

Save Transport, Time and Energy: Work at Home two to three Days a Week

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This case is first of all concerned to unveil the subtleties of the interplay between motives and barriers for introducing distance working into organizations of tomorrow and to discuss the impact that distance working will have on travel behavior. The overall report is based on a comprehensive literature survey on distance working and transportation studies and reports from a distance working case study at the Danish Technological Institute: 'Save Transport, Time and Energy: Work at Home two to three Days a Week' (in the following referred to as the DTI case study).

The case study is qualitative in nature. It applies comprehensive semi-structured and open-ended qualitative forms of interviews, time-budget analysis techniques, and diary writings. 13 persons participated in the experiment. The experiment started February 1996 and ended October 1997. Based on qualitative data we discuss three major social-psychological aspects which have an impact on the potential for distance working: Social isolation, 'workoholism' and child-caring. In addition, we present findings indicating that distance working has a reasonable environmental effect in terms of reducing commuting using cars. The participants still work at distance.

The case aims to be able to evaluate the figures and estimations related to the potential for distance working from a qualitative and multifactorial perspective. In the below table 1, we have listed barriers and motives for introducing distance working as a common method of working in organizations. It is these barriers and motives related to the totality of working life we wish to examine in through experimenting with distance working. In the next section we will present the approach of the DTI case study and discuss some preliminary results based on quantitative as well as qualitative methods.

<i>Barriers for distance working</i>	<i>Motives for distance working</i>
<p style="text-align: center;">Tradition:</p> <ul style="list-style-type: none"> • We go to work because of demand of the employer. Thus the employer is the key to introducing distance working. <p style="text-align: center;">Confidence and Self-confidence:</p> <ul style="list-style-type: none"> • The employer's confidence in the employee. • The employee should have common goals with the company and have an interest in fulfilling these goals. • Independent work. <p style="text-align: center;">Organization and Content of Work:</p> <ul style="list-style-type: none"> • Not all kinds of jobs are suitable to be carried out at home. • The content of work must be well-defined and have a character which makes it possible to delimit it compared to other job assignments. • To estimate the work on output rather than on consumption of working hours. <p style="text-align: center;">Homework and Private/Family Life:</p> <ul style="list-style-type: none"> • Social life at the workplace. • Teamwork at the workplace. • Inspiration from colleagues. • Constructive criticism from colleagues. • The employee as a balanced person. • Informal information exchange. <p style="text-align: center;">Demands for Residence:</p> <ul style="list-style-type: none"> • Room for home office. • Placement of the home office. • Environment of the local community. <p style="text-align: center;">Unsolved Legal Matters:</p> <ul style="list-style-type: none"> • Security and insurance at home. • Taxation, e.g. on computers at home. • Working environment. 	<p style="text-align: center;">Motives of the Employees:</p> <ul style="list-style-type: none"> • Flexibility and job control. • Higher efficiency. • Better balance between work and family life. • Opportunity to take care of sick children (important in Denmark where both parents normally are working full time). • Higher emphasis on job content. • Less transportation expenses. • Less transportation time. <p style="text-align: center;">Motives of the Company:</p> <ul style="list-style-type: none"> • Greater flexibility to solve peak loads. • More customer service. • Flexible production. • Increased productivity. • Higher emphasis on 'Human Resource Development'. <p style="text-align: center;">Technology:</p> <ul style="list-style-type: none"> • Better tools and services. • Open networks - the Internet. • Telecommunication - ISDN. • Communication, E-mail, NetFAX, Video conferences, 'Virtual reality'.

Table 1. The table summaries push and pull factors influencing the spread of distance working as a method of working in a massive scale. Sources: The DTI case study, 1996; Mirchandani, 1995.

1.1 The DTI Case-study

We have carried out a distance working experiment called ‘Save Transport, Time and Energy: Work at Home Two to Three Days a Week’. 13 employees (engineers, architect, designer, etc.) from the DTI Energy VISION, a research and development unit at the Danish Technological Institute, participated in the experiment.

The overall aim of the experiment is to unravel the relation between distance working and transportation focusing on social, psychological, organizational and legal issues related to the introduction of distance work into organizations. It applies comprehensive semi-structured and open-ended qualitative forms of interviews, quantitative time-budget analysis techniques, and diary writings. The experiment started February, 1996 and ended October, 1997.

Our technological aim has been to provide the distance workers with the same telecommunication opportunities whether working at home or at work. By means of an ISDN telecommunication line, the home offices of the above 13 employees and the primary office at the DTI Energy VISION have been connected. Thus telecommunication facilities as e-mail, facsimile transmission, Internet, access to the local area network at the DTI as well as printing facilities have been placed at the distance workers’ disposal both at home and at the DTI.

