Workplace location and travel effects from teleworking

Measuring business and commuting travel patterns

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Contents

Abstract

Travel time losses in the Netherlands are likely to get worse in the years ahead if capacity is not added to cope with the demand. This particularly creates problems for business travel, which is characterized by a high “value of time”. In the Netherlands, policy makers have a long-standing interest in telework as a means to reduce mobility and consequently the need to expand physical infrastructure. However, currently the knowledge about the influence of teleworking on work activity and physical travel is limited. But in this paper, a framework is given to identify these relationships in-depth, based on a literature review. This results in an approach to measure business and commuting travel patterns of teleworkers.

Keywords

Mobility, organisational development, working conditions

1 Introduction

1.1 Background

Since the invention of telephone by Alexander Graham Bell in 1876, telecommunications has become an essential component in shaping our economic and social developments. The most recent developments in Information and Communication Technology (ICT) have given rise to new levels of intensity and diversity in information and communication handling. Personal computers can be linked to one another through local or external networks. This "networking" allow workers to gather information from a vast array of outside resources (particularly the world-wide-web) and share it quickly with colleagues, outside business partners and customers. During the 1990s, we have experienced continued proliferation in ICT as more organisations become increasingly connected to these electronic networks. ICT may have arrived as a blessing for firms as it unleashes opportunities for them to redesign their business models, but at the same time, may also erode the traditional structure of the workplace paradigm. The objectives of the paper are to explore various concepts leading to the adoption of telework and also the effects on business and commuting travel due to teleworking. However, as the research study is still at its initial stage, a proposed research method to measure business and commuting travel patterns is discussed.

Telework (also known as e-work) has been around for more than 20 years. In some publications, telework and telecommuting are often used interchangeably. In general, the motives of telecommuters are mainly aimed at achieving travel-time savings, while teleworkers (which may include telecommuters) attempt to work in alternative workplaces. For our study, the definition of telework is:

"Work that requires physical proximity is being substituted by work that uses ICT with the aim of achieving similar results."

This means that there should be electronic connectivity between the workplace of the employee and the host (typically, the electronic network of the employer) and using this type form communication in order to qualify as telework activity. This includes the use of email, instant messaging, fax, telephone, web browser, teleconference, videoconference, etc).

2 Problem definition and conceptual framework

ICT is currently spreading rapidly into workplaces; it will not be too long before ICT becomes an integrated part of all work activities. According to a recent survey by Ecatt [2000], 30% of all establishments in Europe already practise regular telework (i.e. 36% for the Netherlands). Regular teleworkers are those who work less than 90% but more than one day per week at alternative workplaces [Ecatt, 2000]. Also cited in the report, the take up of telework occurs mainly in large organisations (i.e. 500 employees or more) in financial and business services sector. These developments may have consequences in terms of accommodation requirements as businesses may deploy employees to alternative workplaces and thus changing the workplace geography. It is also assumed that in the near future, there may be less need for new infrastructure due to less physical travel.

With respect to telework initiatives aimed at reducing congestion, most have proven unsuccessful. Notable initiatives include the "Fileverdunningsplan" (Traffic congestion reduction plan) in the Netherlands. The plan was aimed at reducing peak hour congestion around the motorways between Amsterdam, Utrecht and Den Haag. However, a feasibility study on the plan shows that although workers may switch to more flexi-work programs, it does not necessarily reduce traffic congestions [M&I, 1999].

According to Limburg [2002], telework changes the temporal-spatial structure of an organisation, and therefore has profound impact on daily routines. Indeed, the shift of work from employer premise to shared-office, home-office or other "teleworkable" workplaces may contribute to the diffusion of work activities away from employer premises. However, on the other hand, telework may also reinforce the stability of the traditional workplace. E.g., workers may become more static if business travel is substituted by the use of online messaging or videoconferencing. These ambiguous trends have indeed presented us with the challenge on how we can tackle this research problem.

Current studies in this field tend to emphasise technological change while underestimating the social implications, which determine the adoption of such technologies [Saloman, 1998]. They provide limited inference in causality and limited insights on how the adoption of telework may affect employee travel patterns. Furthermore, the ambiguous developments in workplace geography (i.e. concentration or diffusion) makes it difficult for us to predict if teleworkers in question are deviating from their standard commuting and business travel patterns. According to Button, present policies are formulated with imperfect broad aggregate trend analysis that hides important interactions at local level and within sectors [Button & Taylor, 2002]. The adoption of such policies is undesirable because the assumptions are general and may not reflect the reality of situations in different sectors of business. At this point of time, very little empirical evidence is available at a disaggregated level to show the impacts of telework on workplace geography and employee travel patterns in different job functions and business sectors.

