5:
   B) No, go to question, 15:

5. How many times have you participated in a Videoconference?
   A) once:
   B) 2-5 times:
   C) 5-10 times:
   D) 11-20 times:
   E) more than 20 times:

6. For what purpose did you participate in a Videoconference?
   A) as a test, by curiosity or of interest:
   B) education:
   C) meeting:
   D) own presentation:
   E) listen to a presentation:
   F) participate in a conference:
   G) other purpose:

7. How many person have on average participated in the videoconference (on "your side")?
   A) 1
   B) 2:
   C) 3-5:
   D) 6-10:
   E) 11-20
   F) above 20:

8. Have videoconferences replaced travel? (are they substituting, complementing or generating?)
   A) Yes, they have replaced trips that I would have had to do
   B) Yes, but it has hardly reduced my total travelling:
   C) Yes, but the meeting partner would have come to me/us instead:
   D) No, but it has made it possible for me to participate in meetings that I otherwise would not have gone to
   E) No, it has given me more and better contacts, generating more travel:
9. If videoconferencing has replaced travel, how large has the average saved distance been (in km, one way trip)?
   A) below 50 km:
   B) 6-100 km:
   C) 11-25 mil:
   D) 25-500 km:
   E) 51-1000 km:
   F) above 1000 km:

10. What means of transportation would have been used, usually?
   A) Car, alone:
   B) Car, more persons:
   C) Bus:
   D) Train:
   E) Flight:

11. Is the use of videoconferencing encouraged within the organisation? (1=not at all, 5=yes, a lot)?

12. How have the videoconference meetings worked out? (1=bad, 5=good)?

13. What were the main problems with the videoconference meetings?
   A) no problems!
   B) problem with connection:
   C) problem with sound transfer:
   D) problem with picture transfer:
   E) technical interruption:
   F) stiff, unfamiliar feeling among the meeting participants
   G) important social part disappears:
   H) other reason:

14. How much of a "real" meeting have the videoconferences replaced? (1-10 => 10-100%)

   To you, who have NOT participated in any videoconference before, we would like to ask a few questions:

15. Why have you not participated in a videoconference?
   A) don't know where the equipment is located, don't know how to go about:
   B) never been asked:
   C) no access to the equipment:
   D) never felt I had a reason to use it:
   E) in-person meetings can't be replaced:
   F) too few or no meeting partners who have access to videoconference facilities:
   G) it is much nicer to travel:
   H) I loose out on tax-free, travel allowance, and frequent flyer points
   I) other reasons:

16. Could you imagine start using videoconferencing?
   A) Yes:
   B) No:
Appendix I b, c and d

Videoconferencing within the Scandinavian Videoconferencing User Group - 99

The questionnaire used in this study was identical to that of the “Videoconferencing at the Scanian Farmers Association (Skånska Lantmännens)” study, with the exception of one extra question:
“Is audio- and/or videoconferences mentioned in the travel policy or environmental policy?”

Videoconferencing at Telia

The questionnaire used in this study was identical to that of the ‘Videoconferencing at the Scanian Farmers Association (Skånska Lantmännens)” study, with the following exceptions:

• In question 3: ‘Main Professional Role?’ the following alternatives were given:

• Question 6 is called 6a, and has added the answer alternatives: Technical support and Interview

• Question 6b is added, asking “Why have you chosen Videoconference as a form of meeting?”

  A) saving time: B) cost savings : C) convenient, flexible way of meetings: D) environmental concern: E) asked by the meeting partner: F) fun, interesting, exciting form of meeting:

Videoconferencing at Tetra Pak

This questionnaire that was sent out via e-mail, differs in several instances from the other Internet-based studies presented above.

• Question 5 has different answer alternatives: A) never, B) only a few times, C) 1-5times/year, D) 6-10 times/year E) 1-2 times/month F) 3-5 times/month G) 6-10 times/month, H) >10 times per month.

• Question 8: answer alternatives A) Yes, they have, to a considerable extent, replaced trips that I would have had to do. B) Yes, reduces a marginal part of my travel.

• Question 10: added the answer alternatives Taxi, Boat and Other

• Question 11: Answer alternatives: Not at all, very little, some, yes, yes. a lot, and very much.
**Appendix II a**

**Questionnaire: Telework at Telia AB**

1. **Do you telework to any extent?**
   - A) yes, proceed to question 2
   - B) no, but I'm interested in starting to telework, proceed to question 14.
   - C) no, I'm not interested. No more questions need to be answered, but please comment why you are not interested.

2. **How many days per month do you telework?**
   - A) 1 day or less:
   - B) 2-5 days:
   - C) 6-10 days
   - D) more than 10 days per month:

3. **How is the telework distributed in time?**
   - A) full days:
   - B) part of days:
   - C) evenings and weekends:
   - D) other solution (please explain)

4. **Where does the telework take place?**
   - A) in the home:
   - B) while travelling (in a car, on a hotel, on a journey etc.):
   - C) telecentre, telecottage or other local centre:

5a. **Do you want to telework more or less than you do today?**
   - A) no
   - B) yes, in such case:

5b. **In such case: where?**
   - A) in the home:
   - B) while travelling (in a car, on a hotel, on a journey etc.):
   - C) telecentre, telecottage or other local centre:

5c. **In such case: how often?**
   - A) 1 day or less:
   - B) 2-5 days:
   - C) 6-10 days
   - D) more than 10 days per month:

6. **What equipment do you have at your workplace at home?**
   - A) Lap-top computer:
   - B) Desk-top computer:
   - C) Ink beam writer:
   - D) Laser writer:
   - E) Normal telephone:
   - F) ISDN:
   - G) ADSL:
   - H) Fax:
   - I) Scanner
   - J) Furniture, specially for telework
   - K) Other equipment, please specify

7a. **What technical equipment would improve your work?**

7b. **What furniture would you like to have?**

8. **Did you know that Telia Assist can provide office equipment for your workplace at home?**

9. **Do you have a special contract with your employer regarding telework?**
   (insurance, working time etc).
   - A) No.
   - B) Yes, what does the contract include?
10. Are there any hindrances to expand your telework?
   A) customer contact requires daily presence at the main workplace
   B) telework is not allowed/supported by the management
   C) high degree of paper-based information management
   D) the work demands access to technical equipment only accessible at the main workplace
   E) meeting are scheduled, not considering the teleworkers situation
   F) other reasons

11. In what way do you get to the main workplace?
   A) Car, alone
   B) Carpooling
   C) Train, subway
   D) Bus
   E) walking or bicycling

12. What is the distance between your home and the office?
   A) < 1 km:
   B) 1-5 km:
   C) 5-10 km:
   D) 10-15 km:
   E) 15-20 km:
   F) 20-25 km:
   G) 25-30 km:
   H) 30-40 km:
   I) 40-50 km:
   J) > 50 km If above 50km - how far?

13. Has your travelling decreased due to your telework?
   A) no, rather increased:
   B) don't know:
   C) yes, but less than 1000 km/year:
   D) yes, 1000-2000 km/year:
   E) yes, 2000-5000 km/year:
   F) yes, more than 5000 km/year

For those who never teleworked, but would like to start, the following questions were asked:

14a. Where would you like to telework?
   A) in the home:
   B) while travelling (in a car, on a hotel, on a journey etc.):
   C) telecentre, telecottage or other local centre:

14b. How often would you like to telework?
   A) 1 day or less:
   B) 2-5 days:
   C) 6-10 days
   D) more than 10 days per month:
Appendix II b

Questionnaire: Telework in the SNTW

(1. What do you expect to get out of your membership in SNTW?)

2. Do you telework to any extent?
   A) yes, proceed to question 3
   B) no, but I’m interested in starting to telework, proceed to question 15.
   C) no, I’m not interested. No more questions need to be answered, but please comment why you are not interested.

3. How many days per month do you telework?
   A) 1 day or less:
   B) 2-5 days:
   C) 6-10 days
   D) more than 10 days per month:

4. How is the telework distributed in time?
   A) full days:
   B) part of days:
   C) evenings and weekends:
   D) other solution (please explain)

5. Where does the telework take place?
   A) in the home:
   B) while travelling (in a car, on a hotel, on a journey etc.):
   C) telecentre, telecottage or other local centre:

6. What equipment do you have at your workplace at home?
   A) Lap-top computer:
   B) Desk-top computer:
   C) Ink beam writer:
   D) Laser writer:
   E) Normal telephone:
   F) ISDN:
   G) ADSL:
   H) Fax:
   I) Scanner
   J) Desk-top video
   K) Copy machine
   L) Furniture, specially for telework
   M) Other equipment, please specify

7. Has your employer paid any of your teleworking equipment?
   A) yes, some technical equipment
   B) yes, all technical equipment
   C) yes, all technical equipment and furniture
   D) yes, only furniture

8. Have you bought a “hemdator” facilitated by your employer?
   A) yes,
   B) no, but planning to
   C) no, not interested

9. Those of you working from at home, how does your telework office look at home?
   A) no special arrangements for telework
   B) special desk for telework
   C) special room for telework
   D) special building for telework
10. Would you like to work from a local centre, fully or partially?
A) yes, all telework from here
B) yes, part of the telework
C) no

11. Do you have a special contract with your employer regarding telework?
(insurance, working time etc).
A) No.
B) Yes, what does the contract include?

12. Are there any hindrances to expand your telework?
A) no
B) customer contact requires daily presence at the main workplace
C) telework is not allowed/supported by the management
D) high degree of paper-based information management
E) the work demands access to technical equipment only accessible at the main workplace
F) meeting are scheduled, not considering the teleworkers situation
G) technical problems
H) security reasons
I) risk for isolation and alienation
J) other reasons

13a. In what way do you get to the main workplace?
A) Car, alone
B) Carpooling
C) Train, subway
D) Bus
E) walking or bicycling

13b. What is the distance between your home and the office?
A) < 1 km:
B) 1-5 km:
C) 5-10 km:
D) 10-15 km:
E) 15-20 km:
F) 20-25 km:
G) 25-30 km:
H) 30-40 km:
I) 40-50 km:
J) > 50 km If above 50km - how far?

13c. Has your travelling decreased due to your telework?
A) no, rather increased:
B) don't know:
C) yes, but less than 1000 km/year:
D) yes, 1000-2000 km/year:
E) yes, 2000 -5000 km/year:
F) yes, more than 5000 km/year

For those who never teleworked, but would like to start, the following questions were asked:

14. Has your telework influence your choice of were to dwell?
A) No
B) Yes, I've moved further away from the main workplace
C) Yes, I've moved closer to the main workplace
D) Yes, I move part of the year to another place (summer cottage etc)

14a. Where would you like to telework?
A) in the home:
B) while travelling (in a car, on a hotel, on a journey etc.):
C) telecentre, telecottage or other local centre:
Appendix III

Questionnaire: Telia Nära Survey – originally in Swedish:

OM2 – Telia Nära AB, Concerning Meetings, Travel and Virtual Media

About the Questionnaire

This questionnaire is part of a project whose aim is to:

- Develop and support the implementation of realistic policies, regulations and incentives with the view to replace business travel with Virtual Meeting forms.
- Develop new services that can strengthen Telias competitive position.
- Identify and manage barriers which make those at Telia not practice what they preach.

The project is a collaboration between Telia Nära, Telia AB, Telia Research and the International Institute for Industrial Environmental Economics at Lund University. Telia Nära are contributing to the project as we have already begun to work with our meeting forms and we have already succeeded in reducing our travel costs with the help of alternative meeting forms. Our experiences will be used to create changes in the rest of the Telia family. Your answer, sent to us anonymously, will help us to better understand experiences and opinions surrounding business travel and Virtual Meetings that exist at Telia Nära, plus to understand the factors that influence the choice of meeting media. After many of the questions there is room for your comments. All comments are of interest and are appreciated, but are not compulsory. The time required to fill in the questionnaire is approximately 10 minutes. Thank you for your participation.

About yourself:

In the section below, follow the questions concerning your role at Telia Nära. Kindly choose the best alternative that corresponds to your circumstances.

1. What city is your office located in?
2. Which division do you work in?
   a) Telia Nära - National
   b) Telia Nära – Local
3. What is your job title?
4. Have you participated in any work projects in which the participants are located in another city?
   a) Yes
   b) No (go directly to question 6)
5. Is your role as project leader or sub-project leader in any of the projects that you have or are participating in?
   a) Yes
   b) No

6. Do you supervise any personnel?
   a) Yes
   b) No

7. In your work have you come in contact with representatives from the top management of Telia Nära?
   a) Yes
   b) No

   Comments:

8. In your work have you come in contact with representatives from other Telia subsidiaries?
   a) Yes
   b) No

   Comments:

**About meetings, travel and virtual media**

**About Meetings:**

In the section below, follow the questions concerning meetings. Kindly choose the best alternative that corresponds to your circumstances. PLEASE ALSO NOTE THAT WE ONLY CONSIDER MEETINGS IN WHICH ONE OF THE PARTICIPANTS IS SITUATED IN ANOTHER CITY.

9. How large a share of your meetings (approximately), physical or virtual, is with personnel from Telia’s top management?

   Comments:

10. How large a share of your meetings (approximately), physical or virtual, is with personnel from another Telia subsidiary?
    a) None at all
    b) Less than 30%
    c) Between 30% and 60%
    d) More than 60%

   Comments:

11. How large a share of your meetings (approximately), physical or virtual, is with external company personnel (non-Telia employees)?
    a) None at all
b) Less than 30%
c) Between 30% and 60%
d) More than 60%

Comments:

12. Is there any type of meeting, in general, that you think should be held using virtual media?

13. Is there any type of meeting, in general, that you think requires physical presence?

14. Have you travelled to meetings that, in your opinion, might as well could have been held by virtual means?
   a) Never
   b) Less than 6 times/yr
   c) Less than 12 times/yr
   d) 12 times or more

15. Who calls the meetings that you consider being called to unnecessarily?
   a) Personnel within Telia Nära
   b) Personnel within Telia Management
   c) Personnel within another Telia subsidiary
   d) External contact (non-Telia employee)

Comments:

About Travel:

In the following section a number of statements regarding travel are presented. Please choose the alternative that you consider to be most correct. Please also note that only business travel is considered (excluding commuting to and from work).

16. Travel to a location other than the one I work at is part of my job.
   a) Yes
   b) No (proceed to the next section, question 19)

17. I travel an average of:
   a) 1-2 times per year
   b) 3-5 times per year
   c) 6-10 times per year
   d) 11-20 times per year
   e) More than 20 times per year

   If you have stated that you travel more than 20 times per year, please specify.

18. The most common purposes for my travel are:
   a) Project meeting or another work-related meeting
   b) Customer contact, marketing
   c) Education and/or Conference
   d) Network Meeting
About Virtual Meeting:

In the concept of Virtual Meetings we include all forms of meetings in which information and communication technology are used for communicating in real-time.

19. I have received instructions about the infrastructure (hard and software) that is available at my workplace to support Virtual Meetings (e.g. meeting rooms with conference telephones, videoconferencing equipment, NetMeeting, etc).
   a) Fully agree
   b) Partly agree
   c) Do not agree
   d) Don't know/undecided

Comments:

20. I have received information about how to use the virtual media at my workplace.
   a) Fully agree
   b) Partly agree
   c) Do not agree
   d) Don't know/undecided

Comments:

About Audioconferencing

Please note that when we refer to audioconferencing, we consider meeting with three or more participants, in which at least one participates via telephone.

21. I participate in audioconferencing at work.
   a) Yes
   b) No (proceed to the next section, question 25)

22. I participate in audioconferencing on average:
   a) 1-6 times per year
   b) 7-12 times per year
   c) 2-5 times per month
   d) 6-10 times per month
   e) More than 10 times per month

If you stated more than 10 times per month, please specify.

23. It has happened that I get irritated during an audioconferencing session due to other participants lack of meeting skills.
   a) Never
   b) Sometimes
   c) Often
Comments:

24. I feel just as comfortable during an audioconference as I do during a physical meeting.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

About NetMeeting

In this section there a number of statements regarding ‘NetMeeting’. Please select the alternative that you
consider most correct.

25. I participate in Virtual Meetings in which we use Microsoft NetMeeting as a compliment.
   a) Yes
   b) No (proceed to the next section, question 33)

26. I participate in meetings in which NetMeeting is used on average:
   a) 1-6 times per year
   b) 7-12 times per year
   c) 2-5 times per month
   d) 6-10 times per month
   e) More than 10 times per month

If you stated more than 10 times per month, please specify.

27. I feel confident with using all the functions in NetMeeting.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

28. I can, without technical assistance lead a NetMeeting.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

29. My impression is that most of my colleagues know how to use NetMeeting
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

30. It has happened that I get irritated during a NetMeeting session due to connection problems or
other technically related problems.
   a) Fully agree
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

31. It has happened that I get irritated during a NetMeeting session because other participants are uncertain of how to use the software functions
   a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

32. I have used the video function of NetMeeting
   a) Never  
b) Yes, I have tried it out  
c) Yes, regularly

About Videoconferencing:

In this section there a number of statements regarding videoconferencing. Please select the alternative that you consider most correct.

33. I have access to videoconferencing equipment at my workplace
   a) Yes  
b) No (proceed to the next section, question 47)

Comments:

34. I participate in videoconferences in my job
   a) Yes  
b) No (proceed to the next section, question 47)

Comments:

35. I participate in videoconferences on average:
   a) 1-6 times per year  
b) 7-12 times per year  
c) 2-5 times per month  
d) 6-10 times per month  
e) More than 10 times per month

If you stated more than 10 times per month, please specify.