<i>Monday May 27, 1996</i>									
<i>Time</i>	<i>Working at home</i>	<i>Working at DTI</i>	<i>External Meetings</i>	<i>Means of transportation</i>					
				<i>Bus</i>	<i>Car</i>	<i>Bicycle</i>	<i>Plane</i>	<i>Train</i>	<i>Other</i>
6:00									
6:30									
7:00									
7:30									
8:00									
etc.									

<i>Means of communication</i>	<i>Working at home</i>	<i>Working at DTI</i>
Number of e-mails		
Number of facsimile transmissions		
Telephone (in minutes)		
Internet (in minutes)		

Table 2. An illustration of the schemes used for logging of quantitative data. ‘DTI’ is our company acronym.

The schemes shown above have been used to log the quantitative data. We have used a very simple scheme to reduce the participants’ workload when logging their working, transportation, and communication behavior. We wanted to be able to distinguish between the means of transportation, the time used working at home, and the time used working at the company. Furthermore, we wanted to be able to analyze when the work is carried out. In addition, we wanted to be able to scrutinize any change in the communication behavior during the experiment. We have collected data through random samplings. The duration of a single sample is three weeks. The data presented below is based on four samples:

We have observed that two variants of distance working have been used by turns. That is, the participants have been working at home a couple of hours before or after working at the office and working at home full days. In addition some participants have been working at home a few hours on Saturdays, Sundays, and other non-working days but only in a minor scale.

An analysis of our time budget data have shown that the individual employees participating in the experiment on an average have worked 40 hours a week. 22% of these were spend working at home. The participants have combined working at home with working at the office in 30% of all working days. The participants worked full days at home in 13% of all working days. This corresponds to 0.65 days per week on an average. The participants used their car for commuting purposes in 83% all commuting trips.

By working at home the individual participant on an average saved 27 commuting hours (scaled to one year). On full days working at home the individual participant on an average saved 55 commuting minutes. The group as a whole saved 9.5 working weeks not commuting when working at home (scaled to one year). The group as a whole saved 11.500 km not commuting when working at home during the experiment. This corresponds to approximately 1000 liters gasoline savings (11 km pr liter).

These figures should be compared with the relatively low average commuting time per employee (about one hour in car, about two hours in bus/train or about 1_ hour on bicycle per day). The figures should also be related to the fact that no transportation is saved on the days where distance workers work both at home and at the office. Furthermore our interviews showed that when working at home full days the spouse often take over the car for commuting purposes in which case there is no reduction in transportation in the category 'car as driver'

Even though technical problems in connection with the implementation of computers and other telecommunication facilities could explain the present relatively low frequency of days working at home, it seems that two to three days may be a too high estimate for the average of distance working at DTI. As mentioned we have used qualitative techniques to further explore the impact of a range of the psychological and sociological issues which have had an impact on the distance working behavior.

One of the main drawbacks of distance working claimed has been in relation to the notion of 'social isolation'. One claim is that it can be difficult for the distance worker to keep up to date in what is going on at the office in regard to social interactions of working life. At work it is possible easier to get to know your colleagues - what their interests and preoccupations are. In addition, distance workers are often excluded from engaging in informal social activities like 'birthday cake get-togethers' and canteen gossips and chats. As one of the employee told us:

"I don't think I'm going to use the opportunity to work at home in a massive scale. I like to be together with my colleagues. I kind of enjoy it working with all these people around me. Being at home too much I think I'll get bored".

Being isolated from work can be a major problem to some people. As humans we are in fact social animals. Being at work with our colleagues is often essential for maintaining self-confidence. If we lose confidence in ourselves, it is most likely that motivation for doing our job as well as our work performance will decrease. This

could be the beginning of a vicious circle. One way to avoid the feeling of social isolation is to have regular meetings at the workplace to ensure formal as well as more informal discussions about work, family life, project initiatives, the latest movie, changes in office policies, etc.

For the time being we, at the DTI Energy VISION, do not have regular meetings. This could be another reason why we have not used the opportunity to work from home as much as expected. On the other hand, as discussed in relation to the definition of distance working, the participants of the experiment are free to commute to work whenever they want. So far, our experience is that voluntariness is an important part of distance working so no one is forced into social isolation. In fact our findings indicate a work pattern where people work some early hours at home, travel to work and stay until mid-afternoon whereupon they travel back to home and finally work an hour or two during the evening.

Another major drawback often mentioned in relation to distance working is the notion of 'workoholism'. In some ways 'workoholism' forms a contrast to the notion of social isolation. 'Workoholism' is not a new phenomenon arisen with the opportunities to work at distance. But the immediate access to work through the information and communication technologies within an 'arm's length' at home seems to play a certain role in creating 'workoholics'.