As Patricia Mohktarian [1998] summarises it:

"Obtaining richer disaggregate data on communication activities presents some formidable measurement challenges. Nevertheless, they are challenges worth tackling, in return for improved insight into telecommunications – travel relationships which is sure to result".

For this study, instead of a pragmatic approach by design and intervention, it begins at fundamental stages of a research. Firstly, through a rigorous problem defining process followed by a diagnosis of the symptoms. This two-stage process will lead to the building of a more reliable and robust theory of the causal relationship between telework, workplace and travel.

2.1 Formulating research objectives

For formulating research objectives, we first defined the project context according to the research types. In *practice-oriented* research, the context concerns solving practical problems, creating new situations or instigating new developments. This type of research can be further broken down into five research processes: Problem finding, diagnosis, design, intervention and evaluation research. In *theory-oriented* research, the context concerns about solving a problem encountered in theory building process. Theory-developing research is often conducted when a new theory needs to be developed or when there are gaps in existing theory. In theory-testing research, existing theory is "almost" complete but further testing, adjustments and refinement are needed.

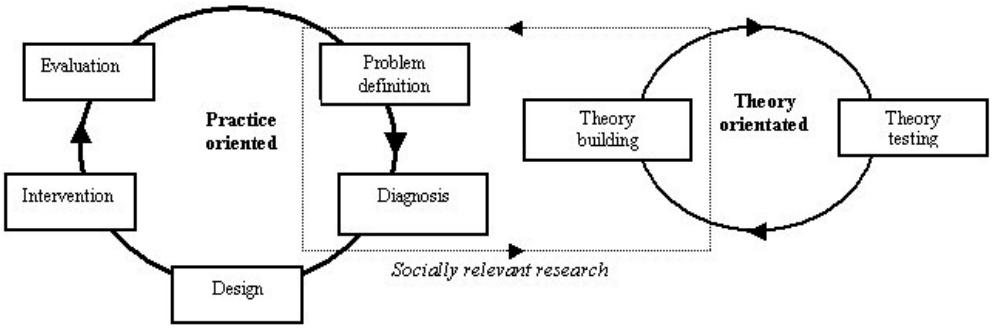

Figure 1: Scheme for defining the context of research process

Although scientists often make a distinction between conducting practice-oriented research and theory-oriented research [Leeuw, 1990], I have opted to iterate between the two types. This form of research may be classified under *socially relevant research*. The research falls between pure scientific research and applied research, which aims to deliver knowledge of a general kind (i.e. theory) but with explicit relevance to a practical problem (i.e. practice oriented). During the course of research, multiple cycles of "reflective thinking" are iterated between the practical situation and theory building process. The rationale behind the choice of doing socially relevant research is that although the goal is geared towards improving a practical situation, there are gaps in theory with regards to the relationship between telework, workplace and travel. Pragmatic approaches in solving the practical problem will be ineffective and unreliable.

Taking into account the time and resource constraints for the research project, three main research processes will form the nucleus of this study: *problem definition*, *diagnosis* and *theory building*. The advantage of such methodology is that the researcher is able to iteratively improve the understanding of practical problem and the theory-building process simultaneously. With that in mind and the establishment of the project context, the research objectives are formulated as follows:

1. To develop a theory on the relationships between teleworking alternatives, workplace location and physical travel.

2. To specify relationships empirically by measuring business travel patterns and workplace locations in relation to teleworking alternatives.

2.2 Conceptual framework

In the previous section, we have highlighted the research objectives and extent of the project context. The next logical step is the designing of the conceptual framework that can be used in order to realise our research objectives. This may include putting objects under certain boundaries and conditions. Although there are several methodologies available for formulating a research framework e.g. systems approach, I have chosen to use the causal model to illustrate the necessary steps needed before arriving at our objectives. Unlike other methods, the causal model provides concrete descriptions of the causes and effects, which makes the model more robust and reliable against changes of time. Indeed, these characteristics are in fact the basis for effective theory building.