36. When you participate in videoconferences you utilise equipment from:
   a) Telia Näras own facilities  
b) In-Good-Company's facilities
c) Both of the above

d) Another alternative

Comments

37. I think the video equipment at my workplace is viable and works satisfactorily
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

38. I know how the videoconferencing equipment works and can manage to start a videoconference on my own
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

39. I know who to contact if I need assistance in handling the equipment or other technical problems during a videoconference.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

40. I know how the support technology (document camera, digital projector, etc.) in the videoconferencing facilities functions.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

41. I think that the booking system for the videoconferencing studio(s) I use works well.
   a) Fully agree
   b) Partly agree
   c) Don’t agree
   d) Don’t know/undecided

Comments:

42. It is much more complicated to arrange a videoconference with participants outside Telia Närna, as compared to if the meeting is held internally within Telia Närna.
43. It has happened that I am irritated during a videoconference due to other participants having bad videoconferencing skills.
   a) Fully agree
   b) Partly agree
   c) Don't agree
   d) Don't know/undecided

Comments:

44. I feel just as bothered during a videoconference as I do during a physical meeting.
   a) Fully agree
   b) Partly agree
   c) Don't agree
   d) Don't know/undecided

Comments:

45. If I could rely on that the videoconferencing facility I use worked without delays or technical problems, I would use it to replace more physical meetings than today.
   a) Fully agree
   b) Partly agree
   c) Don't agree
   d) Don't know/undecided

Comments:

46. If the currently available videoconferencing facilities were upgraded with better sound and picture quality and more support functions (e.g. electronic whiteboard), I would replace more physical meetings than today.
   a) Fully agree
   b) Partly agree
   c) Don't agree
   d) Don't know/undecided

Comments:

About your opinion

In the following section a number questions and statements concerning your own opinion and preferences are presented. Please select the alternative that you consider most correct.

47. Lack of time is a serious problem in my work
a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

48. If I had the option I’d rather increase my salary, than increase the days of paid vacation.  
a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

49. I consider global warming to be a serious problem for the environment and people  
a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

50. It is important for me to work in an organisation that takes actions to minimise its environmental impacts  
a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

About Telia Nära’s customers

In the following section a number questions and statements concerning Telia Nära’s customers are presented. Please select the alternative that you consider most correct. If you don’t have any customer contact in your work, you can go directly to question 53.

51. It is common that our customers use virtual media to make their meetings more effective.  
a) Fully agree  
b) Partly agree  
c) Don’t agree  
d) Don’t know/undecided

Comments:

52. Telia is good at communicating the usefulness of its Virtual Meeting services to customers  
a) Fully agree  
b) Partly agree
c) Don't agree

d) Don't know/undecided

Comments:

Last question!

Do you have any other questions regarding meetings, travel or virtual media?

Thank you for your participation. The results of the survey will be published soon.
Appendix IV a

Questionnaire: City of Lund Survey – originally in Swedish:

Telework in Lund

Today, there are currently only a few employees who regularly telework that are supported by an agreement with their employers. However, we don’t know how high the demand for telework is in the municipality. In addition, we don’t have an understanding of the attitude that managers have towards telework. What we do know is that telework is a growing mode of work that does not suit all types of employment and workplaces. Through this survey, we hope to get your help in answering a few questions regarding telework. Your answers will be kept anonymous. If you would like to enter in the bike lottery, please sign your name at the end of the survey. Your answers will remain anonymous, as your name is kept separate from your answers. You can also indicate your interest in participating in a telework project that the mobility centre at the Technical Administration will launch during the year (see at the end of the survey form) We define telework as work that you bring home from your workplace to complete at home, anywhere from a few hours, evenings, half or whole days.

Thank you in advance.

General questions about yourself

1. What work category description best suits your work? If nothing is appropriate please add another category.

   a) Foreman  
   b) Occupational therapist  
   c) Assistant  
   d) Librarian  
   e) Firefighter  
   f) District/Company nurse  
   g) Assistant Accountant  
   h) Accountant Secretary  
   i) Departmental Manager  
   j) Travel Agent  
   k) Travel Manager  
   l) Preschool Manager  
   m) Healthcare Manager  
   n) Preschool Teacher  
   o) Engineer  
   p) Senior Teacher  
   q) Teacher  
   r) Salary Clerk  
   s) Human Resources Assistant  
   t) Politician  
   u) Secretary  
   v) Physiotherapist
w) Nurse  
x) School Assistant  
y) Principal  
z) School Nurse  
 aa) Social secretary  
 bb) Career Counselor  
 cc) Technician  
 dd) Caretaker, driver  
 ee) Other, please specify  

2. Gender  
a) Male  
b) Female  

3. Age  
a) – 20  
b) 21-30  
c) 31-40  
d) 41-50  
e) 51-60  
f) 61-  

4. How long is the distance between your home and your workplace?  
a) 0-2 km  
b) 3-5 km  
c) 6-10 km  
d) 11-15 km  
e) 16-20 km  
f) 21-30 km  
g) 31-40 km  
h) Over 40 km  
   If over 40 km, specify how far  

5. How do you usually travel to work?  
a) On foot  
b) Bicycle  
c) Car  
d) Bus  
e) Train  
f) Ride sharing  
g) Other  
   Comments:  

6. Do you telework to any extent?  
a) Yes (proceed to question 7)  
b) No (proceed to question 16)  

For you that telework  

7. How often do you telework? (on average)  
a) Now and then  
b) 1 to 3 times per month
c) Once per week
d) 2 to 3 times per week
e) Full-time
Comments:

8. In what ways do you telework? Please note that you may check more than one alternative.
a) Bring work home evenings and weekends
b) Work part of the day at home
c) Work all day home
d) Work from the car
e) Other
Comments:

9. Why do you telework?
a) I have a long commuting distance
b) To catch up with my workload, e.g. evenings and weekends
c) I can concentrate and get more work done at home
d) Other
Comments:

10. What technical equipment do you use when teleworking? Please note that you may check more than one alternative.
a) Telephone
b) Fax
c) Computer
d) Printer
e) Scanner
f) Copying machine
Comments:

11. Do you have access to the Internet from home?
a) No
b) Yes, through modem
c) Yes, through broadband
Comments:

12. Do you need Internet access for your telework?
a) Yes
b) No
Comments:

13. How well does telework function for you?
a) Very well
b) Well
c) Not very well
d) Poor

14. In what way do you think that your telework could be improved? Please note that you may check more than one alternative.
   a) Better technical equipment
   b) Better support
   c) Improved acceptance among colleagues
   d) Improved acceptance from Management
   e) Improved working environment in the home
   f) Direct connection to the server
   g) Agreement with the employer regulating telework
   h) Other
      If you chose other, please specify

15. What do your colleagues think of you teleworking?
   a) They say it works, ok
   b) Don’t say anything
   c) Some make ironic comments now and then
   d) They are very suspicious
   e) Don’t know
   f) Other
      Comments:

For those that don’t telework

16. Would you like to telework?
   a) No (proceed to question 20)
   b) Yes
   c) Yes, but it isn’t possible with the type of job I have
   d) Yes, but I don’t have room in my home
   e) Yes, but Management won’t approve it
   f) Yes, but I am missing the technical equipment necessary
      Comments:

17. What would you need to start teleworking regularly?
   a) Technical equipment
   b) Other work tasks
   c) Acceptance from Management
   d) More space at home
   e) Other
      Comments:

18. How often would you prefer to telework?
   a) Evenings and weekends
   b) Part-time
   c) Fulltime
      Comments:
19. To what extent would you like to telework?
   a) A few hours a week
   b) A few days per month
   c) A day per week
   d) Two days per week
   e) Several days per week
   Comments:

Management Issues

20. Are you in a Management position?
   a) No (proceed to question 26)
   b) Yes
   Comments:

21. Do you supervise employees that work?
   a) Yes
   b) No (proceed to question 25)
   c) Don’t know (proceed to question 25)
   If yes, how many

22. How often do your employees telework? Please select the most commonly occurring alternative.
   a) Now and then
   b) 1 to 3 times per month
   c) Once per week
   d) 2 to 3 times per week
   e) Full-time
   f) Don’t know
   g) Other
   Comments:

23. How well do you think it works?
   a) Very well
   b) Well
   c) Not very well
   d) Poor
   Comments:

24. Have you made an agreement with any of your employees concerning their telework?
   a) Yes (Verbal)
   b) Yes (Written)
   c) No
   d) Don’t know
   Comments:
25. What do you think is a suitable level of telework at your workplace?
   a) More than today
   b) The current level is fine
   c) Less than today
   d) Not at all
   e) Don’t know
   Comments:

And Finally

26. Would you like to participate in the mobility center’s telework project? This would require that you would regularly telework for 1-2 days per week for four months.
   a) Yes, I’m interested
   b) No, I’m not interested
   c) Perhaps, I would like to get more information
   d) Don’t know

27. Please write your name and tell us how we can reach you if you would like a chance to win a bicycle

Thank you for participating!
Summary of results of the survey at the City of Lund.

In cooperation with the Mobility Centre[^122] in the City of Lund, the author initiated and developed a telework project in the City of Lund (CoL) during the year 2001. The aim of the project is to develop a framework for telework that could help reducing the environmental impact from commuting in the municipality. The underlying reason for the CoL to engage in this project was that they had identified that approximately 60% of the CO\textsubscript{2} emissions from all of municipality’s transport activities originated from commuting. The CoL is consequently one of the few organisations that have taken responsibility for the environmental impact from their employees’ commuting activities. However, no written policy or strategy for telework exists within the organisation.

A web-based telework survey was conducted among 2500 of LM’s employees. The survey revealed that 32% of the respondents did telework, and approximately \( \frac{3}{4} \) of the persons who did not, would like to. Most of the respondents (86%) worked during evenings and weekends, and only 13% teleworked whole days. Out of the survey’s approximately 700 respondents:

- 48% claimed that they teleworked to ‘concentrate better and get things done’ and;
- 38% teleworked because they wanted to ‘catch up with the work load’;
- 93% thought that the telework functioned well or very well, but in order to telework more regularly:
  - 60% needed a network connection to the municipality’s server;
  - 35% would need more or better technical equipment;
  - 30% wanted an official agreement with the employer, and;
  - 13% needed acceptance from the superior management.

Moreover, among the non-teleworkers:

- 51% would like to telework whole days, and;
- 43% parts of days;
- 31% would like to work one day per week;

[^122]: The Mobility Centre is a unit belonging to the Technical Services Department of the City of Lund (or Lund Municipality), promoting and implementing mobility management issues and projects.
- 22% would like to work two days per week or more;
- 41% would need technical equipment, and;
- 31% acceptance from the management.

Based on the survey, meetings with participant representing the e.g. the human resource department, ICT-department, several trade unions, technical services department, and a seminar involving most departments in the municipality, the human resource department has agreed to create a telework policy for the municipality, and a framework for setting up individual telework agreements. Moreover, the ICT-department has agreed to take necessary measures to make it technically possible for remote network connection.
<table>
<thead>
<tr>
<th>Name of organisation</th>
<th>Type of org</th>
<th>Main activity</th>
<th>Size</th>
<th>Outreach (local, national, multinational)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telia AB</td>
<td>Company group</td>
<td>Telecommunications operator</td>
<td>25 000 employees</td>
<td>Mainly national, but has activities in more than 40 countries.</td>
<td>One of the largest users of telework, audio- and videoconferencing in Sweden</td>
</tr>
<tr>
<td>Telia Nära</td>
<td>Subsidiary company to the Telia AB group</td>
<td>Sells ICT solutions and services to private consumers and small companies</td>
<td>3600 employees</td>
<td>National, 90 offices in 35 cities</td>
<td>Extensive use of audioconferencing. Formalised virtual meeting procedures</td>
</tr>
<tr>
<td>City of Lund (Lund Municipality)</td>
<td>Municipality</td>
<td>Administrates all municipal activities</td>
<td>11 000 employees</td>
<td>Local</td>
<td>Strongly promotes and implements mobility management issues and projects</td>
</tr>
<tr>
<td>Vellinge Municipality</td>
<td>Municipality</td>
<td>Administrates all municipal activities</td>
<td>30 000 inhabitants</td>
<td>Local</td>
<td>A large percentage of the inhabitants commute to other municipalities daily.</td>
</tr>
<tr>
<td>The Swedish Network for Teleworkers (SNTW) (Nätverket för distansarbete)</td>
<td>NGO for telework</td>
<td>Information, newsletter, conferences etc.</td>
<td>450 registered members when surveyed.</td>
<td>National</td>
<td>One of the largest non-profit telework associations in Sweden</td>
</tr>
<tr>
<td>Scandinavian Videoconferencing User Group (SVUG) (Telebild-användarna)</td>
<td>NGO for video-conferencing</td>
<td>Information, newsletter, conferences etc.</td>
<td>170 members when surveyed.</td>
<td>Mostly national, some Nordic members</td>
<td>Members include commercial users, suppliers, companies, schools, universities, and other public service providers</td>
</tr>
<tr>
<td>Tetra Pak</td>
<td>Company group</td>
<td>Packaging company</td>
<td>19 000 employees</td>
<td>Multinational company, activities in more than 100 countries</td>
<td>Extensive international use of video-conferencing</td>
</tr>
<tr>
<td>The Scanian Farmers Association (Skånska Lantmännerna)</td>
<td>Farmers cooperative</td>
<td>Intermediary of agro business services and products</td>
<td>11 000 members, 500 employees</td>
<td>Mainly local</td>
<td>Has VC studios located at regional offices around the province Scania in Southern Sweden</td>
</tr>
</tbody>
</table>
Estimation of the application’s environmental impact

The total environmental impact of telework and teleconferencing can be estimated by a multiplicative model. The equation is originally designed for calculating the number of teleworkers in a community but, slightly modified, it can be used for teleconferencing as well, and can be applied at an organisational level. The model, developed from Mokhtarian, is expressed as Equation 1 and Equation 2, when applied to an organisation’s telework and teleconferencing:

**Equation 1. Estimation of the number of teleworkers $T_{TW}$ and the number of teleworking occasions $O_{TW}$ in an organisation.**

$$T_{TW} = E_{TW} \times A_{TW} \times W_{TW} \times C_{TW}, \text{ and}$$

$$O_{TW} = E_{TW} \times A_{TW} \times W_{TW} \times C_{TW} \times F_{TW} = T_{TW} \times F_{TW}.$$  

$E_{TW}$ = the number of people employed at the organisation;

$A_{TW}$ = the proportion of employees who are able to telework;

$W_{TW}$ = the proportion of those able to telework who want to;

$C_{TW}$ = the proportion of those able and wanting to telework who choose to, and;

$F_{TW}$ = the average frequency of teleworking, expressed as a fraction of a five-day workweek;

$T_{TW}$ = the expected number of people who are in a period of active teleworking at any given time;

$O_{TW}$ = The number of people teleworking at any given day, i.e. the expected number of teleworking occasions.

**Equation 2. Estimation of the number of employees using teleconferencing $T_{TC}$ and teleconferencing occasions $O_{TC}$ in an organisation.**

$$T_{TC} = E_{TC} \times A_{TC} \times W_{TC} \times C_{TC}, \text{ and}$$

$$O_{TC} = E_{TC} \times A_{TC} \times W_{TC} \times C_{TC} \times M_{TC} \times F_{TC} = T_{TC} \times M_{TC} \times F_{TC}.$$  

**Teleconferencing**

$E_{TC}$ = the number of people employed at the organisation;
ATC = the proportion of employees who travel in business;
WTC = the proportion of those who travel who would like to communicate via TC instead;
CTC = the proportion of those who travel and would like to communicate via TC, who choose to;
TTC = the expected number of employees who are using teleconferencing to replace business travels;
MTC = the average number of business meetings per person (per time unit);
FTC = the average frequency of teleconferencing, expressed as a fraction of the number of business meetings held via TC by these persons, out of all business meetings they attend;
OTC = The expected number of business meetings held via teleconferencing (per time unit).

By adding the environmental dimension, the resulting environmental impact (EI) from the applications can be expressed as follows:

Equation 3. Total Environmental Impact (TEI) for telework and teleconferencing as a function of the number of occasions (O), and Environmental Impact (EI).

\[
TEI = O \cdot EI
\]

O = The expected number of occasions the application is used at any day (TW) or at any business meeting (TC);
TEI = Total environmental impact of the application;
EI = Environmental impact from one TW or TC occasion.

The TEI has no specific unit and can only provide us with a very rough estimate. However, the TEI can be represented by one, or a set of relevant indicator(s), such as the use of energy, emission of e.g. CO₂ and NOₓ, or the use of non-renewable resources. The maximum or minimum environmental impact \(TEIMₘ\) can be estimated by assuming extreme conditions from an environmental perspective (e.g. full substitution of business trips, or no complementing or generating effects of transportation). A more realistic result, taking various rebound-effects into account, can be estimated by \(TEIR\), which, given the present conditions, would be an estimation of the application’s actual environmental implication.

The choice of indicator(s) for the TEI (e.g. use of energy or water, generation of CO₂), also determines the focus of interest when estimating the environmental impact (EI). The EI is, in turn, the sum of the impacts from a number of implications that the applications bring about. The main implications discussed in this dissertation can be categorised as the ones affecting travelation (EIₜ), equipment and communication (EIₑᶜ), or office space (EIₒₛ). In the case of telework, additional impact categories,
such as space at home (EI\textsubscript{HS}) or at a local centre (EI\textsubscript{LS}), are relevant. For teleconferencing, the equivalent is true for the use of hotels (EI\textsubscript{H}). The environmental impact for telework on one telework occasion EI\textsubscript{TW}, or one teleconferencing occasion EI\textsubscript{TC} can consequently be expressed as:

\begin{align*}
\text{Equations 4 & 5. The environmental impact: } EI \text{ of telework or teleconferencing can be expressed as:} \\
EI_{TC} &= \sum (EI_x)_{TC} = (EI_I) + (EI_{EC}) + (EI_{OS}) + (EI_H), \text{ and} \\
EI_{TW} &= \sum (EI_x)_{TW} = (EI_I) + (EI_{EC}) + (EI_{OS}) + (EI_{HS}) + (EI_{LS})
\end{align*}

Thus, the environmental impact for each of these categories has to be estimated. By using LCA or equivalent environmental assessment tools, the environmental impact of e.g. a piece of equipment, a trip from point A to B with a certain means of transportation, or one square meter of office space, can be estimated.