Our observations show that one of the major strengths of distance working is flexibility according to when you want to work and when you do not. On the other hand, it can be difficult to distinguish between work and leisure. The problem is that the workplace is moved to your home and the computer with all its e-mail, facsimiles, Internet and other opportunities for carrying out work exactly as if you were at the traditional workplace is only a few seconds away. To some people it has been difficult to stay away from the computer - some times only to check for any new e-mail. As one of the participants of the experiment told us:

"It was not because I wanted to do any work at home, but I just wanted see if there was any e-mail for me. But having turned on the computer and received some new e-mails you might as well go on answering them. Now, in answering the mail you just need to get hold on some information in a document you have been working on lately. In doing so you find that some of the calculations included in the document need some refinements.....and suddenly you have spend hours working and your wife starts grumbling about."

Another of our findings related to 'workoholism' is that some people tend to work round the clock. That is, they tend to spread their working hours throughout day and night. There is no doubt that 'workoholism' in the long term could contribute to so-called 'burn-outs' and other related sufferings. In the short term there is no reason to think that 'workoholism' could be harmful. At present, we need more data to conclude if 'workoholism' is a de facto work pattern within our experimental group.

The last major social-psychological point we will discuss is the relation between family life, children, child-care, and distance working. One of the authors of this paper has been interviewed a number of times in relation to distance working. The journalists often want a photograph to go with their writings showing a cheerfully playing baby just next to the hard-working distance worker in front of his or hers personal computer. If there is no babies around the photograph should at least include some toys scattered around in the home office. The journalists try to sum the wildly

held view that distance working is particularly suitable for those with children to look after. Work and family-life can be reintegrated and the responsibilities of child-care reconciled with the needs and pleasures of work. There is no doubt that the possibility offers greater flexibility to those with child-care responsibilities. It is for example possible to take care of children when they are feeling ill. You can stay at home and look after the child during daytime and then when your spouse arrives from his or her work you can work through the late afternoon and the evening. Families with small children often mourn about the fact that they do not have enough time with their children. Using the opportunity of distance working it is possible to spend more hours with the children throughout the day.

Our study shows that it is of great advantage to be able to take care of your sick children during daytime and then 'pay for it' by having to work in the evening. On the other hand we have findings indicating that it is difficult to assume working full-time at home while caring for a young child at the same time. The problem is that you are at home physically, but not mentally. It can be difficult to take care of or play with a child while being deeply involved in solving intricate problems concerned with your work. So the possibility of working at home does not necessarily remove the need for other types of child-care arrangements.

The findings based on both quantitative and qualitative data indicate that there is a reduction of commuting time. To reduce travel time to and from work is one of the main motives for distance working for the employees involved in our experiment. Another finding is that the frequency of distance working tends to be lower than expected. The barriers presented in table 1 seem to be stronger than we predicted. We have looked at what we believe is the major social-psychological factors. In our experiment social isolation has a clearly negative effect on the frequency of distance working. The possibility of combining distance working with child-caring in case of childrens' illnesses has a positive effect. It is still too early to predict the influence of 'workoholism'. We certainly need to make further research into these intricate and often contradictory social-psychological motives and barriers for distance working.

In addition, further research into the following conditions is needed as they have not yet been sufficiently clarified. Therefore one of the next, and new, steps within studies of distance working is to shed more light on legal matters as working environment, security and insurance at home, taxation e.g. on computers and other telecommunication facilities at the distance worker's disposal at home. The overall thesis is that distance workers should have the same rights guaranteed by the company compared with employees who work full time at the company (this is for instance claimed by a Danish labor union).

The findings presented indicate that distance working reduces transportation though in a minor scale. In the next section we will put the findings into perspective. First we will take a look at international studies of the impact of distance working on transportation and the environment. After that we will discuss the potential for distance working in Denmark and relate it to the findings presented in this section.

1.2 Does it matter to transportation

Distance working is often seen as means for travel substitution in replacing commuting between home and work with telecommunication. A common hypothesis within transportation studies of distance working is that the combination of information technology and telecommunication is a natural substitute for passenger transportation: Digital traffic can replace vehicle traffic on the streets and highways of the transportation infrastructure (e.g. Niles, 1994). As mentioned many American researchers use this transportation-telecommunication-substitute approach when dealing with distance working. This is reflected in the term 'telecommuting' and some definitions of the term - cf. Mokhtarian's (1991) definition:

"The use of telecommunication to partially or completely replace the commute to and from work".