Prior to arriving at the causal model (as shown in Figure 2), a large amount of literature was reviewed. From that experience, I have concluded that it is simply not productive to look into every aspects of telework in a broad scale. In order for the project to be manageable, I have applied some boundaries to the model. By isolating the effects of telework in an organisation from the external environment, we can differentiate the macro and micro forces acting on the phenomenon. By investigating micro effects, we can uncover rich sources of knowledge on how and why telework can lead to reorganisation of workplaces and travel patterns. Although the study itself is qualitative and in-depth in nature, the macro forces of social, economic and political components are taken into account as they directly or indirectly influence the behaviour of actors and stakeholders in organisations. For these reasons, quantitative data suggesting such influences may be useful for our research.

In the next few paragraphs, I will explain how the causal model was developed and why certain criteria are adopted. These criteria will be further explored in detail so that we have a greater understanding of the causes and effects that lead to the phenomenon we are investigating. In the course of explaining the model, references will be cited to support the arguments and knowledge that is missing will be highlighted.

From literature reviews, three dominant criteria are apparent for assessing the feasibility of telework in organisations. They are *corporate satisfaction*, *individual satisfaction* and the *quality of facilities* for telework. These criteria enable the

organisations to make choices among the assorted types of telework that can be implemented in the organisation.

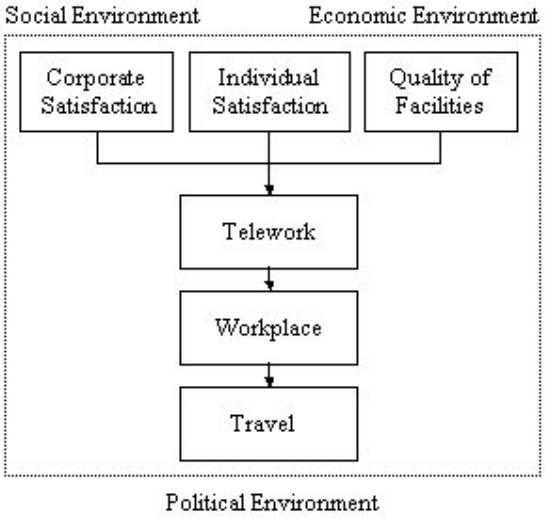

Figure 2: Causal model for the research project

2.2.1 Corporate satisfaction

For the last 10 years, organisations are forced to evolve quickly because of growing competition in today's customer-driven environment. Clients demand shorter delivery terms, higher quality and more customer-oriented products and services. In order to satisfy the needs of customers, organisations strive to improve the quality of *customer service* by integrating email, telephone, self-service application and personal face-to-face interactions so that customers have consistent support regardless of how customers interact with the company.

The firm can improve face-to-face support by repositioning service agents closer to their customers. However, this argument is based on the assumption that face-to-face meeting is a requirement for fulfilling 'good' customer service. Of course, it is also arguable that service can also be delivered by means of ICT (i.e. the use of telephone, video-conferencing, instant messaging, web browser etc). Indeed, online customer services are growing rapidly especially in the computer service sector. Computer software is becoming more interactive and user-friendly. Customers are able to communicate online with "virtual" technicians in real-time for fixing computer problems. From these examples, we can assume the choice between "face-to-face" and "online" delivery methods will depend on the nature of the tasks (whether they are ICT substitutable) and also to a large extent, the cultural background of the customer. Furthermore, through practical observations, the need for face-to-face meetings tends to increase as the value of business transactions becomes higher. Will firms deliver more "face-to-face" or "online" customer service in the near future? The answers however are not so straightforward as knowledge in this area is lacking.

In order to satisfy need for improved *organisational efficiency* within the firm, telework can be useful in solving business problems by decreased overhead costs (i.e. office space, parking space, travel expenses etc). In some reports, firms are able to

save as much as 50% of its office space costs by relocating employees to an alternative location. On the other hand, telework may reduce the need for relocations, with significant savings possible by not moving into urban agglomerations where real-estate costs may be higher.