The results from this assessment can be used directly to estimate any given category (EI\textsubscript{x}), but this implies that there is a perfect connection between the use of the application and the total environmental impact. (e.g. all teleconferences replace business trips, all teleworking days lead to reduced commute trips). Because this is seldom the case, we need to analyse if, and, to what extent, the application has actually led to any positive or negative environmental impact, in terms of e.g. the need for an extra computer, substitution of commuter trips, or reduced need for office space. By introducing a Reality factor R, that adjusts the EI\textsubscript{M} to the actual outcome EI\textsubscript{R}, the TEI can be expressed as Equation 6.

\begin{align*}
\text{Equation 6. Total environmental impact as a function of Occasions (O), Maximum Environmental Impact (EM), and Reality factor R.} \\
TEI &= O \times ((EI_{x1})_M \times R_{n1} + (EI_{x2})_M \times R_{n2} + ... ) = \\
&= O \times ((EI_{x1})_R + (EI_{x2})_R + ...) 
\end{align*}

In addition, the EI consists both of a variable part EI\textsuperscript{V}, which is dependant on the number of Occasions O, and a fixed part EI\textsuperscript{F}, independent of O. For example, the environmental impact from buying extra equipment to the home will be a fixed EI, while the impact from running the equipment is a flexible part.
Equation 7. Total environmental impact as a function of both fixed and variable environmental impacts.

\[ \text{TEI} = O \times \left( (EIV_{X,n1})_R + (EIV_{X,n2})_R + \ldots \right) + (EIF_{X,n1})_R + (EIF_{X,n2})_R + \ldots \]

**Relationship Between Environmental and Economic Implications**

Using the same approach and categories as when calculating the environmental impact, the economic implications can be estimated, parallel to the environmental impact. In addition to the categories covered for environmental implications, a factor estimating the effect of change in efficiency, is added to the equation, as shown in Equations 8. Furthermore, the economic implications are in some categories divided into effects for the individual and for the organisation.

Equations 8. Total economic impact as a sum of different categories of economic impact, estimated for both telework and teleconferencing

\[ \text{TEcITW} = \sum (EcIX) = (EcIT) + (EcIEC) + (EcIOS) + (EcIH) + (EcIE) \]

\[ \text{TEcITC} = \sum (EcIX) = (EcIT) + (EcIEC) + (EcIOS) + (EcIH) + (EcIE) \]

T: travel, EC: equipment and communication, OS: office space, HS: home space, H: hotel, E: efficiency.
Appendix VII

Examples of studies approaching the interconnection between the use of ICT and environmental impact.

Study I. One approach is suggested by Arnfalk (1999) in which the theoretical, positive environmental potential of a limited number of ICT applications’ are evaluated, based on a set of criteria:

- **De-materialisation**: the possibility to reduce material for the function sought for (compare with MIPS);\(^{123}\)
- **Reduced energy use**: possibly reduced energy consumption for the function sought for.
- A specific focus area was also **Transport substitution** for which the possibility to replace personal or freight transport with electronic communication was estimated.

In addition to estimating the positive environmental potential, a ‘reality’ factor is introduced as a measure of how realistic these potential effects are.

Moreover, a measure of causality and measurability of environmental impact is used. Within this framework, three indirect effects are considered: **growth effect** (rebound effect), **degree of substitution** (how well is the ICT application able to replace the physical alternative), and **mayfly effect** (dagsländeeffekten – the accelerating speed at which ICT equipment is becoming out-dated). The evaluation scheme, presented in Figure A, is more an approach to assess how interesting these applications are from a pollution prevention point of view, rather than being an evaluation of the actual environmental implications.

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\(^{123}\) MIPS; Material Input Per Service, an evaluation tool developed at the Wuppertal Institute in Germany.
Studies II and III: Scenarios can be used as a planning and communication tool to explore complex, uncertain and sometimes disputed futures. The scenario technique has repeatedly been used to predict ICT’s potential impact. The European telecom research institute EURESCOM, presented in 1996 a scenario study on telecommunications and the environment, creating four scenarios based on the telecom operators and society’s future progressive or conservative development (Tuppen 1996). Modelling the scenarios, the areas of potential societal benefits taken into account were energy, materials, communication and knowledge transfer, travel and transport, culture and leisure, and ‘other’. Five years later, scenarios have been used to explore how e-Commerce and Internet may influence our way to sustainability (Eames, Berkhout et al. 2001). In this analysis, four scenarios are created by the two dimensions globalisation/localisation, and individualism/community, see Figure B. For each of these four scenarios, the potential social and environmental impacts are estimated, illustrated in Table A.

Study IV. Another approach, used by Romm, Rosenfeld et al (1999), explores current and future impact of the Internet economy on energy consumption and the environment. The study is divided into effects on the overall energy intensity, as well as the buildings, manufacturing and transportation sectors. This wide-ranging study includes both qualitative and quantitative analyses, estimating direct and indirect
effects, the applications telework, B2B and B2C e-commerce,\textsuperscript{124} and effects like travel substitution, (d)e-materialisation, energy efficiency, etc.

\textbf{Figure B.} Scenarios used in the analysis of impacts from the ‘new economy’ (Eames, Berkhout et al. 2001).

\textbf{Table A.} Summary table of impacts from the ‘new economy’ estimated for four different scenarios (Eames, Berkhout et al. 2001).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Cyber-Space</th>
<th>Digital-Islands</th>
<th>Cyber-Society</th>
<th>Networked Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP Growth per year</td>
<td>3.5%</td>
<td>2%</td>
<td>2.75%</td>
<td>1.25%</td>
</tr>
<tr>
<td>Unemployment</td>
<td>6%</td>
<td>9%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Private car use</td>
<td>85%</td>
<td>90%</td>
<td>78%</td>
<td>75%</td>
</tr>
<tr>
<td>GHG emissions (million tonnes)</td>
<td>780</td>
<td>845</td>
<td>625</td>
<td>600</td>
</tr>
<tr>
<td>Waste (million tonnes)</td>
<td>250</td>
<td>200</td>
<td>175</td>
<td>125</td>
</tr>
<tr>
<td>Dominant device for online access</td>
<td>mixed</td>
<td>digital TV</td>
<td>PC/PC</td>
<td>PC</td>
</tr>
<tr>
<td>Dominant use of networks</td>
<td>commercial</td>
<td>commercial</td>
<td>mixed</td>
<td>private</td>
</tr>
</tbody>
</table>

\textsuperscript{124} B2B: Business-to-business, B2C: Business-to-customer
<table>
<thead>
<tr>
<th>Potential Social Impacts of the New Economy</th>
<th>(\checkmark\checkmark)</th>
<th>(\checkmark)</th>
<th>(\checkmark)</th>
<th>(\times)</th>
<th>(\times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low cost access to online services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access without IT skills</td>
<td>(\checkmark\checkmark)</td>
<td>(\checkmark)</td>
<td>(\times\times)</td>
<td>(\times)</td>
<td></td>
</tr>
<tr>
<td>Equal access to all online services</td>
<td>(\times)</td>
<td>(\times\times)</td>
<td>(\checkmark)</td>
<td>(\checkmark)</td>
<td></td>
</tr>
<tr>
<td>Equal opportunities for off-line population</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times)</td>
<td>(\checkmark)</td>
<td></td>
</tr>
<tr>
<td>Strong consumer protection</td>
<td>(\checkmark)</td>
<td>(\times\times)</td>
<td>(\checkmark)</td>
<td>(\checkmark\checkmark)</td>
<td></td>
</tr>
<tr>
<td>High efficiency of public services</td>
<td>(\checkmark\checkmark)</td>
<td>(\checkmark)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td></td>
</tr>
<tr>
<td>Improved political participation</td>
<td>(\checkmark)</td>
<td>(\times)</td>
<td>(\checkmark)</td>
<td>(\checkmark\checkmark)</td>
<td></td>
</tr>
<tr>
<td>Balanced regional development</td>
<td>(\times\times)</td>
<td>(\times)</td>
<td>(\checkmark)</td>
<td>(\checkmark)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential Environmental Impacts of the New Economy</th>
<th>(\checkmark\checkmark)</th>
<th>(\checkmark)</th>
<th>(\checkmark)</th>
<th>(\times\times)</th>
<th>(\times\times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource-efficient production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource-efficient supply chains</td>
<td>(\checkmark\checkmark)</td>
<td>(\checkmark)</td>
<td>(\checkmark\checkmark)</td>
<td>(\times)</td>
<td></td>
</tr>
<tr>
<td>Dematerialisation of products</td>
<td>(\checkmark\checkmark)</td>
<td>(\checkmark)</td>
<td>(\checkmark)</td>
<td>(\times)</td>
<td></td>
</tr>
<tr>
<td>Sustainable consumption patterns</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\checkmark)</td>
</tr>
<tr>
<td>Green consumerism</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times)</td>
<td>(\checkmark\checkmark)</td>
<td></td>
</tr>
<tr>
<td>Less heavy goods transportation</td>
<td>(\checkmark)</td>
<td>(\checkmark)</td>
<td>(\checkmark\checkmark)</td>
<td>(\checkmark\checkmark)</td>
<td></td>
</tr>
<tr>
<td>Less light goods transportation</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\checkmark)</td>
</tr>
<tr>
<td>Fewer individual shopping trips</td>
<td>(\checkmark)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td>(\times\times)</td>
<td></td>
</tr>
</tbody>
</table>

Key:
\(\checkmark\checkmark\) progress towards objective  \(\times\times\) movement away from objective
\(\checkmark\) some progress towards objective  \(\times\) no progress towards objective

Narrowing the scope to a) individual applications such as telework or e-commerce, b) facilitators like Internet, c) implication areas like dematerialisation or effect on transport, or combinations of those categories, we find more in-depth analysis of several other attempts to model the indirect effects.

Study V. An early actor in this area was British Telecom (BT) that made a relatively simple and straightforward comparison of teleconferencing and travelling in 1991. In this comparison, the energy used to make a telephone call was compared to that of a
journey, either by car, rail or air (BT 1991). The results, listed in Table B shows the equivalent time a telephone call could be made for the energy used when travelling.

Table B. Comparison of the energy used for transportation and a telephone call (BT 1991).

<table>
<thead>
<tr>
<th>Type of call</th>
<th>Mode of Transport</th>
<th>Distance, in km</th>
<th>Length of time on phone to use equivalent amount of energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Car</td>
<td>10</td>
<td>21 hours</td>
</tr>
<tr>
<td>Trunk</td>
<td>Rail</td>
<td>320</td>
<td>33 hours</td>
</tr>
<tr>
<td>Trunk</td>
<td>Car</td>
<td>320</td>
<td>7 days</td>
</tr>
<tr>
<td>International</td>
<td>Air</td>
<td>5000</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>

It should be noted that present conditions differ strongly from the decade-old data, as e.g. optic fibres have lowered energy consumption for telecom transmission dramatically.

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125 It should be noted that present conditions differ strongly from the decade-old data, as e.g. optic fibres have lowered energy consumption for telecom transmission dramatically.
Reprints of Papers I - III


Introduction

Whether we call it a shift in paradigm, an information or knowledge society, or the new or Internet economy, we cannot help but notice the drastic changes the world is currently undergoing. The ‘digitalisation’ of our lives is becoming increasingly apparent as the use of information and communication technology (ICT) products and services changes the way we work, live, communicate, socialise, travel and so on. Amid such drastic societal changes, it may be a smart move to take the opportunity to alleviate some of the drawbacks of our industrialised society.

One of the more devastating drawbacks is the environmental deterioration we have generated through extensive resource depletion. Great expectations have been expressed in that moving from atoms to bits (Negroponte 1995) could lead to dematerialisation, a reduction in material and energy consumption, and substitute travel. In this chapter I will discuss the potential and limitations of substituting travel with various means of ICT-based communication, and the implications for the global environment. I will then discuss the future outlook of, and some of the barriers to, holding virtual meetings using ICT-based communication tools in business enterprises. However, some background information on travel and its environmental impact needs to be highlighted.

Travel: an overview

According to the World Tourism Organisation (WTO), the total number of international arrivals\(^1\) has grown in the last 50 years from 25 to nearly 700 million, corresponding to

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\(^1\) International arrivals refer to international travel by all commercial transportation modes: air, train, road transport and boat.
an average growth rate of 7% per annum. Business travel accounted for 18% of total arrivals. Not only has it grown in terms of numbers, it has also expanded geographically. Air transport remains the dominant means of international travel (43%), followed by road transport (42%), rail transport (7%) and sea transport (8%) (WTO 2000).

One explanation for this trend is that travelling is becoming more accessible and affordable to an increasing number of people. Another key factor, particularly for business travel, is the general trend towards globalization. The marketplace is expanding to an international level, with customers often located in distant corners of the world. Companies are merging into multinational conglomerates with factories and offices distributed worldwide. Consequently, this development generates an increased need for business communication between remote units in a company: for example, between a design department in the US and a production facility in Manila.

A globalised market also creates a need for international salesperson–customer interaction, contact between wholesalers and retailers, and so on. These communication needs generate a lot of meetings, of which many, in turn, require people to travel long distances to attend. A similar increasing trend is found in domestic business travel. This is a rational and straightforward explanation of what generates business travel, but it is probably only part of the story behind business travel’s massive growth. Other less tangible drivers may also be contributing factors.2

The classic German expression ‘Wenn jemand eine Reise tut, so kann er was verzählen’3 (‘the one who travels has got something to tell’) indicates the kind of respect and interest that a traveller experiences. Being a cosmopolitan globetrotter is often considered to be positive and thrilling, and legendary travellers such as Marco Polo, Christopher Columbus, Dr Livingstone, Scott and Amundsen, and even Phileas Fogg, enjoy a place in history for their travelling escapades.

Because of the prestige of global travel, a number of companies use business travel as a selling point in recruitment. Business travel is still surrounded by an aura of status and glamour even though travelling in business class has become increasingly commonplace and is no longer the privilege of top management alone. That a company considers you and your work to be important enough to spend thousands of dollars to send you to some remote part of the world is enough to boost most people’s egos, and signals professional success. However, in companies where most of the staff travels, the motivation is less, and travelling is considered hard work that you would happily reduce.

Travel: environmental, social and business implications

Transportation has become one of the major contributors to a number of global environmental problems: climate change, acidification, eutrophication, local air pollution, loss of biodiversity and noise. Greenhouse gas emissions from the transport sector in the

2 After the terrorist attacks on 11 September 2001, travelling has decreased, including business travel. Many companies restrict their employees’ travel; and the security risk, as well as fear (and sometimes the argument ‘my family won’t allow me’), has become an acceptable excuse for many not to travel for business purposes. At the same time, the audio- and videoconferencing market has experienced a dramatic increase.

3 From the poem ‘Urians Reise um die Welt’ written in 1786 by Mattias Claudius (set to music by Ludwig van Beethoven).
European Union (EU) are expected to increase by 39% by 2010, compared to 1990 levels, making transportation the single largest contributor to the EU’s greenhouse gas emissions. This would seriously jeopardise the possibilities of achieving the reduction target in greenhouse gas emissions agreed under the Kyoto Protocol (a total decrease in CO₂ emissions of 8% during the same period) (EEA 2000). Moreover, stabilising atmospheric CO₂ concentrations at safe levels will require a 60%–80% cut in carbon emissions from current levels (Brown et al. 1999).

Despite its obvious environmental threat, mobility has long been considered a necessity for society’s growth and welfare, for company sales and competitiveness, and for personal development and success. The OECD (Organisation for Economic Co-operation and Development) policy meeting on ‘Sustainable Consumption and Individual Travel Behaviour’ concluded that:

The individual’s right to unlimited, motorised personal mobility has emerged as an important measure of progress in modern, democratic societies. As a result, many governments have been hesitant to expressly seek to change people’s behaviour to achieve less environmentally harmful travel patterns. It has become clear that technical solutions alone will not be sufficient to mitigate transport’s negative impacts (OECD 1997).

Interestingly enough, aviation has long enjoyed an exemption from tax on all jet fuels used on international flights since 1944 and ‘slipped through the net’ again when the CO₂ emissions reductions were adopted as part of the Kyoto Protocol in 1997 (IPPR 2000). However, it is becoming clear that the transport sector will have to internalise a larger share of its environmental and social costs in the future, resulting in higher prices for freight transport and travelling.

In the business sector, there is also a growing awareness of the environmental and financial impact of travel. One illustrative example of this is the telecom company Ericsson, which estimates that 73% of the CO₂ per capita emissions of its Swedish employees originated from their business travel (Ericsson 1998). The cost of travel is another emerging business concern. The average annual travel cost per US business traveller is about US$9,000. Business travel-related activities (including entertainment) in 1999 amounted to US$39.6 billion and accounts for the third largest controllable expense in US corporations after payroll and information services. In many non-manufacturing firms, the total expenditure of corporate travel has become the second largest item in the expense budget (Gibbs 2000).

Yet another strong incentive to reduce the volume of business travel is the time it requires and therefore displaces from both professional and personal activities. This may lead to travel-related stress, something that one in every four business travellers in the US experiences. The predominant causes of such stress include spending time away from their family and worrying about work piling up at the office (Infocom 1999).

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4 Society’s expenses for transport infrastructure and usage amounts to 1%–2% of GDP in OECD countries, while the total social cost, which traffic would have to pay for in order to internalise all external costs, amounts to 4%–8% of GDP.
Virtual meetings and the ICT-based communication medium

One way to tackle this growing problem is to replace travel with virtual meetings. I will briefly describe the concept of a virtual meeting and elaborate on the possibilities and consequences of shifting some of the business communication to the ICT-based medium.

Virtual meetings: what are they?

Virtual meetings have been around ever since Alexander Graham Bell invented the telephone in 1876. Since then, we have been able to communicate with each other at two or more locations in real time. The virtual communication toolbox has expanded rapidly over the years, with a number of new communication tools and users. The telephone system has been described as the ‘world’s largest machine’ with more than one billion stationary telephones (POTS—plain old telephone system), mobile phones, faxes, modems and other communication tools connected in a literal World Wide Web. The cost of telecommunications is constantly declining, while availability and reliability is increasing.