In a case study of 280 distance workers carried out by the Washington State government (cf. CADDET, 1995) it is concluded that distance working impacts energy consumption in three major areas: It generally saves transportation and office energy use, but increases home energy use. The estimated net energy savings were about 5,000 MJ (about 1,400 kWh) annually per distance worker - primarily due to a reduction in transportation (gasoline). All distance workers in the case study taken together saved about 6,460 round trips (30% reduction per distance worker compared with a non-distance worker), 372,970 kilometers (75% reduction), and about 35,200 liters of gas (50-60% reduction of the outlet of pollutants) per year.

Another hypothesis contrary to the above is that distance working in reality does not reduce transportation as much as claimed. American studies show that even though distance working actually reduces commuting between home and work, the use of other kinds of transportation (e.g. trips between home and shops) increases in stead. In a case study from California it was estimated that 6% of the labor force used distance working on average 1.2 days a week. Scaled to the whole of California this only resulted in 0.5% net transportation energy savings (cf. Mokhtarian, 1996). The U.S. Department of Transportation (1993) estimates that distance working in the year 2002 will reduce the total annual vehicle miles traveled by only approximately 1% below the level expected to be seen if there were no such thing as distance working. The U.S. Department of Energy (cf. Niles, 1994) calculates that the reduction in mileage is likely to be even less because of commuters moving further away from work and other travelers taking the road space vacated by distance workers.

Many surveys and estimations point to savings related to transportation as a result of introduction of distance working, but disagreement exists between researchers about to what extent these savings turn out to be. We find it important to point out that if we look upon one single distance worker, a big potential of savings exists on an average day, but when this saving is related to a total transportation energy saving, the potential is reduced considerably. In the below table, we have grouped arguments for the two above perspectives on the impact of distance working on transportation behavior.

<i>Main hypothesis: Information technology and telecommunication is a natural substitute for passenger transportation</i>	<i>Circumstances claimed to work against the hypothesis</i>
<ul style="list-style-type: none"> • Digital traffic replaces vehicle traffic as distance workers do not need to commute to work on those days they work at home. • A number of studies have proved actual reductions in passenger transportation as a result of the introduction of distance working. • One of the main motives for working at home among the DTI distance workers is to avoid transportation time/commuting. 	<ul style="list-style-type: none"> • Distance workers will move further away from work - commuting as much as they did before (traveling fewer days, but at a longer distance). • Distance workers may reduce commuting, but at the same time increase other kinds of transportation (e.g. trips to shops, friends/family, and sport activities). • Some days distance workers work both at home and at the primary office. • Other travelers will take the road space vacated by distance workers, e.g. when the wife (normally using her bike, the bus etc.) uses the car in stead of her home working husband. • Researchers claim that even proven results concerning reductions in passenger transportation have been misinterpreted and abused for commercial purposes (e.g. telecommunications corporations have a great interest in proving the public utility of distance working).

Table 3. The table summaries arguments for two different perspectives on how much distance working will impact transportation behavior/commuting. Sources: E.g. The DTI case study, 1996; U.S. Department of Transportation, 1993; Mokhtarian, 1996; Nilles, 1996; Telecommuting, 1992.

Now, it is not likely that the above American estimates can be directly transformed into European and Danish conditions among others because the average commuting distance in kilometers is much longer in the U.S. compared with Europe and especially Denmark.

Our calculations of the impact of distance working on transportation behavior in Denmark are based on information on transportation in 'car as driver' due to the fact that the majority (60%) of all kinds of transportation in Denmark can be traced back to this category and that transportation is not reduced if distance workers commute by public transport or in 'car as passenger'. The Danish Ministry of Transport (Trafikministeriet, 1996) estimates that the total commuting kilometers on an average day in Denmark totals 39.7 million kilometers, of which 23.3 million kilometers can be traced back to transportation in 'car as driver'. This corresponds to 36 commuting kilometers 'in car as driver' per Dane on an average day.

On the basis of the above information and definitions (7% of the total workforce working at home two to three days a week as an average), we have worked out that in

the year 2000 the total reduction of commuting in cars on a single distance working day accounts for about 2 million kilometers. Pr. working year this amounts to about 437 million kilometers. This corresponds to a reduction of 5.1% of the total annual commuting in cars in Denmark. Seen from another perspective the 5.1% totals 18.7 days of total commuting in the year 2000.

Our findings support the view that distance working does reduce transportation and saves energy. From an environmental perspective it is certainly worthwhile on a societal basis to support distance working.

It is though important to pay attention to the fact that the rapid development of telecommunication and information technology is not the only parameter to be taken into account when estimating the future spread of distance working. Through the DTI case study we have analyzed psychological and social parameters concerning working life which will influence the expansion of distance working in future.