The *productivity* of employees can be improved by raising the quality of their work life. Morale, motivation and job satisfaction are also improved as they manage their own time and assume greater responsibility for their own work. Furthermore, stress related to traffic congestions, train delays and continuous office interruptions are reduced. The costs of absenteeism are also lower as the result of better work-family life. With respect to solving human resource problems, telework can be used as a benefit to retain experienced employees who are demanding more flexible work time due to family commitments. Because of serious shortage of skilled labour not available locally, firms may resort to hiring workers from a distance. Furthermore, through telework, jobs can be created for workers with health and disabilities problems. To a certain extent, may also help solve some of their labour problems. However, it would be unrealistic to suggest that there are no barriers towards implementation of telework in organisations. Most of the concerns include data security problems, doubts as to productivity of teleworkers and how workers can be supervised.

From the above arguments, we can see from the employer's perspective, there are several reasons why telework can or cannot be used as an option to help solve business problems.

2.2.2 Individual satisfaction

The criteria for individual satisfaction are to a certain extent intertwined with corporate ones; however, it is still worth differentiating because the reasons pertaining individual satisfaction are mostly related to home, family commitments and individual desires. Being stuck in traffic congestion is considered *stressful*, undesirable and *lost of productive time*. This is perhaps one of the most important reasons why workers may attempt to use part of the loss time to perform productive tasks at an alternative workplaces. This "corrective" process may induce workers to avoid travelling at peak hours or avoid travelling altogether resulting in less commuting and business travel. Indeed, some studies have already suggested that people might seize the opportunity to become more *static* to reduce tiring and tedious journeys to work and for business travel [Vilhelmson & Thulin, 2000]. On the other hand, through practical observations, workers may still choose to travel despite of telework opportunities. Perhaps, this phenomenon can be explained by Yacov Zahavi's theory of travel time budget. He argued that people would always devote on average a constant fraction of their daily time to travel [Zahavi, 1979].

As workers spend more time working at employer premises due to increasing workload and commitments, the balance of work-family life may be disrupted. Telework provides the opportunity to increase the quality of work-family life by working at alternative workplaces where home responsibilities can be fulfilled more easily. (E.g., fetch children from school, go shopping etc). However, in terms of traffic effects, it may generate additional leisure traffic.

The desires of some workers to dissect from regular working times in order to achieve more autonomy and control over their work schedules may use telework as an option to accomplish this. As individuals may be more creative and productive in certain hours of the day or night, typical commuting patterns and standard working hours may restrict the freedom for them to start and stop when it suits them. However, this may apply only to certain back-office job functions such as desk research or web programming which may not require frequent physical interactions with colleagues, customers or suppliers.

2.2.3 Quality of facilities

The embedding of ICT into new ways of work (i.e. telework) will lead to a demand for better workplace facilities. Nowadays many firms recognise that links exist between accommodation, the layout of the workplace and ICT. Although the domain of facility management (FM) originally revolves around integration of buildings, interior design, maintenance, security and cleaning, recent trends have suggested that ICT support services are increasing integrated within FM to facilitate telework.

The diffusion of work activities to other alternative workplaces poses are challenge to managers on how the quality of these facilities can be maintained or made comparable to those in the employer premises. Recent trend suggest that work is being gradually performed partly or fully at home-offices, telecentres or even on public and private transport modes. Indeed, some leading firms (e.g. KPN Telecom and Deutsche Telecom) have laid down agreements on the necessary facilities in order for telework to be possible at other workplaces [KPN, 2000 & DT-TM, 1995].

The developments of “car-office” on roads are often over-hyped, although safety and security functions on the vehicle have been improved to assist car driving while the driver performs other tasks. Online traffic information can help improve driving behaviour and choices of routes so one can reduce travel time on roads. Business travellers who are dependent on their cars to do business will appreciate office connectivity such voice email messaging. However, the question is not if automotive telematics will happen, but when, how fast and what functions will become prevalent. [TRG, 2002].

2.2.4 Influence on workplace location

The embedding of telework activities into ‘normal’ work routines has definite consequences on where, when and how work is performed. To further explain what I mean by this, I have adapted Hagestrand’s time geography diagram for illustration [Hagerstrand, 1970]. The figure below shows a mobile teleworker performing work in three separate workplaces within a day.

In the morning, in order to avoid rush hour traffic on the roads, he teleworks from home by connecting his PC to employer network. In the late morning, he arrives at his office for meetings with his supervisors and colleagues. Via the company website, he responds to enquiries and requests from customers through emails and customer relationship management (CRM) software. In the afternoon, he travels to client’s office to seal an important business transaction. When he arrives at a client office, he

connects his laptop to the network and he retrieves up-to-date information prepared by his colleagues. If the customer requires additional information, he retrieves it instantly via the network.