Most telephone conversations take place between two people. If a meeting with more than two people is scheduled to take place, a multi-user audioconference call can be used to connect three or more telephones at the same time. Another option is to connect via a conference telephone, a type of telephone with a speaker function that allows a group of people to communicate via the phone with one or several people at the other end. These two options are called audioconferencing. The big drawback of audioconferencing is that you cannot see the person or people with whom you are talking. This problem is overcome by videoconferencing, in which two or more places are connected via special equipment that allows the participants to both listen and to see each other.

There are two main types of videoconferencing system: desktop systems and group systems. A group system typically consists of a big television and a camera along with such accessories as electronic whiteboards, document cameras and computers. Using this system, several people can participate at each end. Desktop or personal videoconferencing usually consists of a computer equipped with a small camera, a microphone, a video and audio circuit board, and special software. With this equipment one to two persons can communicate from each computer. Multi-user conferences are possible as several computers can be connected simultaneously.

Computer links also offers the possibility of online collaboration, making it possible for a group of people to simultaneously and remotely edit the same document, draw pictures, give oral and visual presentations and so on. Communication via the Internet offers a nearly unlimited range of options, and this technology is developing very quickly (Halme et al. 2001).

Virtual meetings and their environmental implications

The electronics industry is generally considered to be a ‘clean’ industry with a limited environmental impact. This may be true compared to many other industries. However,
the size and growth of the electronics industry makes its environmental impact potentially very significant. Materials production and manufacturing require large amounts of resources, including a number of heavy metals. End-of-life systems for electronic goods currently exist in only six countries, leaving the vast majority of countries in the world with a minimal or non-existent system in place for take-back and recycling of electronics.

Consequently, an important question needs to be asked: do virtual meetings have an eco-advantage over business travel once the environmental impacts of the necessary communication technologies have been factored in? British Telecom (see Table 14.1) tackled this issue in 1991 when the company compared the energy used to make a telephone call with that of a journey, either by car, rail or air (BT 1991).

A more comprehensive approach is to examine this question from a life-cycle analysis (LCA) perspective. In one Swedish LCA study, the environmental impact from a videoconference between two offices in Stockholm and Gothenburg was compared with the impact of one person travelling by high-speed train and by air (Östermark et al. 1999). The study took into account seven different ecological impact categories (resource depletion, global warming, acidification, eutrophication, photo-oxidant formation, toxicity and eco-toxicity) using two different possible scenarios. In scenario 1, the equipment was used 5 hours per week and left in standby mode for the rest of the week, while in scenario 2 the videoconference was used 30 hours per week and left in standby mode only during office hours.

The LCA study found an environmental advantage for the videoconference, though not in all circumstances. The environmental impact of the virtual meeting was at least five times less than flying. In scenario 2, when the equipment was used 30 hours per week, the environmental impact was comparable to that of a train trip. However, when the equipment was used as little as in scenario 1 and left on all the time, the train trip had less environmental impact in several impact categories. The frequency and type of use is

<table>
<thead>
<tr>
<th>Type of call</th>
<th>Mode of transport</th>
<th>Distance (km)</th>
<th>Length of time on phone to use equivalent amount of energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Car</td>
<td>10</td>
<td>21 hours</td>
</tr>
<tr>
<td>Trunk</td>
<td>Rail</td>
<td>320</td>
<td>33 days</td>
</tr>
<tr>
<td>Trunk</td>
<td>Car</td>
<td>320</td>
<td>7 days</td>
</tr>
<tr>
<td>International</td>
<td>Air</td>
<td>5,000</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>

Table 14.1 Comparison of the energy used for transportation and a telephone call
Source: BT 1991

5 Norway, Switzerland, the Netherlands, Taiwan, Japan (March 2001) and Sweden (July 2001).
6 The system boundaries set up for the LCA were intentionally chosen to be unfavourable for the videoconference as compared to the two means of transport. The construction, use and scrapping of the telecom equipment and networks were included in the comparison, but this was not the case for the two transportation modes. For the train and aeroplane, only the use of electricity/fuel was included. When only the use of the electronic equipment was included, the impact from videoconferencing was a hundredfold less.
obviously a very important factor in garnering an environmental benefit (as well as economic benefits) from the use of ICTs.

**Virtual meetings as a replacement for travel**

Does the use of virtual communication technology reduce travelling? This question has been the subject of numerous research studies, focusing mainly on the use of teleconferencing. In one of the first studies of its kind (1983–86), David Bennison found that 87% of the respondents in the UK were convinced that the use of the videoconference had led to a reduction in travelling, while no one claimed that it had caused an increase in travel (Bennison 1988). According to a 1993 Yankee Group study, Fortune 1,000 companies were asked about their use of videoconferencing and how much travel it had replaced. One third of the respondents said that it had had little impact on their companies’ travel; 16% said that video meetings had replaced travel a lot; and 51% said it had replaced travel ‘somewhat’ (Feldman 1993). A comprehensive review article in the *Transportation Journal* concerning the effect of videoconferencing on business air travel concluded that 79% of corporate travel managers think that videoconferencing reduces travel costs, audioconferencing more commonly replaces travel than videoconferencing, and that the meetings that most often are replaced by virtual meetings are internal business meetings (Bender and Stephenson 1996).

In 1999, I conducted a number of studies on the use of videoconferencing and its impact on business travel in Swedish companies and organisations (Arnfalk 1999). Figure 14.1 show the conclusion of the surveys that ask respondents to state how the use of video-

![Figure 14.1](image-url)

**Figure 14.1**  Respondents’ impression of the effect that their use of videoconferencing has had on their own business travel. Personnel in four Swedish organisations were surveyed: the Scandinavian Videoconferencing User Group, the companies Tetra Pak and Telia, and the farmers’ association Skånska Lantmännen.

*Source: Arnfalk 1999*
conferencing had impacted their travelling. The results from these studies support the findings from the previous research that substitution (i.e. the technology is used to replace an in-person meeting that would have required travelling) of trips is the dominant effect. To a lesser extent, videoconferencing was also found to be used as a complement (i.e. virtual communication used as a complement to ordinary in-person meetings—the applications do not affect travelling) to an unchanged number of business trips.

But in very few cases, the survey showed generation (i.e. the use of virtual communication makes it possible to initiate and maintain more geographically distant contacts, leading to a net increase in travelling) of additional travel. The savings in travelling differed between the surveyed organisations, and depended on such factors as frequency of equipment usage, the number of participants in a meeting that would have had to travel, the geographical distribution of the organisations studied, and the type of meetings substituted.

**The limited use of virtual meetings**

As the virtual meeting format is a relatively new phenomenon and relies on technology that has been developed over the last few decades, it may take some time before conference telephones and videoconference equipment become standard office technologies. However, the promise of improved efficiency, increasing demand for ‘quality’ time, cost–benefit savings and so on associated with virtual meeting technologies may never be realised unless there is an increase in the number of users in companies and organisations. To find out why people were so reluctant to switch to virtual meetings, I conducted a comparative study of users and non-users in 1999 using a group of employees from two Swedish organisations: the Scanian Farmers Association and the telecom company Telia (Arnfalk 1999).

**Non-users**

Employees from these two organisations were asked why they had never used the videoconferencing equipment and their responses are shown in Table 14.2. The two most common responses were ‘never been asked to try’ and ‘never felt any need to use it’. These two answers indicate that there is a lack of basic awareness of these technologies, and that the employees have little or no knowledge of what videoconferencing can be used for. It is noteworthy that the telecom company Telia has employees that do not know how to locate or how to use the videoconference equipment.

Very few respondents asserted that not being able to take advantage of tax-free goods (at airports, on ferries etc.), frequent flyer credits and travel allowances have influenced their decisions. However, when people in this group were asked what they consider as the major obstacle in the efforts to reduced travel, a majority of the respondents agreed that these factors are important or very important. An interesting anecdote illustrates the importance of the frequent flyer programme. Given a choice between an immediate departure with an airline that did not provide any bonus points or waiting an extra hour for an airline that did, 18 out of 20 employees at a major Swedish company on a flight between Oslo and Stockholm chose the later flight (Kogg 2000).
Figure 14.2 shows the responses from the employees who use the videoconference equipment and they indicate that they are far from satisfied with how the technology works. Technical problems can eventually be overcome, but issues such as the lack of socialising and bonding with colleagues and business contacts and doing away with the discomfort of the new forms of meeting are much harder to resolve.

One key problem with virtual meetings is that they do not fully replace in-person meetings. A large part of communicating and getting an impression of somebody is through eye contact, facial expressions, gestures, handshakes, scents, the way they dress and so on, and much of this kind of information unfortunately gets lost in a virtual meeting setting. A videoconference studio with good sound and picture transfer, combined with the possibility of viewing and sharing documents, is probably the closest (commercially available) alternative to a real meeting today. But how much of an in-person meeting does this actually manage to replace? This question was posed to the employees at four organisations and the responses are noted in Figure 14.3. The average ‘degree of substitution’ was 61%, varying from 50% to 68% between the different organisations, with more than 15% of the respondents believing that 100% of the meetings could be replaced (Arnfalk 1999).

A more common form of virtual meeting is audioconferencing. In a recent study at the Swedish telecom company Telia, employees were asked about their use of audioconferencing, videoconferencing and Netmeeting (an Internet and PC-based conference system). Audioconferencing was by far the most frequently used, with more than 90% of

<table>
<thead>
<tr>
<th>Reasons for never using videoconferencing</th>
<th>Telia (%)</th>
<th>Skånska Lantmännens (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t know where the equipment is; don’t know how to do it</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td>Never been asked to try</td>
<td>77</td>
<td>70</td>
</tr>
<tr>
<td>No access to the equipment</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Never felt any need to use it</td>
<td>41</td>
<td>52</td>
</tr>
<tr>
<td>Can’t replace a physical meeting</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Too few/no meeting partners with access to videoconferencing equipment</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Nicer to travel</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Miss out on travel expense compensation, on tax-free and frequent flyer points</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Other reasons</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 14.2 Reasons for not using videoconferencing given by respondents in the organisations Skånska Lantmännens (Scanian Farmers’ Association) and the telecom company Telia

Source: Arnfalk 1999

Users

Figure 14.2 shows the responses from the employees who use the videoconference equipment and they indicate that they are far from satisfied with how the technology works. Technical problems can eventually be overcome, but issues such as the lack of socialising and bonding with colleagues and business contacts and doing away with the discomfort of the new forms of meeting are much harder to resolve.

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### Figure 14.2

*Main problems experienced during videoconferences. The results shown are the average figures from surveys at the Scandinavian Videoconferencing User Group, the companies Tetra Pak and Telia, and the farmers’ association Skånska Lantmännen.*

*Source: Arnfalk 1999*

<table>
<thead>
<tr>
<th>Problem</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other problems</td>
<td>10%</td>
</tr>
<tr>
<td>Social contact missing</td>
<td>15%</td>
</tr>
<tr>
<td>Stiff, uncomfortable participants</td>
<td>20%</td>
</tr>
<tr>
<td>Technical interruption during session</td>
<td>25%</td>
</tr>
<tr>
<td>Picture problems</td>
<td>30%</td>
</tr>
<tr>
<td>Sound problems</td>
<td>35%</td>
</tr>
<tr>
<td>Connection problems</td>
<td>40%</td>
</tr>
<tr>
<td>No problems</td>
<td>45%</td>
</tr>
</tbody>
</table>

### Figure 14.3

*Respondents’ impression of the ‘degree of substitution’ that videoconferencing had in relation to an in-person meeting. Results are collected from surveys at four organisations: Scandinavian Videoconferencing User Group, the companies Tetra Pak and Telia, and the farmers’ association Skånska Lantmännen.*

*Source: Arnfalk 1999*
the respondents using telephone conferences for business meetings (on average eight times per month). This can be compared to the use of Netmeeting (71% on average once per month) and videoconferencing (14.5% on average three times per year). The respondents were also asked if they felt as comfortable having a virtual meeting as when they had an in-person meeting. In the case of audioconferencing, 9% fully disagreed, as compared to 22% for videoconferencing. Concerning both types of meeting, a majority of the respondents agreed that they were disturbed by other participants’ lack of skills in how to act in the meeting and how to use the equipment.

The future outlook for virtual meetings

How can we overcome the deeply rooted travel and in-person meeting culture and make the transition to a more sustainable work environment? An important step may be for companies and organisations to acknowledge and understand the environmental dimensions of business travel. If the environmental angle does not get the necessary attention, then bringing greater awareness of the financial cost of travel expenses may help convince senior management as to the importance of this issue.

Another important step is to have easily accessible and well-functioning virtual alternatives to in-person meetings. Common facilities such as conference telephone rooms or video studios to hold a virtual meeting are essential as is a person within the organisation with responsibility for ensuring that the communication technology and equipment is in good working order. In too many cases people have had bad initial experiences with the technology and are scared away forever. It should be as simple as booking a flight with a travel agent.

Moreover, employees need to know and understand the different options available. They should be encouraged to try the videoconference equipment and learn what kind of meeting it can be used as a substitute for. The initial resistance in trying out and learning something new can be a powerful discouraging force. If top management ‘walks the talk’ and acts as a vanguard, this shift has a greater chance of being successful in the long run.

Once the basic technology and human resources infrastructure is in place, an organisation needs to make a firm commitment in facilitating and supporting a shift away from the traditional business travel system. To move away from thinking just in terms of travelling and instead focusing more on actual meetings and communications, an organisation may wish to devise a common booking system for both virtual meetings and traditional business trips. A meeting bureau may be retained instead of a travel bureau to help suggest and set up the optimal form of meeting for each type of occasion. Furthermore, the budget allocation for travel can instead be targeted for meetings, and a travel allowance may become a meeting allowance. Making these kinds of shift can be a major challenge, as they disturb systems that are well established in people’s minds and in organisational culture. The important thing is to develop awareness and acceptance of the alternatives to travel, throughout the entire organisation.

7 The construction company Skanska and the travel bureau Bennet BTI are currently building a joint system for this kind of meetings management.
References


Biography

Peter Arnfalk, MSc in Chemical Engineering and Licentiate in Industrial Environmental Economics, is an associate professor at the International Institute for Industrial Environmental Economics, Lund University, Sweden. He has experience of conducting research and working with environmental issues in Sweden, as well as in the US and Japan. He presented his licentiate dissertation ‘Information Technology in Pollution Prevention’ in October 1999.
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Service Transformation – Managing a Shift from Business Travel to Virtual Meetings

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Abstract:
It has been shown that the potential for environmental, and financial, improvements through the increased substitution of in-person meetings by virtual communication is considerable. However, it has also been shown that this potential is not automatically realized by investing in the technology that can enable virtual meetings. This paper describes two case studies that explored the factors that influenced communication and meeting behavior. A number of drivers and barriers for virtual meetings are identified, and, in addition, measures are proposed to improve the utilization of virtual tools for business communication.

Key words: virtual meetings, ICT, teleconferencing, business travel, environmental management

Prologue
This paper analyses how an organization can facilitate a shift from using one communication mode to another; more specifically this document address ways and means to replace some business travel and face-to-face meetings with virtual communications. The two studies, on which this article is based, were not intentionally approached from a Product Service System (PSS) perspective; the focus was rather on studying corporate management in a situation where environmental improvements are highly dependent on the individual employee’s behavior.
However, while some of the common failures of e.g. videoconferencing have to do with technology related problems, we found that the attitudes, skills, and preferences of the employees expected to use the systems, are equally as important. It is possible to see this, as a failure of the management in the organization that invests in the technological equipment, but it may also be expressed as a lack of system’s perspective, which includes the human factors. It is thus, equally relevant to argue that our failure to optimally capitalize upon the environmental promise of virtual meetings can be seen as a lack in development of an integrated product-service system (PSS) approach. Thus, this article introduces a complimentary input on the PSS point of view with regard to enhanced communication simultaneous with reduced needs for business travel.

Introduction

Regardless of whether ICT is contributing to an increase of personal transport on a macro scale or not, the fact remains that there are currently a range of ICT tools available that allow people, at different locations, to communicate and to meet each other without having to travel, by having so-called virtual meetings. The potential is that by using these approaches, an organization can lessen the environmental impact of its activities and, at the same time, obtain substantial financial improvements as a result of cost savings due to reductions in time and costs of travel. However, it is clear, from empirical evidence, including the research undertaken at the IIIEE\(^2\), that the volume of business travel is not automatically reduced as a result of ICT infrastructure being installed in a company. Our goal was therefore, to see how this potential can be realized, on a micro level, by a change of management policies and practices within an organization.

Most organizations are strongly dependant upon their ability to communicate; internally as well as externally. Much of this communication takes place in the form of meetings, a more or less formalized form of ‘an assembly for a common purpose’.\(^3\) Indeed many professionals, particularly executives, spend most of their time at work, in meetings. Business meetings are held

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1 With ICT mediated meetings or virtual meetings, we refer to situations when professional (business) meetings between geographically remote participants are made possible with the help of audioconferencing, videoconferencing or web-meetings (such as NetMeeting).


for a number of reasons; to inform, discuss, present, collaborate, sell, strategize etc. Frequently, there is more than one reason for a particular meeting. Still it seems safe to assume that no matter whether the purpose is to improve the team spirit or to do a sales pitch, the ultimate reason for meeting is the need to communicate.

Currently ICT technologies provide a number of possibilities to replace some of the in-person meetings. By substituting a physical meeting that requires one, or more, meeting participants to travel, with a virtual meeting, the organization can reduce the volume of business travel and thus, save money and at the same time reduce the company’s impacts upon the environment.

An Optimal Meeting!?

But, before we proceed, it is important to recognize that it is not only the environmental and economic aspects that are of importance when deciding which meeting form\(^4\) is the most appropriate. The character of the information that should be conveyed and the purpose(s) of the communication must be considered, but there are also other factors of importance. A meeting can, for instance, provide a good possibility to expand one’s personal network and/or build a deeper relationship with other meeting participants. Both of these outcomes could be useful for the individual as well as the organization.