From the above example, we can see that telework activities are performed at three separate workplaces. Other possible "teleworkable" workplaces may include telecentres, branch offices or even during journeys. Instead of driving a car or sitting in public transport, work can be performed during travel by using ICT, which can reduce the disutility of travelling [Dijst, 2001].

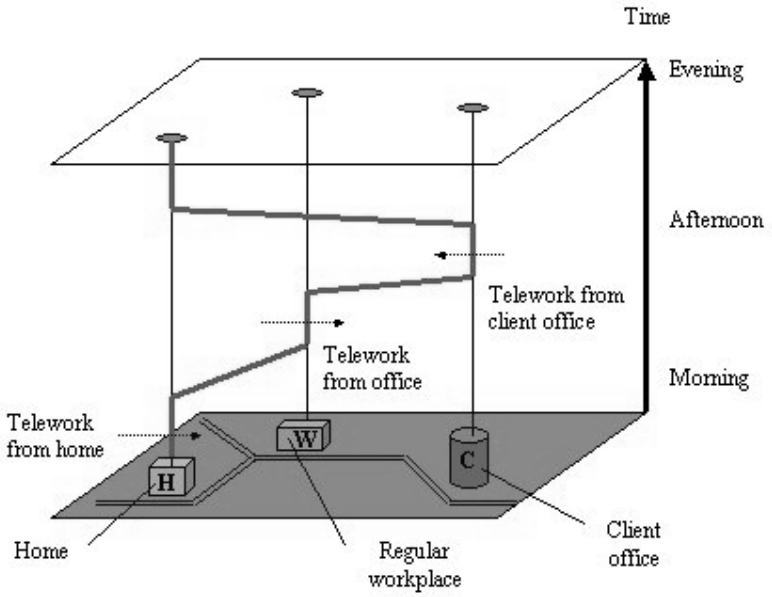

Figure 3: Adapted from Hagerstrand & Graham's time geography diagram

On a broader scale, there are two opposite perspectives on the effects of telework on spatial-economic development: *diffusion* or *concentration*. The use of ICT applications and infrastructures at first sight enable firms to become less place bound; diffusion effect. This means that the physical distance to customers, suppliers, and labour market becomes less important for the proper functioning of firms. On the other hand, urban agglomerations, with their established production structures, labour supply and physical and social infrastructures create externalities that may determine the location of ICT-related activities. Result is, further concentration. This theoretical tension between diffusion and concentration creates empirical questions concerning spatial-economic growth. How and to what extent does telework induce agglomeration or spatial diffusion of work activities?

2.2.5 Influence on travel pattern

To help better understand the relationship between telework and travel, researchers have found it useful to view telecommunication (or ICT) and travel as alternate modes of communication. As mentioned in a report by Mokhtarian [2000], communication can happen in three main modes:

- Face-to-face, involving passenger transportation

- Through the transfer of information objects (a book, letter, diskette, videotape), involving goods movement of some kind; or

- Through ICT or telecommunications (phone, fax, email, internet, videoconferencing etc.)

The effects on travel behaviour would be more apparent especially for teleworkers who spend substantial amount of their working time communicating with people. The question now is how far-reaching are they in using ICT to communicate? Do they still prefer face-to-face communication or the combination of various communication modes? The choice of communication modes is further complicated by the use of alternative workplaces as part of their strategy to satisfy individual and corporate demands as mentioned earlier. A study conducted in the Netherlands a few years ago has concluded that developments of ICT may not lead to a decrease in total demand for transportation but changes will lead to journeys being spread evenly over the day [KPMG-BEA, 1997].

We can see that identifying travel patterns of teleworkers is not as straightforward at first sight, but the modes of communication can be used as the starting point. Identifying groups of teleworkers who engage in frequent communication during the course of their work will provide us with the opportunity to study their travel behaviour. We can further segregate these groups into various categories: home-based, mobile-based and telecentre-based teleworkers

3 Research Method

It is assumed that in forthcoming years, the integration of ICT into work activities will play increasing role in shaping the new workplace geography. The potential complex outcome of workplace re-organisation and resulting travel pattern warrants an interpretative approach (Burrell & Morgan, 1979). Therefore, taking into account of this philosophical assumption and project context established earlier (in section 2.1), the following research questions are formulated in order to fulfil the research objectives:

- How does telework influence the use of workplaces? What are the trends with respect to the use of alternative workplaces? Are these trends stable in the long term?