The concept ‘Optimal Meeting’ was developed to illustrate the complex range of aspects that influence the costs and benefits that relate to a meeting.

The benefits of a meeting can be divided into two categories, private benefits, and organizational benefits:

- **Private benefits** should reflect the sum of each meeting participant’s individual benefits from a meeting. This could include e.g. building personal networks, building deeper personal relations, the pleasure of getting out of the office and seeing new places, etc.

- **Organizational benefits** should reflect the sum of each participating organization’s use of the meeting, including the short-term and long-term consequences of the meeting. But organizational benefits could also include private benefits that are of use for the employer as well, for instance if an employee forms a close relationship with a customer, this is also likely to be of benefit to the employer.

\(^4\) By *meeting form* we are referring to the means of communication selected for a meeting, e.g. physical meeting, videoconference, or audioconference supported by electronically shared documents etc.
The cost of a meeting can be divided into three categories, private costs, organizational costs and societal costs:

- **Private costs** should reflect the total of each meeting participant’s individual discomfort from a meeting, this could include; having to stay away from home over night, or getting up very early in the morning to catch a flight, fear of flying, etc. \(^5\)

- **Organizational costs** should reflect the participating organization’s full cost of the meeting including, e.g. travel cost, cost of accommodations, cost of travel allowances, the connection cost (virtual meetings), cost of time not used for effective work during travel, etc.

- **Societal costs** should reflect the cost to society of a meeting including the environmental impacts caused by the meeting, but also the costs of infrastructure, health care etcetera, that have not already been included through taxes or pricing mechanisms, i.e. the externalities.

Both costs and benefits will, of course, be affected by the choice of meeting form. By choosing a meeting form in which the total benefits exceed the total costs by as much as possible, or possibly where the total costs exceed the total benefits by as little as possible, the meeting is optimized. This is based upon the assumption that the firm’s leaders recognize/accept that environmental impacts are valid factors for their business to factor into their decision-making process and that they believe that they have a responsibility to minimize their environmental impacts.

By introducing the concept of “optimal meetings,” we are not suggesting that complicated valuation models should be employed when deciding on which meeting form to employ. However, while the concept will not, in itself, provide guidance on how to change meeting behavior, it has been proven to be useful as a platform for decisions regarding business meetings, travel and the environment. As the concept clearly addresses positive and negative impacts of meetings, we have found that it allows us to move a discussion past the stage of defending or critiquing current meeting behavior into a more constructive discussion about what to do and how to make such decisions in a more fully informed manner.

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\(^5\) The terrorist attacks in September 2001 and the current increased fear of terrorism, has discouraged many people from flying. Many organizations have reacted by restricting their employee’s business travels.
Two case studies

In case studies of two Swedish companies, both subsidiaries to Sweden’s largest telecommunications company Telia AB, we had the opportunity to take a close look at the drivers and barriers for the substitution of business travel by virtual meetings. Our objective was to explore and understand which and how different factors influence meeting behavior within an organization, and to explore the managerial implications of these findings for a company’s leadership that wishes to change meeting behavior in order to realize the environmental and financial benefits of virtual meetings.

The first case study was undertaken at Telia Research AB (TRAB). TRAB is a company with approximately 300 employees situated in four different cities in Sweden, conducting research within the field of telecommunications. All offices have advanced ICT infrastructures, including high quality videoconference facilities, conference telephones, Microsoft NetMeeting and similar electronic alternatives for effecting real-time communications. Another characteristic of this company is that the majority of the employees are highly educated and are experienced ICT users.

This study was finalized by September 2000 and the results were presented in a Masters thesis of one of the authors of this document. Based on the findings from this study, a wide-ranging project was subsequently initiated within Telia AB Corporation to ‘optimize’ meeting behavior, ultimately, within the entire organization. As a part of this project a second case study was performed. The company studied is Telia Nåra AB (Nåra), a company twelve times the size of TRAB and with approx. 90 offices located throughout Sweden and having 3600 employees.

The company sells ICT solutions and services to private consumers and small companies. This company is different from TRAB not only in terms of size, and geographic locations, but also in terms of organizational structure, culture and the demographic composition of its employees. Characteristics of the two studied companies can be compared in Table 1.

Table 1. A comparison of selected characteristics of the two studied case companies.

<table>
<thead>
<tr>
<th>Characteristics of the company</th>
<th>Telia Research AB (TRAB)</th>
<th>Telia Nåra AB (Nåra)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>300</td>
<td>3600</td>
</tr>
<tr>
<td>Number of office locations</td>
<td>4</td>
<td>35 (90 offices)</td>
</tr>
</tbody>
</table>

This second case study, finalized in July 2001, applied basically the same methodology as for TRAB (as discussed in the following methodology section). As a result of a longer research period, and a sincere top management commitment from the studied organization, this second case study provided an opportunity to put a deeper research focus on the managerial implications for the organization that seeks to ‘optimize’ it’s meetings.

**Methodology**

As explained above, our ambition with these studies was to explore how the environmental and financial promise or virtual meetings can be realized on a micro level. Recognizing that *meeting behavior* is likely to be influenced by many different factors, the case study form was chosen, as it is particularly appropriate when investigators desire to cover contextual conditions and when they rely on multiple sources of evidence such as inter-organizational partnerships and management information systems.

However, it should be noted that this is not a positivist research project where the successful implementation of ICT technology is analyzed through empirical studies of the experiences within a company that has successfully changed meeting behavior. Instead the case company was chosen because of its potential and commitment to the project and it’s willingness to change

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7 An organization described as ‘organic’ is characterized by flexible working arrangements, basing their coordination on mutual adjustment or direct supervision. On the other hand, an organizational structure described as ‘formalized’ or ‘bureaucratic’ can be described as bureaucratic to the extent that its behavior is predetermined or predictable, in effect standardized. Mintzberg, H. (1983). *Structure in Fives*. Englewood Cliffs, NJ, Prentice-Hall.

8 The term *meeting behavior* is used for the collective choices that the individual, or individuals referred to, make with regards to meeting form for different types of meetings.

meeting behavior. This fact obviously needs to be reflected in the methodology. The methodology that was developed for this study is based on ideas of Action Research.\textsuperscript{10} Distinguishing characteristics of the action research approach used were that we, as researchers, had an integral involvement in an attempt to change the studied organization. This intent was clearly communicated with representatives of the case companies. Moreover, in the research process, we did not only use the support from established theories, but also attempted to characterize and conceptualize our experiences into new theory development. The repeated research approach in the two case companies, which in turn, builds on the closely related experience from preceding research within Telia AB, can be described as a series of interconnected cycles, involving planning, acting, observation and reflection of the process after every step.

The practical methodology approach can be divided into three phases:

**Phase 1. The character of the problem was identified through discussion with key people in the test organization.** Based on the discussions, initial fieldwork, and literature studies within the field of communication theory, models of the factors influencing meeting behavior in the case study organization was constructed (See Fig. 1 and 2).

**Phase 2. Based upon primary data, each of these factors were then evaluated.** Primary data were collected through a web-based survey that allowed us to map out values, preferences, opinions, skills and attitudes of employees in relation to (a) virtual meetings in general as well as the currently available ICT infrastructure and the ICT support in the organization. (b) travel and physical meetings in general as well as the current culture, organization and management control system at the case study organizations relating to business travel, and (c) environment, career opportunities, work satisfaction, free time, money and other forms of compensation.

In addition, interviews were conducted with employees representing a random sample of the full population. The results of the interviews provided a deeper understanding of how people in the organization communicate. The interviewees where asked to bring to the interview, a record of all meetings that they had had during the last two weeks. Then each meeting was discussed by mapping out who they met, what media were used (physical or different virtual solutions), why these media were selected, the purpose of the meeting, what tools (e.g.

whiteboard) they used, the form of the meeting (e.g. discussion structured according to an agenda, a workshop, etc.) who initiated the meeting and a few additional questions. These interviews not only gave a detailed picture of the needs that the employees have in different meeting situations, but also provided useful data on the groups that are most important to influence i.e. the most common initiators of meetings. Provided that the sample is representative and large enough, the results can also be extrapolated to give an estimation of how many physical meetings could be replaced by virtual meetings in the organization, and thereby, make it possible to prepare quantitative estimations of cost and environmental savings to be compared with investment costs.

Finally, some interviews with key people within the organization, were necessary to gain an understanding of the organizational factors that are or can be used to support virtual meetings, such as the ICT infrastructure, human resource management, management control systems, travel management etc. These interviews allowed the research team to identify who in the organization has the skills and the power, to initiate changes in these factors.

By analyzing the data, drivers and barriers for virtual meetings were identified and manipulable and non-manipulable variables were identified.

Phase 3. A literature review of appropriate theories related to change management and a review of case studies of good and bad experiences with ICT-based communications within organizations formed a backdrop, for the final analysis of the findings and the design of recommendations for action.

The findings and proposals were discussed in a workshop together with key people within the organization, to benefit from their expertise and to ensure shared ownership of the final recommendations. The workshop was structured in two main segments. The first segment was comprised of a brief introduction to the concepts of optimal meetings, and some quantitative data were provided on the current meeting behavior within the organization followed by discussion of the costs and benefits related to this behavior. This session resulted in a documented consensus statement that explains why a strategy of “Optimal Meetings,” should be developed and implemented in the organization.

In the second segment, the findings of the initial analysis of meeting behavior within the organization were presented and discussed. After that, a ‘brain-writing’ session was held where all participants had to generate a number of suggestions of what measures can be undertaken to initiate a change of meeting behavior. These suggestions were then presented, discussed and prioritized by the group.
At this point the case studies of TRAB and Nära ended, but the process has further developed in the following ways:

a. A person at Telia has been assigned to give a concrete form to “Optimal Meetings,” and to implement the recommendations derived from the project at a company group level;

b. A high-level executive steering group has been established to take the necessary decisions on a company-wide policy level;

c. The researchers act continuously as discussions partners in the development of new policies, changes in existing policies, guidelines for and practical design of the virtual meetings’ setting.

Looking for explanations - communication theory

As discussed in the introduction, communication is an essential part of successful operations of businesses. It therefore, is reasonable to take a closer look at research within the field of communication theory for the purpose of finding theories that can be used to explain meeting behavior within organizations.

There are two prominent schools within the field of communication studies. The first school looks at communication as the creation and exchange of meaning. This school is primarily concerned with semiotics, looking at the content of communication and its role in culture. The second school is looking at communication as the act of transferring a message. This school is concerned with the efficient and accurate transfer of messages and the role of different types of media in this process.11 Since we where primarily interested in why people select a certain meeting form and not the content of their communication, it was the latter school that we decided would be most relevant for the purposes of this study.

Media Richness Theory

‘Media Richness Theory,’ is based on the idea that the choice of communication channel should be based on the character of the information that needs to be communicated. Originally, intended to be a prescriptive model for choice of communication channel, guiding organizations

towards increased communication efficiency,12 ‘Media Richness Theory,’ has gradually been transformed into a theory, that explains how and on what grounds the communication channel is chosen within organizations.13

According to this theory, different communication channels can be rated according to their density. The density is a measure of each channel’s potential for the effective transfer of complex, and ambiguous information, based on the following criteria:14

- Potential to provide continuous feedback;
- Ability to send and receive multi-signals (e.g. body language and tone of voice);
- Possibility to customize the message according to the specific characteristics of the situation and the receivers;
- Potential for language variation.

The density of the channel is said to correspond to its bandwidth, i.e. the amount of information per unit time that can be transferred. For effective communication the bandwidth, or the density, of the media should correspond to the character of the message.

‘Media Richness Theory,’ argues that to communicate efficiently and to avoid misunderstandings, a message with a high degree of complexity and/or ambiguity should be transferred through a dense medium. Clear and simple messages should conversely be communicated through a low-density medium, thus avoiding redundancy and the risk of overworking the information.15

If one agrees with the idea that this theory can be used to explain the meeting behavior in organizations, it is assumed that the communication channel is chosen based on the ambiguity and complexity of the information that should be communicated in relation to the individual’s perception of the density of the media.16


‘Media Richness Theory,’ has been criticized for being too simplistic in these assumptions, and it has been claimed that other factors such as situational and social factors must also be taken into account if we wish to explain why a certain type of media is chosen for a communication task. These types of factors would not only influence the behavior directly but also indirectly by influencing the perception of different types of media.

As a result of this critique, many different versions of an expanded ‘Media Richness Theory,’ have been developed. Trevino (1987)\textsuperscript{17} expanded the theory to encompass two new factors influencing the choice of media, situational factors (time and place) and symbolic considerations (i.e. the ambition for a dignified form of communication). Fulk (1987)\textsuperscript{18} suggests, in his ‘Social Influence Model,’ that the most important influence on the individual's choice of communication media is his/her co-workers, and yet another study has shown that the individual’s personality also, to some extent, explains the choice of media.\textsuperscript{19}

Others argue that it is the degree of personal character in the message that influences the choice of media rather than the ambiguity and complexity. This argument is based on studies showing that employees preferred to use the phone for messages of a personal character, whereas e-mails were considered more appropriate for impersonal, work-related communication.\textsuperscript{20}

**Channel Expansion Theory**

One offspring from ‘Media Richness Theory,’ that is of particular interest, when one has the ambition of promoting the use of a certain type of media, is the ‘Channel Expansion Theory.’ This theory argues the bandwidth of a medium expands over time as the user learns how to use it better and better. This means that a less dense medium could be developed into a denser medium providing that the parties using it are on the same level on the learning curve for using it.\textsuperscript{21}

The ‘Channel Expansion Theory,’ has been supported by findings in a number of studies. One example that is often mentioned is that people with a lot of computer experience frequently rank


\textsuperscript{18} Fulk, J. (1987). A social information processing model of media use in organizations. *Communication Research.* No. 4


\textsuperscript{20} Markus, L. (1994). Electronic mail as the medium of managerial choice. *Organization science.* No. 5

e-mails much higher on the ‘Media Richness Theory,’ density scale than people with less computer experience.22

**Why is ‘Channel Expansion Theory’ relevant for an environmentalist?**

‘Channel Expansion Theory,’ argues that intense use of a highly dense medium can prevent other less dense media from evolving. Therefore, we can draw the conclusion that there are not only a number of situational, social, and other factors that may influence meeting behavior, but that the current meeting behavior in the organization will also be influenced by previous meeting behavior, unless something is done to change the situation.

But the most interesting aspect of ‘Channel Expansion Theory,’ is not that it can help to explain the current meeting behavior. The theory is particularly relevant because it can be used to send a clear message about what is important when managing meeting behavior within an organization with the intent to promote a specific type of communication channel. It tells us that it is important to have uniform meeting behavior so that everyone is on the same level on the learning curve for the types of media that are used, and it also tells us that by promoting the use of virtual communication channels it is possible to expand the bandwidth of these types of media, thus, increasing their range of use, and the potential for increased substitution of physical meetings with virtual meetings.

**A model of meeting behavior**

It was not our intention to try to either prove or disprove any of the theories presented above. Instead, we drew from all of these theories in an attempt to understand what influences meeting behavior at the case study organizations.

The findings in the TRAB study supported the arguments of the ‘Media Richness Theory,’ that the character of the information that needs to be communicated is one factor that influences the choice of media. However, the findings also support the critique of the ‘Media Richness Theory’, in the respect of not taking other important factors into account. Clearly, situation-specific factors such as time, location and the relation between the meeting participants, the purpose of

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the meeting and the character of the message that is to be communicated, also play an important role in the choice of communication channel or meeting form. Information contained in Box 1, includes a number of quotes, underlining the importance of these factors, that were collected from the TRAB and Nära studies.

We called all these type of factors *situational factors* as they are specific and change for each meeting. A number of situational factors are depicted in Figure 1. The characteristics of these factors are such that it is difficult and sometimes inappropriate to manipulate them with the intention of changing meeting behavior.

*Box 1 – see end of article.*

![Figure 1](image-url)

*Figure 1. A model of situational factors that may influence the choice of communication channel.*

The importance of situational factors attracted our attention to examine how the type and character of a meeting affected the choice between physical and virtual meeting forms. In the Nära survey, respondents were asked to specify in what type of meeting situations they preferred using virtual communication, and correspondingly, in what situations they preferred the physical alternative. The results are listed in Tables 2 and 3.
Table 2. Types of meetings when virtual alternatives are preferred. The table lists the number of respondents that stated a certain type of meeting in a survey at Telia Nära.

<table>
<thead>
<tr>
<th>Form of meeting, categories of words</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up, check-up meetings</td>
<td>56</td>
</tr>
<tr>
<td>Informing, information meetings</td>
<td>51</td>
</tr>
<tr>
<td>Time: short meetings, maximum number of hours</td>
<td>37</td>
</tr>
<tr>
<td>Regular, repeated, consecutive meetings</td>
<td>29</td>
</tr>
<tr>
<td>Monthly-, weekly meetings</td>
<td>11</td>
</tr>
<tr>
<td>‘Working’ meetings</td>
<td>10</td>
</tr>
<tr>
<td>Decision making</td>
<td>8</td>
</tr>
<tr>
<td>[when people] know [each other]</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3. Types of meetings when the physical alternative is preferred. The table lists the number of respondents that stated a certain type of meeting in a survey at Telia Nära.

<table>
<thead>
<tr>
<th>Form of meeting, categories of words</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kick-off, kick-out</td>
<td>79</td>
</tr>
<tr>
<td>Discussion</td>
<td>11</td>
</tr>
<tr>
<td>Long meetings</td>
<td>10</td>
</tr>
<tr>
<td>Customers, external [contacts]</td>
<td>9</td>
</tr>
<tr>
<td>Important meetings, issues</td>
<td>8</td>
</tr>
<tr>
<td>Information meetings</td>
<td>6</td>
</tr>
<tr>
<td>‘Working’ meetings</td>
<td>6</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>5</td>
</tr>
<tr>
<td>[situations requiring] Creativity</td>
<td>4</td>
</tr>
<tr>
<td>Many participants</td>
<td>3</td>
</tr>
</tbody>
</table>

From these data, it became clear that the virtual communication alternative was considered more appropriate for certain types of meetings than for others. The results at Nära indicate that the virtual meeting alternative may be best suited for follow-up and information tasks, as well as for short and repetitive meetings. Particularly for ‘kick-off’ and ‘kick-out’ meetings, i.e. meetings in the beginning and end of a project, the physical alternative were considered the most appropriate.

We have to recognize that the prerequisites and preferences differ between organizations, and that each organization will have to identify its own set of preferences. Nevertheless, the results clearly underscore the importance of considering the type and character of meetings when choosing between the virtual/physical meeting alternatives.
While these situational factors evidently influence the choice of meeting channel, the findings in the TRAB study also indicated that they still do not cover the whole picture. It must be remembered that the meeting always takes place in a context. The meeting is not an isolated event, and in real life, meeting participants are likely to weigh many different objectives against each other when deciding on the most appropriate meeting form. To place the meeting behavior into its context, a model of contextual factors that may influence meeting behavior, in addition to the above identified situational factors, was developed. This model, presented in Figure 2, includes organizational factors, travel service providers, employees, the family of the employees, and the external meeting participants. The same model was used when studying contextual factors in the Nära study.

A model is, by definition, not a complete picture of the context for each meeting participant. The rationale for including the factors selected, was that each of them has either a direct or indirect interest in the meeting behavior at the companies, and could, therefore, influence it in some way either consciously or unconsciously. The second rationale is that all of these aspects influence a majority of the employees in the organizations.

The arrows in Figure 2 indicate the flow of influence among the different factors in the model. As meeting behavior ultimately is up to the individual, it is argued that only employees and external meeting participants can influence the meeting behavior directly. The other factors can influence meeting behavior by enabling different ways of meeting and/or influencing the choices of employees and the external meeting participants.
Figure 1. A model of contextual factors influencing meeting behaviour at TRAB.

- Organizational factors:
  - Human Resource Mgmt.
  - Organizational Culture
  - Mgmt. Control Systems
  - Organizational Structure

- Meeting Infrastructure
- Travel Policy
- Environmental Policy
- Information Policy

Figure 2. A model of contextual factors that may influence meeting behavior at TRAB/Nära

- Suppliers of personal transport:
  - Airlines
  - Travel agency
  - Swedish Railroad

- Employees:
  - Preferences & Attitudes
  - Values
  - Skills

- MEETING BEHAVIOR AT TRAB/Nära

- External meeting participants:
  - Telia subsidiaries
  - Non-Telia subsidiaries

  Family / Spouse
We found that situational factors play an important role in the choice of meeting form, and that these factors should be taken into account when deciding whether to have an in-person meeting or to use a form of virtual communication. However, with the objective of this research in mind, the questions we asked were not only - which are the more important factors influencing meeting behavior, but also, which of these factors can and should be manipulated, either directly or indirectly, in order to influence the meeting behavior?

As stated previously, the situational factors can be very difficult to manipulate. It is also questionable whether it is appropriate, to attempt to manipulate situational factors, for the purpose of decreasing the environmental impact of business meetings. It would, for example, be very awkward to manipulate the character of the message to be communicated, for the purpose of adapting it for virtual meetings. While it would be entirely possible to manage location of different meeting participants to reduce business travel, simply by relocating all employees to one office, this would not only have significant social implications for the employees that were forced to move, it might also affect the core business of the company.

Many of the contextual factors could however, be manipulated by the organization for the purpose of introducing or reinforcing drivers, or for removing barriers to virtual meetings. The preference, skills and values of the employees in the organization can be impacted by manipulating factors within the organization. External factors are more difficult to influence but it seems reasonable to assume that the organization could influence the meeting behavior of external meeting participants, and in particular those with whom they have frequent collaboration, through special agreements and/or requirements regarding available meeting infrastructure. The travel agency could be influenced through agreements regarding the type of service that they should provide to the organizations members.

Analyzing the influence of contextual factors at TRAB and Nära

How do the different contextual factors influence the meeting behavior in the two companies studied, and can these be manipulated? In an attempt to answer these questions, the barriers and facilitators pertaining to different factors presented in Figure 2, were analyzed for each of the companies. The analysis is based on company literature, interviews and surveys conducted within the two studies. A compilation of the main findings is presented in Table 4, structured according to the suggested influencing factors.
Table 4. Summary of conditions constituting drivers and barriers for an increased substitution of physical meetings found at TRAB and Nära.

<table>
<thead>
<tr>
<th>Organizational factors</th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizational structure</strong></td>
<td>Geographically dispersed organisation working largely in projects – large need for remote contacts. No real drivers or barriers for VM found.</td>
<td>Geographically scattered organisation, most of the work in the line organisation, but also much project work – also large need for remote contacts. Drivers and barriers as TRAB.</td>
</tr>
<tr>
<td><strong>Organizational culture</strong></td>
<td>Technical curiosity an initial but not long-term driver. Highly independent employees do not want to be told how to do their job, which works against the VM according to 'Channel Expansion Theory'.</td>
<td>The prevailing 'cost-awareness' is a strong driver for VM. Relatively high acceptance of directives regulating travelling and VM. No strong technical curiosity, rather a hesitance to accept new, complicated methods.</td>
</tr>
<tr>
<td><strong>Management control systems</strong></td>
<td>Not a driver as control systems that reward economic or environmental efficiency hardly exist. Budget for travel not a limiting factor.</td>
<td>Both the budget process and the balanced score card system, helps to ensure that costs are kept down on a group and individual level, and provides incentives, in the form of bonuses, to lower costs. Nära's EMS identifies travel as the company's main source of environmental impact, and therefore, promotes VM to reduce them.</td>
</tr>
<tr>
<td><strong>Policies</strong></td>
<td>Telias' travel and environmental policies strongly support VM, but VM is not mentioned, specifically, in TRABs’ travel policy. Policies generally have little influence on employees at TRAB; e.g. only 16% claim knowing of the content in the environmental policy.</td>
<td>VM is mentioned in Nära’s travel and environmental policy. However, these seem to have limited effect on the CTMV. A strong driver is the information policy, effectively influencing the use of VM.</td>
</tr>
<tr>
<td><strong>Meeting infrastructure</strong></td>
<td>Two types of in-house VC systems are available. Repeated failures discourage 60% of the respondents from further use. AC &amp; NetMeeting are readily available, few Web-cams.</td>
<td>Out-sourced VC facilities, numerous AC conf. telephones, ‘quiet rooms’ designated for VM. NetMeeting readily available, few Web-cams. Yet more ‘quiet rooms’ with AC &amp; NetMeeting were requested. Approximately, 83% of the interviewed employees were disturbed by poor reliability in NetMeetings.</td>
</tr>
<tr>
<td><strong>Human resource management</strong></td>
<td>No training in, &amp; little information given about VM. Information has to be collected on the Intranet. Most employees do not feel comfortable to handle the VC equipment.</td>
<td>As for TRAB.</td>
</tr>
<tr>
<td><strong>Employees</strong></td>
<td>Since there is no major driver for VM in the TRAB organisation, the CTVM is highly dependant on the individual.</td>
<td>Strong promotion of AC and a formalized management structure supporting it, leaves less up to the individual to decide on the CTVM as compared to TRAB.</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td>General attitude of VM as ‘second-class’ meetings. PM signal higher interest, seriousness and respect than VM. 70% enjoy getting out of the office, 50% agree that frequent BT is an indication of professional status, 70% enjoy BT abroad, but only 30% enjoy domestic BT. AC the most preferred mode of VM.</td>
<td>More than 2/3 thought that a larger share of PM should be replaced with VM. AC is becoming accepted as a business meeting alternative. VC seen by over 80% as too difficult, cumbersome, and expensive alternative. AC the most preferred mode of VM.</td>
</tr>
<tr>
<td><strong>Preferences and attitudes</strong></td>
<td>Many employees are unfamiliar with the VM tools. Only 40% think it is easy to</td>
<td>98% of the respondents used AC, 14% VC, &amp; NetMeeting was used by 77%. At half of</td>
</tr>
</tbody>
</table>
operate the VC facilities. Frequent users found VC easier to handle. Project managers are not more skilled than other workers. Only 16% can handle VC support tools and 15% NetMeeting as a support tool to AC.

Values

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
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</thead>
<tbody>
<tr>
<td>Weak link between the employees’ environmental concerns and CTVM.</td>
<td>As for TRAB.</td>
<td></td>
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</table>

Family/Spouse

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large influence on CTMV, particularly employees with small children prefer to travel less.</td>
<td>As for TRAB.</td>
<td></td>
</tr>
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</table>

Suppliers of personal transport

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>None of the individual travel service providers had any significant impact on CTVM. As a whole they may have influence due to the travel-sector’s extremely user-friendly ordering and booking systems.</td>
<td></td>
</tr>
</tbody>
</table>

Airlines

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have bonus system for frequent travellers, no direct indication that this would influence CTVM, although 1/3 agree or strongly agree to the statement that they appreciate the benefit of ‘frequent flyer miles’, and 78% agree to the statement that a lot of people appreciate the possibility to buy duty free goods on a BT.</td>
<td>Not covered in the Nära study.</td>
<td></td>
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</tbody>
</table>

Swedish Railroad

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have bonus system for frequent travellers, no indication that this would influence the CTVM. Rail only represent 10% of the BT.</td>
<td>Not covered in the Nära study.</td>
<td></td>
</tr>
</tbody>
</table>

Business travel agency

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not providing any specific incentives for travel, but offer a high service level.</td>
<td>Not covered in the Nära study.</td>
<td></td>
</tr>
</tbody>
</table>

External meeting participants

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>External meeting participants clearly influence meeting behavior in respect of initiating meetings, and thereby deciding the form of meeting.</td>
<td></td>
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</tbody>
</table>

Non-Telia subsidiaries

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hesitant to ask external contacts for a virtual meeting, as it may not be seen as ‘appropriate’. Most respondents had no experience of e.g. a VC with external persons.</td>
<td>For business meetings - as for TRAB. However, standard contact with customers (&gt; 4 million) was predominately held via normal telephone calls.</td>
<td></td>
</tr>
</tbody>
</table>

Telia subsidiaries

<table>
<thead>
<tr>
<th></th>
<th>TRAB</th>
<th>Nära</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than for non-Telia contacts, but still considerable hesitance to suggest VM to other companies within the Telia group. Approx. 50% of the meetings included persons from other Telia companies.</td>
<td>As for TRAB, but Nära has a lower % of inter-company meetings. Several Nära employees mentioned that they had promoted the use of AC in projects other Telia subsidiaries.</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations used in the table; PM: physical meetings, VM: virtual meetings, VC: videoconference/ing, AC: audioconference/ing, BT: business travel, EMS: Environmental Management System, CTVM: choice between the travel and virtual meetings alternatives.

Based on these findings, an evaluation was made of the extent that the studied factors can be manipulated by the management of the organization. Figure 3, depicts the result of this analysis.
The shades in the model indicate the level of influence that the management of the companies have over the different factors.
Figure 3. A model of contextual factors for meeting behavior at TRAB/Nära, highlighting factors that can be manipulated by the TRAB/Nära management. The darker shade is used for factors that the management can change directly, the lighter shade is used for factors that can be indirectly manipulated by the management.
Lessons learned

In the following section, we sum up the lessons learned from the two case studies at TRAB and Nära, starting with general findings relevant for both companies, followed by more specific experiences from the TRAB and Nära case studies.

Managing a shift – beyond the technology issues

While ICT tools and infrastructure enable people to meet virtually, the spontaneous shift from in-person to virtual meetings in an organization is very limited, even in a company that is characterized by a very high level of ‘IT competence’ and a general curiosity for new ICT solutions. Although, part of the explanation can be attributed to technical inadequacies, it is clear that many other factors influence the meeting behavior in the studied organizations.

A general insight to derive from these studies is that if a reduction in travel is to result from the increased use of ICT, systems have to be put in place to encourage, support and provide incentives for the increased substitution of physical meetings with virtual meetings. The success of virtual communications is as dependent on “people-issues” as it is on “technology-issues”. This could be simple measures such as training and information about available options, as well as support functions and user guidelines. Do not take for granted that people know how to use the tools available to them even if they are familiar with working with ICT. Also, don’t forget that communication over a new medium requires some ‘getting used to’ before it feels comfortable for the users. It’s just like learning to ride a bicycle, it is not until you know how to do it intuitively, that you can forget about the process of biking and start enjoying the scenery.

The importance of training

The lack of training was particularly evident in the use of videoconferencing. Awareness of how and when to use the tools was remarkably low in both organizations, particularly bearing in mind that they are both telecom companies. A large number of the respondents had never tried videoconferencing, and those who have, often had very limited training on how to use the media. Consequently, the use frequency of the media was very low.

However, it is not clear that training and information will be enough, as, (returning to our bicycle analogy) one also needs to provide a bicycle that is suitable for the purpose of the user, and ultimately convince him/her that bicycling has benefits that can outweigh the benefits of the alternatives, e.g. a Boeing 747, (business class, drinks included). These measures may include changes of the ICT infrastructure, the provision of incentive systems for a greater use of virtual meetings, the complication of the procedures involved in organizing a business trip etc. Here it
should be stressed that the situation, in particular, with regard to organizational factors such as human resource management, organizational culture, management control systems and organizational structure, meeting infrastructure etc. are very different in different organizations and thus, cannot be generalized.

**Management influence**

The factors that were found to present either a barrier or a driver for virtual meetings in the case companies include; meeting infrastructure, organizational culture, employee preferences, attitudes and skills, possibly employee values, the family situation, external meeting participants and, to some extent, suppliers of personal transport. What is interesting is that the management of a company can manipulate some of these factors, directly or indirectly, in order to stimulate the increased substitution of physical meetings with virtual meetings. The most difficult factor to manipulate is the organizational culture, and this factor may constitute a major barrier for the introduction of new ways of meetings. However, through leadership and through direct modifications within the other internal factors, management may consciously influence the organizational culture as well as the skills, preferences, and attitudes and values of their employees.

**Project leaders influence**

In addition to managers in the line organization, project leaders play a key role in this respect. As the organizations increasingly shift towards working in projects, more and more meetings are initiated within these projects. Commonly, it is the project leaders’ role to call upon the participants to join the meeting, and depending on this person’s attitude toward, knowledge of or skills in using virtual meetings, the use of these media for project meetings are more or less common.

**Policy issues**

In policy statements, the management can clearly express their support for the use of virtual meetings within the organization, and create a foundation for its development. However, the response to the policies strongly depends on how well they are supported by the management, and if they are accompanied by a system for implementation. If not, policies suffer the risk of becoming ‘toothless’ and ignored.

By agreements and policy statements relating to virtual meetings and business travel, it is also possible to influence external meeting participants, especially among other Telia subsidiaries.
External factors

Travel service suppliers could act as a potential barrier to an expanded use of virtual meetings, simply because they make travel so ‘user-friendly’, as illustrated by the quote from the Nära survey “as long as it is simpler to travel to a meeting than to arrange a virtual meeting, people will chose the traditional, simple way”. Transportation providers are likely to be difficult to influence. There is, of course, the possibility of changing travel agencies that are more cooperative in helping the company to decrease it’s reliance upon certain modalities of transportation. However, since the major railway and airline in Sweden have monopolistic positions on many routes, this possibility is limited.

The current services offered by the travel agency do not include the virtual meeting alternatives, and currently this service organization does not promote the non-traveling alternative. However, through an agreement between Telia AB and the business travel agency, it might be possible to modify the travel agency’s influence on virtual meetings. A move in this direction is currently taking place between the construction company Skanska AB and their main travel agency Bennet BTI. Skanska is aiming to cut cost for traveling by shifting towards a larger share of virtual meetings, but in doing so, they are dependant on ensuring that their travel agency can suggest and provide a solution for a virtual alternative to the physical travel. As Skanska is a large multinational company and naturally a treasured customer to a travel agency, Bennet BTI has agreed to help Skanska in their efforts, and the two companies are now developing a sort of ‘meeting agency’ business together. Thus, Bennet BTI is becoming more than a travel agency, just like BP is claiming that it is becoming an energy provider rather than only a supplier of petroleum products. This is an interesting new trend of product-services provision.

Lack of ‘meeting proficiency’

A last general reflection is the casual way that meetings are sometimes planned and undertaken, leading to many meetings being ineffective in terms of the time and resources. A quote from the Nära survey underlines the lack of ‘meeting proficiency’: “Most often the ‘[going to a meeting] in vain’-feeling is more related to poor preparations, expectations and structure. In those cases, many meetings feel like a waste of time, and if long traveling is involved, this feeling is, of course, emphasized, in respect of time consumption, expenses, and waste of time”

Even though it may seem like a far cry from environmental management, indications are that a better culture of meeting management could lead to more effective meetings, reducing the number of meetings and thus, the need for business travel. It should also be noted that effective preparation and meeting management are of even more importance in a virtual meeting, since the
media may restrict the possibilities to improvise solutions e.g. for sharing documents and slide shows.

**Family influence**

A driver for virtual meetings was found to be related to the family situation, as particularly employees with small children were reluctant to travel frequently to meetings. Another group of employees that favored virtual meetings were frequent travelers, who expressed weariness for traveling back and forth to the company’s main office. However, the most frequent travelers, persons involved in sales and procurement, were little inclined to approach the virtual meeting tools, which may be explained by their high degree of external contacts. Environmental concern could not be linked to an interest for virtual meetings, even though a majority of the employees expressed a feeling that environmental issues were important.

**Attitudes to virtual meetings – ‘second class’**

An interesting barrier related to individual preferences and attitudes was a prevailing hesitancy, particularly among many TRAB employees, about whether it is appropriate to meet e.g. customers virtually, an indication that virtual meetings were sometimes perceived as less significant, or “second class”, meetings. External meeting participants could also represent a barrier, as well as a driver, depending on their attitudes, and skills etc. in their role as meeting initiators. The meeting infrastructure of external meeting participants was indicated to be a barrier (lack of access to equipment), but it was difficult to assess how significant this barrier was, as virtual meetings, other than telephone conferences, were found to be very rare and the option was seldom discussed.