- How does telework activities affect urban agglomerations? What are the trends in terms of the flow of work activities in urban agglomerations? (concentration or diffusion ?)

- What are the derived business and commuting travel patterns of teleworkers?

- What are the recommendations for future research directions with respect to the design of future transport infrastructures?

The research questions aim to examine the two main effects of teleworking (i.e. workplace and travel effects) in the causal chain (refer to section 2.2). In order to collect the required evidence, an *integrated approach* consisting three phases with various research instruments may be applied.

For phase 1, a sectoral survey particularly targeted on managers in the business services sector is conducted. Reasons for choosing this sector are as follows: In these establishments, the number of teleworkers is above average as compared to other sectors [ECATT, 2000]. Also, business trips generated in this sector are on average higher than others [KPMG-BEA, 1997]. Names of firms that have already implemented telework programmes can be found in various case study publications as well as from the Dutch Telework forum. Classification of business services sector can be retrieved under NACE codes, which may include financial intermediation, insurance, real estate agency, tax, legal, auditing, market research and business consulting activities [NACE, 2002].

Managers who are involved in implementing telework in their respective organisations will be requested to fill in a survey questionnaire. The survey questionnaire will enable us to pick up qualified teleworkers (as defined in project proposal) for further investigation. Therefore, questions asked would yield data such as the type of telework being practised, the use of alternative workplaces and the stability of telework practices in their organisations. In order to study the effects of telework on urban agglomeration, we need to make a distinction between urban and non-urban regions. This will enable us to identify whether work activities are moving away or remain concentrated in existing agglomerations. Although there are various criteria (such as economic, social, mental or morphological) in determining

urbanisation, we will adopt the most modern approach based on "networking". This approach is followed by the official spatial planning policy in the Netherlands. Here, a typical "urban concentration zones" (UCZ) emerge when a threshold value is set for intensity of the relationships between urban functions such as commuting, use of urban facilities, recreation etc. For this study, we will focus particularly on the UCZs of Randstad. This region has high transport relevance because of its chronic traffic congestion problems. In addition, business travellers travelling around this region may provide us with clues on how congestion can be avoided through intelligent use of workplaces and travel choices.

For phase 2, travel diary surveys are conducted on teleworkers who are being identified earlier from the sectoral survey (phase 1). Depending on the type of telework being practised, the selected group of teleworkers will be asked to fill in a one-week travel diary. This would reveal the actual business and commuting travel patterns as well as the workplace and residential locations of the workers.

In addition, the workplace and residential locations of workers can be mapped into separate cases according to three geographical distinctions. For example, in case A, the employer premises and employee homes are both located in UCZs of Randstad. In this case, three potential sets of travel patterns can be collected from three categories of teleworkers. (I.e. home-based, mobile-based, and centre-based).

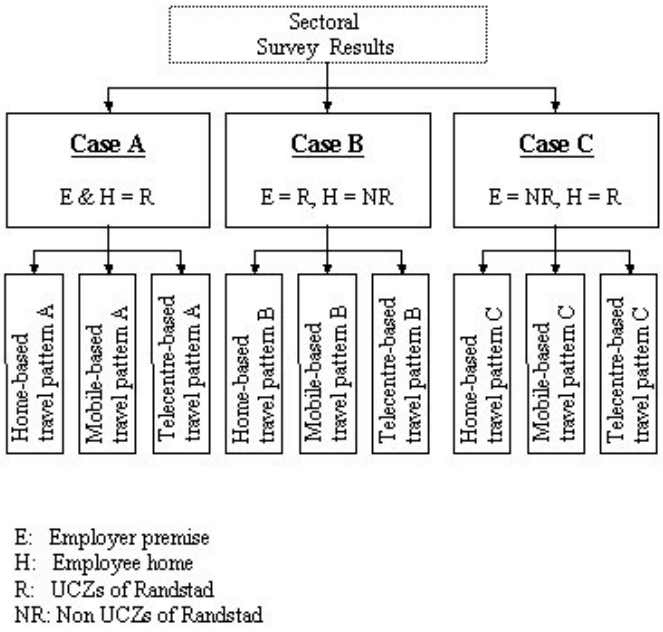

Figure 4: Sub-cases with geographical distinctions

Travel diaries as compared to other methods (such as stated preference methods) provide a more accurate and robust method of data collection although a lot of time is required to fill in the travel diary and may produce a lower respond rate. Therefore, it is our intention that the travel diaries do not take more than a week's data as noticeable degradation of data quality may occur due to respondent attrition and fatigue.