**The success of Audioconferencing at Nära**

The use of audioconferencing and to some extent NetMeeting, has been very successful in the Nära organization. The extensive use of audioconferencing is so notable that it is used by the Telia group as an example of good-practice for the environment. The wide-spread application justifies a closer look at the prevailing conditions at Nära that have made this development possible. A number of factors are of vital importance in explaining the achievement. First of all, the managers in Nära, particularly, the Information Manager, have actively promoted audioconferencing. The top management has sent directives to the Nära employees advocating

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23 The Information Manager who has been a major driving force in the use of audioconferencing recently received Telia Nära’s annual environmental prize for his efforts and success in replacing business trips with audioconferences and Netmeetings. Telia’s Environmental Report 2000 also brings up audioconferencing at Nära as a good example.
the use of audioconferencing and also served as models by using telephone meetings combined with NetMeetings for several key meeting functions. It could be mentioned that, in turn, a major reason for promoting this meeting form has been because of strong directives from the Telia HQ to limit travel within the entire company group. However, the personnel at the HQ often call to meetings at their premises in Stockholm, expecting employees from different offices around the country to come visiting the office, as illustrated by the Nära quote: “the management at the HQ are experts in calling to physical meetings, even if it only is a one to two hour meeting. The lack of experience [in managing audioconferences] becomes clearly evident when someone suggests that s/he can join by telephone. They consider it as troublesome and the next time, they call someone situated in Stockholm to the meeting instead”

Moreover, meetings in the Nära line organization are scheduled far in advance and the contents planned in detail. In addition, the form of the meeting is suggested, i.e., if it should be an in-person meeting or a virtual meeting. This improves the possibilities to utilize optimized types of meetings for specific meeting purposes. It also gives the participants a chance to prepare presentations, discussion topics and not the least themselves, for a specific form of meeting.

**Audioconferencing vs. Videoconferencing**

In both companies, but particularly at Nära, audioconferences were used more frequently than videoconferences. The technical infrastructure supporting both kinds of media is in place, but higher accessibility to conference telephones, simpler use, less or no need for booking, and higher reliability, may all have contributed to that the employees preferred telephones over videoconferencing. Another crucial aspect is that the support and advocacy that audioconferencing enjoys from the Nära management, is on the contrary almost non-existent for videoconferencing.

**A suggested approach for the realization of the environmental and financial promise of virtual meetings**

There is a need to include a range of different types of expertise in the development and implementation of a strategy for “Optimal Meeting.” This expertise may include the IT department, the financial department, the corporate controller staff, the human-resource department, the information department, the environmental coordinator and representatives of the users. Only by including representatives responsible for the different contextual factors, will it be possible to manipulate those factors, to remove barriers and to introduce or reinforce drivers
for virtual meetings. It should be noted that the modifications required within each of these factors do not need to include any fundamental changes.

An analysis of current meeting behavior is critical in the study of how to change an organization’s meeting behavior, and suggestions for improvements should be directly based on an understanding of the organization; each of the contextual factors, and; if and how the contextual factors are drivers or barriers for virtual meetings.

There is a need to understand the specific situation of the organization before one proceeds into the design and implementation of the process to replace or partially replace some business travel with virtual meetings. Nevertheless, while our research can not give a definite answer to what measures will be effective for increasing the substitution of business travel by virtual meetings in each particular case, it highlights some of the drivers and barriers that can influence the process, and it provides a general approach for addressing the issues that are applicable in any organization.

The methodology developed for these case studies was designed for initiating a process of change within a company. It was intended to answer the following questions, the answers to which we consider essential for the development and implementation of a successful strategy for “Optimal Meetings”:

1. What characterizes the current meeting behavior within the organization? What are the needs of the users, and is there a potential to substitute some of the physical meetings with virtual meetings?

2. Which contextual factors influence this behavior – what are the most important drivers and barriers for virtual meetings for the managers and employees within the organization?

3. Which of the relevant contextual factors can be influenced by the organization?

4. Who do we need to involve to influence the factors that are can be manipulated?

5. What measures should be implemented to influence the factors in order to reinforce the drivers and overcome the barriers for virtual meetings?

Some reflections on the research approach

One of the effects of performing action research in an organization is that researchers presence and the study actually affect the organization while one is studying it. This was seen in the case of TRAB and Nära.
It is perhaps, best illustrated by the fact that the study at Nära is a direct result of the study at TRAB. But it is not just another study, this time the case study is part of a much larger project, and while we, as researchers, have the opportunity to take an active part in this project, it is completely owned and driven from within organization. The role of the IIIEE researchers is not only to lead a research project but also to provide support and guidance throughout the process of change within the case company.

The commitment to “Optimal Meetings,” within Telia is illustrated by the fact that a high ranking internal project manager has been assigned to the task of running this project, and the inclusion of a wide range of key representatives in the project’s steering committees from corporate management as well as the management of Nära and TRAB. The project is, in effect, designed according to the recommendations that were generated from the TRAB study.

In addition, we have seen effects in terms of an increased awareness of the environmental implications of travel and increased interest in the available alternatives. This can be noticed particularly among the people that have been directly involved in the projects, but also among other employees that have come in contact with the project through its surveys, interviews and workshops. To what extent this will contribute to a change of meeting behavior is difficult to estimate, but we have seen that the project management has taken a conscious decision to optimize the project related meetings. Practically, during this research we did and are walking the talk and are holding all project meetings virtually.
Bibliography


a) “[the choice of communication channel] depends on the topic discussed”

b) “[selecting a virtual or a physical meeting] depends on the length of the meeting in relation to the time it takes to travel”

c) “I would substitute only the [physical] meetings that require very long time to travel”

d) “[We have selected a physical meeting form as] the purpose [of our meetings] is to listen, learn, and to support. You are filled with inspiration after such a meeting; a feeling of pride, and the meeting is characterized by spontaneity. Moreover, the people in the group don’t know each other that well, so the physical meetings contribute to a positive atmosphere. In an audioconference, the purpose of the meeting should be well defined and you should have ‘something to explain’”

e) “[We can not use virtual communication for] the first two meetings… we have to get to know each other first”

f) “I prefer audioconference meetings [to videoconference]. I think the video-part disturbs more than gives benefit”

g) “We use audioconferences more [as] they are working better and better”

Box 1. Quotes collected from the TRAB and Nära interviews and surveys emphasizing: a) – e) the importance of different situational factors’ influence on the selection of communication channel, f) that a low-density medium can be preferred over a high density medium, and g) supporting the ‘Channel Expansion Theory’
Everybody’s Business is Nobody’s Business –

Policy Measures Affecting Business Travel in Sweden

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1 Introduction – Transport’s Costs

Transport is a major source of environmental impact. In the EU, the sector’s growing greenhouse gas emissions, mainly carbon dioxide (CO₂) from road and air traffic, jeopardise the Union meeting its target under the Kyoto protocol.¹ While UN climate scientists recommend that greenhouse gas emissions need to be reduced by at least 60% in the next fifty to a hundred years in order to prevent dangerous climate change, passenger air travel for example is projected to grow about 5% per year between 1990 and 2015,² whereas total aviation fuel consumption is projected to increase by 3% per year. Scenarios of the emissions from aviation in 2050, predict an increase of CO₂ emissions ranging from 1.6 to 10 times the value in 1992.³

Looking at the problem from a societal perspective, Sweden is one of the countries that has made a commitment to reduce CO₂ and other emissions on a national basis.⁴ In addition, there is a desire to keep other large societal costs down that transport is afflicted with, such as casualties and accidents, noise, construction and maintenance of infrastructure, etc. These external costs of transport are estimated at about 8% of GDP on average in Europe. Passenger transport is estimated to be responsible for 65% of total external costs.⁵

Transport activities are also becoming a growing concern among companies and other organisations, as freight and personal transport often constitutes one of the largest sources of their overall environmental impact. This issue has until recently had relatively low priority in most companies, particularly those who have no legal governance from environmental

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² Measured in revenue passenger-km
³ IPCC (1999). Aviation and the Global Atmosphere. Intergovernmental Panel on Climate Change
⁴ Swedish Environmental Quality Objectives, e.g. Limited Climate Change (prop. 2000/01:130)
requirements and authority inspections (e.g. large service companies). Even though environmental management issues may be considered important, they are relatively small compared to costs in terms of drivers for change. However, since transport costs are growing and representing a large share of organisations’ budgets, interest in how to harness this trend in order to keep costs down is rising. This is particularly relevant for the fast-growing number of service companies, in which travel costs, on average, has become the second or third largest controllable cost. 6

In light of these facts, it is surprising that business travel (BT) is allowed to keep growing at such a fast pace. Strong incentives both on the macro and micro level argue that policies should be in place that would limit the growth of travel and its impact. Why isn’t travelling limited to a more sustainable level?

This paper views the problem from the perspective of an organisation. Looking at how the current policy framework steers or influences the amount and mode of BT, it discusses how current policies address travel in general and BT in particular.

2 Society’s Way of Addressing the Problems - Public Policy Measures

Transport policy employs a number of instruments of control in order to induce a desirable reaction among the various actors in the transport-market. The tool-box of policy measures influencing travel can be divided into:

- Regulatory instruments, or so-called ‘command and control instruments’ that mandate a specific restriction on activities;
- Market-based instruments, including taxes, charges and fees, act as incentives for particular behaviour; and
- Information-based strategies, that seek to change behaviour through the provision of information. These can be divided into:
  o Mandatory measures, such as mandatory reporting to authorities; and
  o Voluntary measures, such as eco-labelling and environmental public reporting.

The social costs of transport, including environmental costs, are mainly controlled by regulatory and market based instruments, decided by Government in general, and, to some extent, by local communities. Regulatory instruments include the requirements for vehicles such as emission limits, speed limits, etc., while market based instruments include taxes on fuels and vehicles, road tolls, etc. Market actors are believed to react rationally on the market based instruments by adjusting the transport volume, and by selecting vehicles with e.g. better energy efficiency and less environmentally harmful fuels.

When applied, these general policy instruments are virtually indifferent to whether the travel is for private or for business purposes, the same instruments goes for all. However, this approach does not seem to work perfectly in all situations. One of those is when people travel for business; in order to explain why general travel policies may be insufficient, a reference will be made to the Public Choice Theory.

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3 Public Choice Theory Applied on Companies

A parallel to the public choice theory, introduced by the Nobel laureate James Buchanan and Gordon Tullock in 1962, can help us approach the problem area. The theory addresses a basic dilemma: that individuals in a group are faced with the choice of doing what is best for themselves and what is best for the group. The theory was developed for the political context, recognizing that politicians are also motivated by self-interest.

BT can, to some extent, be exemplified in the perspective of public choice. In a study of shirking in political institutions, Parker and Powers (2002) found indications of the public choice phenomena in congressional foreign travel. We may also find a similar situation within the private organisation. Most people find an intrinsic value in travelling, and ‘don’t mind getting out of the office’. Thus, an employee may, if s/he is given the freedom to do so, choose to travel in business a) more excessively, and/or b) at a higher standard, than what is rational for the organisation. The cost of the BT is paid by the organisation. If perceived benefits exceed the cost (inconvenience) for the individual, and the individual is allowed to make the travel decision, BT on the margin would be higher than what is the optimal level for the organisation. Lack of transparency in these issues, particularly in large companies, may invite self-interest to distort decision on whether, or how, to go travelling in business.

One effect from this phenomenon is that the success of the increasingly viable option of communicating and collaborating virtually, i.e. via audioconference, videoconference or through web-conferencing, may suffer. Why give up the opportunity to go to Tuscany in May (combine the meeting with the week-end wine tasting, spouse joins as well) to sit in a dark videoconferencing studio? – ‘the company will save EUR 3 000, but it’s not my business’.

What does this tell us about the effectiveness of the market-based policy tools regulating the impact of BT? By affecting the total cost for travel, the organisations’ limited willingness to pay for business trips should rationally result in a decreased demand for these services. However, as the organisation is paying the bills and the employee enjoys the benefits, the policy measure only ‘indirectly’ influences the business traveller or potential traveller. Consequently, there is a risk that market-based policy tools are insufficient for addressing the actors upon which they are thought to influence. This leads to further questions: what other policy tools and instruments influence BT?

9 Three general situations or circumstances that promote cheating on the part of elected politicians were identified: poor off-the-job substitutes for the particular activity, imperfect observability and hidden (private) information, and the existence of last-period conditions. Foreign travel is one activity that seems to meet all the condition that invites opportunism. Firstly, members of Congress are often well-received and given a prominent hosting when traveling ‘overseas’ (no waiting in line for tickets, hotels, or luggage, chauffeured around in limousines, meeting dignitaries, grand dinners etc). For most legislators, traveling overseas as a private citizen cannot compare with the treatment that one receives when traveling as an incumbent member of the congress. Secondly, it is difficult, if not impossible to observe what the legislators do during their overseas travel. Voters have to accept whatever explanation the legislator supplies as his or her rationale for making the trip. Finally, foreign travel has historically been an area where last-period problems arise: the so-called ‘lame duck’ travel. Lame duck-travel occurs when someone who is not a candidate in the next election, or has been defeated in the next election, travels overseas before the end of his or her term in the office.
4 Means to Limit the Costs of Business Travel

There are mainly two ways that BT may be controlled and limited. The first is naturally at the micro level, where companies or other organisations are creating internal policies, routines, control- and decision-making systems for BT. It is in the organisations’ interest to keep costs of BT down by avoiding situations where organisational costs for BT exceeds the organisational benefits gained. A further discussion on these challenges, and ways to address them within an organisation, can be found in for example Halme et. al. (2001).10

However, both the incentive an organisation has to address the BT issue, and the organisations’ chances of succeeding in doing so, also depend on other factors, decided upon and controlled outside the organisation. These include general policy measures for transport (e.g. fuel taxes), but also more specific measures targeting BT (e.g. taxation of travel allowance). General policy measures are preferable. However, if individuals make decisions that are not optimal for the company, the general regulatory and market based instruments do not fully succeed in controlling BT. Therefore, there are reasons for looking into what other policies that may influence BT, and to analyse to what extent these policies are steering the level and mode of BT towards a more sustainable level.

5 Mapping of Policy Tools Influencing Business Travel

In this section, a mapping is made of such policies that could act beyond the general regulatory and market-based policy instruments. The policies selected are analysed in terms of the way and extent they are steering towards reduced environmental impact from BT. Particular interest has been placed on how the existing environmental public policy framework, as well as non-governmental environmental policies (such as voluntary initiatives of industry, NGO’s, and other) address BT. The questions includes mechanisms that affect the volume of travelling, as well as those steering towards ‘greener’ passenger transportation, i.e. towards cleaner fuels or vehicles, or shifting from air to rail transport. It also takes in the possibility to substitute transport through for example teleconferencing.

In relation to BT, public policy instruments and tools influence the whole chain of supplying, purchasing and using personal transport. This influence on the transportation ‘sphere’ and on the individual policy actors addressed in the policy (i.e. the receivers of the policy, those who should act upon the policy) within this sphere is schematically categorised in Figure 1.

A selection of policy tools and instruments will be highlighted and discussed, with focus on those affecting the employer and employee buying and using BT. This selection is largely based on the author’s own experience from years of discussions on environmental issues with people in the travel business, travel managers, transport service providers and others.

The scope is consequently limited to professional users of BT in Sweden, excluding private personal transport such as leisure, service, and shopping trips. The focus is on the policy measures that directly influence decision making in a company or other organisation that has employees engaging in BT. Thus, it also will not cover infrastructure, and mapping of the legal framework surrounding vehicles and fuels is limited to a few critical issues.

The structure of the following presentation of policy instruments and tools is based on the actors affected by the policy. The rationale for this is to illustrate how different actors, in the chain of transport suppliers and consumers, are steered or influenced by policies to reduce the environmental impact from transport, particularly BT. The presentation follows the categorization referred to in Figure 1. In addition to mapping existing policy measures, apparent lack of such measures is also brought forward.

5.1 Regulatory Measures

5.1.1 Permit and Environmental Impact Assessment

When establishing a new operation such as a new factory or other major activity, that will have a significant impact on the environment, according to the Swedish Environmental Code,\textsuperscript{11} the operation needs a permit to start or to change this activity. This permit is given either by the government itself, by the county administrative board or by the municipality, depending on the size and severity of the operations and its environmental impact. Operations that are included are manufacturing companies, power plants, incineration plants, major ground and surface water management. In addition, major road, railway, and airport constructions are included.

For certain operations with significant environmental impact, an environmental impact assessment (EIA) has to be conducted.\textsuperscript{12} The evaluation of the environmental impact of the

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\textsuperscript{11} Swedish Environmental Code, 1998:808 (Miljöbalken).

\textsuperscript{12} According to Ordinance regarding Environmental Impact Assessment: SFS 1998:905 (Förordning om miljökonsekvens-beskrivningar) and The Swedish EPA’s mandatory environmental reporting directives for environmentally hazardous activities; NFS 2000:13 (Naturvårdsverkets föreskrifter om miljörapport för tillståndspliktiga miljöfarliga verksamheter).
activities should include transport (3 § 2nd section, 1998:905). However, the assessments are often poorly covering impacts from planned transports.\textsuperscript{13} If transport is included, it is focusing on noise from freight transport or from extensive commuting. Extensive BT has not been considered. The Swedish Environmental Protection Agency is currently asking a pulp manufacturer, Värö Bruk, to supplement information on external and internal freight transport, in order to test how the environmental code can be used to stress reporting of issues such as energy use and transport.\textsuperscript{14}

The vast majority of all companies conduct activities that are not listed\textsuperscript{15} and thus are not required to apply for a permit or do an EIA. For those companies, there are no requirements or control of their transport activities from an environmental point of view. A major service company, can, for instance, have thousands of employees travelling constantly in business, without having to ask for permission for their activity or to report its environmental impact.

5.1.2 Mandatory Environmental Reporting

All operations that have to apply for a permit (so-called A and B companies) and those that are being controlled by the municipalities (C companies), annually have to submit an environmental report to the authorities, according to the environmental code, chapter 26, §20.\textsuperscript{16} In this report, the companies are required to quantify emissions to water and air, but they are not asked specifically to include transport in these figures.

If authorities suspect that a business has a large transport volume and consequently a significant environmental impact, it is theoretically possible for them to ask the company, listed A, B, C, or U (companies listed U have no specific environmental requirements in terms of permits or control) to submit a special report on these impacts. During this research, such reporting request from an authority has not been found.

5.1.3 Business Trip as a Bribe

A matter of concern in terms of professional travelling are trips offered to employees, business contacts, politicians, etc. This could be a way of making the beneficiary generally interested, showing gratitude for something s/he has done, or expecting a service in return.\textsuperscript{17} One professional group that is commonly being offered free travel and accommodation are medical doctors, whose further training is by tradition paid for by the medical industry.\textsuperscript{18}

Offering a trip as a bribe is, in principle, forbidden (the Swedish Penal Code, chapter 17, § 7, law (1999:197)) but it is often hard to determine whether it is a bribe or not. If, for example, offering a customer a free trip to an expo, including travel, hotel, and dinner, is considered a ‘justifiable measure’ if it contains a ‘serious program’ with ‘not too many entertainment arrangements’.\textsuperscript{19}

\textsuperscript{13} M-plus no. 8, July 3rd 2001, p.16.
\textsuperscript{14} M-plus no. 8, July 3rd 2001, p.8-9.
\textsuperscript{15} SFS 1998:808
\textsuperscript{17} Interview with Cathrine Wickerts, chairman of the Swedish Business Travel Association, 010913.
\textsuperscript{18} Palm, Beatrice, (2000), Region Skåne tar fram policy för bjudresor, Sydsvenska Dagbladet, 001129.
\textsuperscript{19} Institutet Mot Mutor, se [http://www.chamber.se/imm/imm_faq.html]
5.2 Market-based Measures

Market-based policy measures are frequently employed as instruments to reach environmental objectives. Most of these are targeted towards vehicles and fuels, use of roads, airports etc. A few target the users directly, among those taxation of travel allowance, users of company cars and private cars for business.

5.2.1 Taxation of Travel Allowance

The Swedish taxation law ‘allows’ a company the possibility to give its employees a tax-free travel allowance, if the following conditions are met:

- The trip must involve a stop-over (one night or more)
- The workplace must be at a distance of at least 50 km from the main work-place.
- There is a so-called ‘maximum amount’ associated with a large number of destinations which must not be exceeded (e.g. the Netherlands 459 SEK/day, Eritrea 200 SEK/day and Japan 1428 SEK/day). If this maximum amount is exceeded, the company and the traveller will have to pay taxes on the exceeding amount.20

Private car for professional use.

Compensation exceeding 15 SEK/10 km that a company gives an employee for using his or her private car, is taxed as additional salary. The company paying the compensation is obliged to make tax deductions as well as paying general payroll tax on the amount exceeding the deductible amount.

Company cars, is another issue that is of great interest when considering environmental impact from BT, however, this will not be covered by this paper.

5.3 Informative measures

5.3.1 Frequent Flyer Programmes

Most airlines have frequent flyer programmes, a system in which you receive bonus points when travelling, staying at certain hotels etc. These bonus points can be collected and used for new trips when the number of points has added up to a certain amount. This system is naturally intended to make the airline more attractive, and attracting more customers to the company. The bonus system can act as a means of competition between different airlines, but it can also attract customers from other means of transportation, such as the train. In addition, it can stimulate more travel in total. Persons travelling extensively in their business, receive a lot of bonus points. These bonus points, generated by their professional travel paid for by their employer, is given to the traveller in person, not to the company. Several large companies have brought pressure to bear upon the airlines to direct the bonus points to the companies instead, but failed.21 This means that it is up to the individual person to use these points either in business or for private use.

In several large companies in Sweden, it is stated in the company travel policy that the company is the beneficiary to those bonus points that are earned through the employees’ BT. If such a policy is not in place (and the bonus points are to be seen as a fringe benefit), or that

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21 Interview with Cathrine Wickerts, chairman of the Swedish Business Travel Association, 010913.
the person chooses to neglect the company policy, this privilege should be treated as an additional benefit from the employer and taxed accordingly.22

However, this law is very poorly followed and also hard to control, as airlines refuse to announce facts about who is receiving bonus points.

The consequence of these programmes is likely that the attractiveness of receiving free, private trips that can be used for leisure travel, can influence a decision of when and how to travel in business, towards more travelling and a higher share of air travel.

It is likely that the bonus of receiving points from business trips that can be used for private travel,

### 5.3.2 Public Procurement

The public procurement sector is annually buying goods and services for 400 billion SEK in Sweden, and the corresponding figure in the EU is 7000 billion SEK.23 It is consequently a potentially powerful force in promoting environmentally preferable goods and services, including transport services. Guidelines surrounding environmental considerations in public procurement are uncertain and not very clear. The main reason for this is the conflict of interest between those who advocate free trade and avoidance of trade barriers, and those who want to set up environmental criterion for procurement.24 The Swedish government agency for public procurement, NOU, refers to a number of official reports on the topic. A report from the EKU-delegation gives recommendations and presents a model for public procurement of transport services.25 However, travelling by air and boat is excluded from the requirements. This is surprising; particularly as air travel represent a large share of BT.

Even though most of the recommendations focus on freight transports and the performance of trucks, one section is devoted to requirements for travel bureaus. The requirements include mandatory demands for a structured and documented environmental management system. In addition, the evaluation criteria are:

- are the travel agency members familiar with the customer’s environmental policy?
- can the travel agency present estimations of emissions and energy use from different travel options?
- can the travel agency provide the customer with statistics for travelling in order to facilitate the efforts to reduce environmental impacts from BT? 26

The EU-commission has issued an ‘interpretive communication’ on the Community law applicable to public procurement, and the possibilities for integrating environmental

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22 Swedish tax law 1997:483, chapter 8, 14 §.
23 According to the Swedish National Board of Trade (Kommerskollegium).
24 Interview with Anette Elmkvist, Nämnden för offentlig upphandling, Stockholm 010919.
26 One example of a travel bureau that is actively working with these issues is Bennet BTI, which jointly with a large construction company (Skanska AB) develops models for reporting of environmental travel data. Moreover, the two companies are looking into the possibility of deliver ‘meeting services’ instead of solely travel, including more cost- and environmentally effective virtual meetings. See Bennet BTI Nordic Magazine, no. 3, 2001.
considerations into public procurement. 27 This interpretation is not binding, as it is the EU court that makes the legal interpretation. The document supports the idea (in line with the Amsterdam treaty) that it should become easier to include environmental requirements in public procurement. It analyses and sets out the possibilities of the existing Community legal framework with regard to the integration of environmental considerations into public procurement. Introduction of further possibilities that go beyond the ones offered by the existing framework requires ‘intervention of the community legislator’.

The document promotes the idea that environmental demands can be placed, at an early stage of a procurement process, on manufacturing processes (e.g. “green electricity” and organically grown vegetables) and as a requirement for eco-labelling. However, regarding the evaluation criteria, judging which product is the most economically preferable, the commission wants to limit the possibility to place environmental demands. In this case, the environmental requirement must yield economic benefits for the procuring unit (the customer). As an improved environmental performance of a product or service is most often something that affects us all, a societal or common benefit and not a specific gain for the procuring unit, it is hard or impossible to translate these environmental criteria into economic terms for the customer.

The EU Court has ruled in a case regarding environmental criterion for public procurement of a bus service in Helsinki (Case C-172/99). The court concluded that within the legal framework controlling the activity, the different suppliers of bus services may compete on basis of environmental performance and energy use.28

5.3.3 Private Procurement

Private companies have no direct support and guidance from public policies when buying a transport service. However, public authorities can act as role models when creating policy documents that may act as a guide for other organisations. The Swedish National Road Administration (Vägverket) has adopted a travel policy, with associated guidelines, stating how to interpret the travel policy.29 In order to reduce the employees’ environmental impact from BT, the guidelines suggest considering virtual communication alternatives, coordination of travel activities, car sharing, cost considerations for modal choices, promotion of public transport, eco-driving etc.

5.3.4 Environmental Management Systems

A number of voluntary company initiatives may influence BT. When companies commit themselves to introducing an Environmental Management Systems (EMS), such as the standardised systems ISO 14 001 and EMAS,30 they will have to identify their most significant environmental aspects. In many companies, particularly non-manufacturing companies, travelling is a major, if not the most significant, environmental aspect. In this way, the company will have to recognise that travelling constitutes a problem and to start


28 The EKU-delegation: “Ett levande verktyg för ekologiskt hållbar offentlig upphandling” , available online: [http://www.sou.gov.se/eku/]

29 The Swedish Road Administration’s travel policy can be found online (in Swedish): [http://www.vv.se/om_vv/policy/rese.htm].

30 EU:s Eco-Management and Auditing Scheme
looking for ways to reduce this problem. In what way do the two major, standardised EMS schemes address travel?

ISO 14 001: Does not explicitly mention transports in general or travelling in particular.

EMAS II: In this revised version of EMAS, personal transport is explicitly mentioned in Appendix VI, section 6.2 g, as transportation of employees is one of the activities for which the environmental aspects should be analysed. However, in the first EMAS document, which was active from 1995 to 2001, only transport in general was mentioned, in association with freight transport.31

5.3.5 Voluntary Environmental Reporting

It has become increasingly common among larger organisation to publish a public environmental report, in which the major environmental issues in the company, and the efforts to tackle them, are reported. A number of organisations have developed guidelines for this type of reporting, however, only a few cover BT. One of those who does is the Global Reporting Initiative, that takes up transport and BT in particular in their criteria for reporting (in Section 6.24). Another organisation is the Swiss Bankers Association, explicitly mentioning BT in their guidelines for reporting.32

5.3.6 Eco-Labelling

Estimating the environmental impact of different modes of transport, vehicles, fuels, etc. is complicated, making a comparison of different alternatives based on environmental concern quite difficult. As guidance when buying a personal transport service, eco-labelling is one potential tool that can help the buyer making decisions and make it feasible to include environmental criteria in the decision-making. In Sweden there is currently three main eco-labelling schemes active on the market. The three schemes were studied to see if they included criteria for passenger transport.

The European eco-labelling scheme the EU Flower does not include transport services, vehicles, fuels or any other transport related items in its scheme.33

The Nordic eco-labelling scheme the Swan or Svanen, like the EU Flower, does not include transport services. However, this eco-labelling scheme does include services (systems for reusable towels, hotels and car wash establishments). There are ongoing discussions among the Nordic member countries to include freight transport among the criterion areas, but the necessary consensus has not yet been reached. Personal transport is considered more complex and so far there are no plans to develop criteria for these services.34

The only eco-labelling scheme relevant for the Swedish market that covers personal transports is Good Environmental Choice (Bra Miljöval), the Falcon or Falken, developed by the Swedish Society for Nature Conservation (Naturskyddsföreningen). The criteria, developed already in 1994, gives threshold values for the energy consumption and emission levels from vehicles powered by fuel from non-renewable energy sources (e.g. fossil fuel), targets energy

31 EMAS is actually both a European and Swedish law, but its adoption is voluntary for an organisation.
33 See EU Eco-label homepage [Available online: http://europa.eu.int/comm/environment/ecolabel/producers/productgroups.htm]
34 Interview with Marie Fallin at SIS Miljömärkning, Stockholm 010919. See also: [http://www.svanen.nu/].
generation for electrically powered vehicles, and includes the end-of-life management of vehicles.

5.3.7 The Role of Travel Agencies

There are currently no policies or regulations affecting travel bureaus in Sweden, that steer their activities towards a more environmentally friendly selection of travel services.35 The Swedish Travel Bureau Association has no recommendations or policies that focus on this direction. Measures have, however, been suggested for this group, as presented in Section 4.1.3.

6 Discussion

Let us start by summarising the findings in sections 3 and 4. In section 3, doubt was raised as to whether the generally applied command-and-control measures and market based tools were sufficient and suitable policy tools to control BT. Public choice theory applied to a private organisation, suggests that employees’ self-interest could lead them to more travel, and in a different (more comfortably and expensively) manner than is justifiable for the organisation.

This led us to look at what other, more specifically directed policies, that influence BT, and to analyse in what way they steered towards a lessened social cost of BT. Particular focus was given to the environmental policy framework. The result of this mapping can be summarised as follows.

Policies influencing professional users and customers

In regulatory environmental measures such as when a permit is required for establishing a new operation, when an environmental impact assessment (EIA) has to be conducted, or when the company mandatory reports its environmental aspects to the authorities, BT and its impacts is seldom, if ever, considered. Another regulatory measure is that which limits the possibility to offer a business trip as a bribe. In practice it is very difficult to determine whether the trip is a bribe or not, and as a result, the law is rarely applied.

A market-based measure that specifically targets BT is taxation of travel allowance. This effectively limits the additional economic incentive for BT that travel allowance causes.

A number of informative and voluntary measures was analysed as well.

It possible for a public authority to put limited environmental requirements on procurement of travel services, but as EU guidelines makes it defacto impossible for the organisation to set up environmental requirements such as emission of CO₂, as the individual organisation have to show that they economically benefit from the selection. Suggested Swedish guidelines for procurement of transport services exclude some transport modes such as air travel.

The dominant standard system for Environmental management systems (EMS) is the ISO 14 000 series. This EMS standard does not explicitly mention transport in general or travelling in particular. However, in the revised version of the standard EMAS, personal transport is explicitly mentioned.

The two large eco-labelling schemes the EU Flower and Nordic Svanen, do not include transport services in their schemes. However, the smaller scheme Falken, developed by the Swedish Society for Nature Conservation targets passenger transport.

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35 Interview with Christina Wennmark, Chairman of the Swedish Travel Bureau Association, 010921.
Few organisations report on travelling in their voluntary environmental report, and most reporting guidelines exclude the issue, but the widely recognised Global Reporting Initiative covers BT in their criteria for reporting.

**Policies influencing service providers**

There is no VAT on the ticket price when buying an international trip in Sweden. The kerosene that is used as fuels for airplanes is internationally exempted from tax. The aviation sector has been deregulated, which has led to dramatic price drops to many destinations.

Frequent flyer programmes provide benefits for individual business travellers, not to the companies. The free travel privilege should be treated as an additional benefit from the employer and taxed accordingly, but the law is very poorly followed and also hard to control, as airlines refuse to announce facts about who is receiving bonus points.

Travel Bureaus do not have any environmental policies or recommendations.

**Looking for explanations**

Consequently, this mapping exercise reveals that policy measures in addition to the general regulatory and market-based measures, with few exceptions, do not promote reduced levels of BT, or a travel with less environmental impact. It is particularly noteworthy that the environmental policies analysed almost exclusively neglect BT. Why is this so?

On the macro level, we have to keep in mind that transport has facilitated and stimulated society’s development and progress, allowing for an efficient production and consumption system. It has given us access to products from distant places, and made the comfort of travel commonplace.\(^{36}\) It also creates value and employment. In the EU, the value created by the transport sector is estimated to 4% (EUR 320 billion) of the total GDP. Moreover, more than 9% of all persons employed in the EU are employed in the transport service sector, in the transport equipment industry or in any other transport related industry.\(^{37}\)

For companies and other organisations, BT is a vital part of most businesses’ activities and considered as a prerequisite for the survival and growth of the business. Moreover, the previously discussed psychological dimensions of BT have to be acknowledged, strongly associating it with status and success. The persons within the organisation travelling the most are usually also the one making decisions, which makes the issue even more intricate. As a result, the issue of reducing or greening of travel rarely gets very strong attention and support from top management.

For the individual, BT differs notably from private travelling. First of all, it is less price sensitive, since it is seldom the traveller that pays for the ticket. This may lead to, particularly in larger organisations, the traveller choosing the most convenient and beneficial means of transport, which is often synonymous with more costly and more energy consuming travel. Moreover, the purpose of the trip differs. The sought after experience and thrill of a leisure trip includes the joy of getting ‘away’ to a remote place, and often also the travel itself. A business trip may be pleasure-filled as well, but it is not (supposed to be) the main purpose.

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Thus, this provides an opportunity to look specifically at possible measures to steer BT in a more sustainable direction.

These explanations suggest that BT nearly enjoys a status of unassailableness. Can organisations be encouraged to engage effectively in reducing the environmental impact from BT, bearing in mind the dilemma that companies and others face in this issue?

**Ways to address the problem**

One way is to raise general transport taxes, particularly for fuel. Increasing prices will encourage organisations to take internal actions to reduce their BT costs. However, bearing in mind the questions’ ambiguous character, it is not surprising that raised prices for fuel (for road transport) lately triggered mass-demonstrations all over Europe. This naturally will make policy makers hesitant to add substantial environmental taxes on fuel, that is already heavily burdened by several hundred percent of taxes and other add-on costs on the price.

Taxation of aviation kerosene is an especially complicated issue, as discussed in Section 5.2. The non-existent tax on this fuel naturally creates competition distortion and is not in accordance with the goal of ‘fair and efficient pricing in transport’ that EU is striving for. As the aviation industry is international in many aspects, this calls for an international solution, i.e. an international tax, not to create unfair competition between airlines in different countries or regions. Landing charges is another way of approaching the problem, but this does not take into account the length of the flight and the corresponding emissions of e.g. CO₂.

In section 5 in this paper, a number of specific policy measures (or lack of such) have been highlighted. In this process, potential room for more stringent policies have been identified in several cases. Consequently, policy makers may need to support organisations in reaching a more sustainable level of travel, by introducing more stringent policy measures specifically targeting BT, beyond the current regulatory and market based measures.

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