For phase 3, interviews with the teleworkers who have completed the travel diary will be conducted to reveal their motives of their workplace and travel choices. This will enable us to study the relationships between telework, workplace and travel and therefore developed a telework theory based on these cases. As compared to surveys in where respondents complete a questionnaire through post or online, interviews are completed by an interviewer based on what respondents say. This method allows control over who responds to the questionnaire and offers opportunity to persuade persons to answer open-ended questions, probe for more information or clarify a question or response to a question. These techniques are not possible in mailed surveys although we do recognise there may be bias and distortion of responses on the part of untrained interviewers.

Finally, cross-case conclusions are drawn from the separate cases to reveal similarities or contradictions so that theory could be developed before providing future research directions. Depending on the theory being developed, future research may be based on design-oriented approach so that existing transport infrastructure and services can be modified to accommodate new travel requirements of teleworkers. An overview of the research strategy is shown on Figure 5.

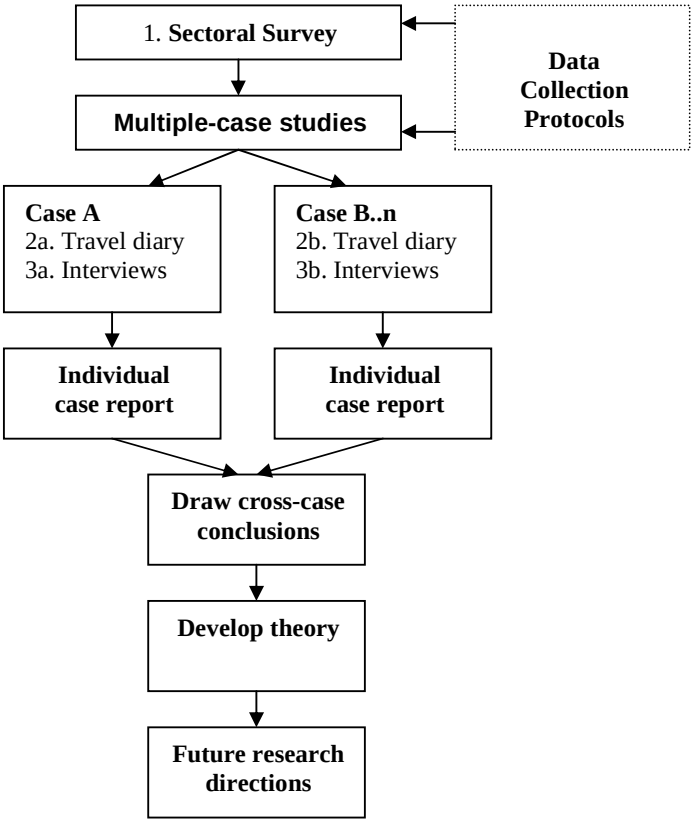

Figure 5: Overview of research strategy

4 Conclusion and discussion

In this paper, we tried to concentrate on development of the conceptual framework and methodology that can be used to measure business and commuting patterns of teleworkers. From the results, we seek to establish the relationship between telework, workplace and travel.

One conclusion is clear: Telework is here to stay, although the extent of telework is not as great as many analysts expected it. Nevertheless, continued proliferation in ICT has lead to more organisations become increasingly connected to the electronic networks and may further erode the structure of the traditional workplace paradigm. These developments will have consequences in terms of commercial space and transportation requirements when adopted in a large scale.

I have briefly argued that one of the reasons for the discrepancy between expected and observed effects of travel due to telework is the lack of knowledge about the relationship between telework, workplace and travel. Many researchers neglect to analyse thoroughly the causal effects that are needed to uncover important interactions at local level and within sectors. Therefore, I believe this integrated multiple case study approach consisting of survey, travel diary and interview is most appropriate for measuring the workplace geography and travel patterns of teleworkers at disaggregated level. From there, we can identify the vital causal relationships that are needed to build a robust theory that can be used for future design-oriented research studies for modifying existing transport infrastructure and services.

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