

## Article

# Telework as a Game-Changer for Sustainability? Transitions in Work, Workplace and Socio-Spatial Arrangements

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**Abstract:** The COVID-19 pandemic makes home-based telework commonplace and promotes a discussion about addressing mobility problems. Many studies focus on the relationship between the urban form at the place of residence and mode of transport or travel distance. Less attention has been paid to the spatial location of the workplace and its implications for mobility. In this article, we investigate these shifting patterns of work (places) from a socio-spatial mobility perspective. Companies in suburban areas are often characterised by limited access to public transport, cause accordingly high commuting volumes of car traffic and have a strong impact on mobility systems throughout whole regions. Anchored in a case study in Burgwedel, in the suburban area of Hannover, Germany, we analyse the impact and the potential of telework concerning workplaces and sustainable mobility. The data analysis is based on qualitative interviews with local employers ( $n = 10$ ) and a survey of employees in Burgwedel ( $n = 367$ ) during October–December 2021. We identify three groups of employees according to their abilities to implement telework defined by the nature of their job and their company’s culture. We show that teleworking can be a game-changer for sustainable mobility in cooperation with local companies.

**Keywords:** home-based telework; suburban area; sustainable mobility; companies



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## 1. Introduction—A Closer Look at Telework and Its Spatial Embeddedness

The world of labour is undergoing major changes [1]. With the processes of digitalisation, the possibilities to telework using ICT (information and communications technology) are increasing. Digital technologies promote the development of this location-independent work (at home, in the office and in other places). The International Labour Office (ILO) has classified teleworking in three modalities: regular home-based telework, highly mobile telework (“in several places regularly, with a high level of mobility”) and occasional telework (“in one or more places outside the employer’s premises only occasionally”) [2]. Especially the regular home-based telework has been intensified by the COVID-19 pandemic [1,3]. This has led to numerous studies on work-family balance [4–8], the relation to health and well-being of employees [9–11], productivity when teleworking [12], the adaption of teleworking by companies [13] or the readiness of homes for home-based teleworking [14]. In addition, the increasing number of teleworkers has also influenced the discussion about the role of teleworking for sustainable mobility [15]. The abovementioned studies show that, on the one side, teleworking can reduce commuting and therefore the carbon footprint of mobility [16–20]. On the other side, teleworkers travel longer distances, thereby offsetting the sustainable effect [21–24]. All of these studies connect teleworking only with large urban areas.

During the pandemic, the number of teleworkers grew from 11% in 2019 to 39% in April 2020 and 48% in June/July 2020 [18,25]. Despite the increase in home-based teleworkers during the pandemic, their socio-spatial characteristics remain largely the same. The social characteristics strongly correlating with home-based teleworking are

education level (74% of home-based teleworkers have a tertiary qualification), job sector (such as education, financial services and public administration) and gender (with a strong bias towards women) [18,26–28]. Additionally, the spatial characteristics of teleworkers remain the same as they were in the pre-pandemic period. The residential place of home-based teleworkers during the pandemic is primarily in urban areas of a city or a city suburb [25]. Furthermore, current studies show that the company's size (according to the annual average number of employees) plays a decisive role in the implementation of teleworking during the pandemic [3,8,18,28]. Although the employees in smaller companies (less than 50 employees) are more likely to telework [8], large companies (50 employees and more) are able to implement teleworking to a higher degree [3,28]. Along with this, important aspects for the adoption of teleworking during the pandemic were the type of business and having implementation support in the planning committee of the company [3]. The managers' ability to lead and coordinate remote teams highly influences whether teleworking is implemented and seen as a future option in the office [13].

The impact of teleworking on sustainable mobility is seen in a twofold manner in current publications: some studies show the positive effect of teleworking on sustainable mobility with a reduction in car use [15–17,19,29,30], others refer to increasing travel behaviour [22–24]. According to Beck et al., teleworking plays an important role in reducing commuting by car [16]. Thereby, the number of days worked from home is crucial, and therefore companies are interested in implementing teleworking. The study of Elldér confirms that part-time teleworkers make more trips than workers who do not telework [17]. However, he concludes that full-day teleworking affects mode choice and can cause a reduction in “travel demand” along with “more use of active transport modes, and congestion relief” [17]. Other researchers state that teleworking cannot reduce car travel [21,22]. Telework increases weekly miles of travel, while commuting weekly miles do not decrease [21]. The reason for this is the trend of teleworkers to live further from their workplace and this increases the tolerance for long-distance commuting [22–24]. Furthermore, teleworkers make more non-work related trips by car [21]. In sum, the research studies mentioned above focus merely on the impact of a teleworker's place of residence and its impact on car-use reduction [15]. An exception is, for instance, Budnitz et al., who confirm that teleworkers' travel behaviour depends on access to mixed-use areas and public transport networks [22]. The current discussion about teleworking is essentially associated with large urban areas [16,18,27]. These studies place less emphasis on the spatial location of workplaces, its local embeddedness, and its implications for mobility behaviour.

Especially in suburban and rural areas, the impact of telework on mobility behaviour is rarely addressed. Due to the suburbanisation and decentralization started in the 1930–1950s in Europe, many workplaces are situated in suburban and rural areas close to urban metropolises [31–33]. These workplaces (for example IKEA) are characterised by limited access to public transport, leading to the dominance of car use. Against this background, we investigate not only the transition of work by using ICT, but also the impact of workplaces on reducing commuting by car from a socio-spatial mobility perspective. The goal of the study is to analyze both social and spatial factors that can contribute to transitions of work and related mobility in suburban areas. The study took place at the time of the COVID-19 pandemic, which allows a comparison with other research from this period. Based on the goal of the study, the following research questions are outlined:

- What experience do companies in suburban areas have with telework?
- What groups of employees can be identified in these companies regarding possibilities to implement telework?
- What are the socio-spatial characteristics and commuting patterns of these groups of employees?
- To what extent can telework be a game-changer and contribute to traffic avoidance and eco-friendly transport use in suburban areas?

For this purpose, we introduce the topic with a definition of workplaces from a socio-spatial mobility perspective. In Section 2, the paper presents its methodology and materials:

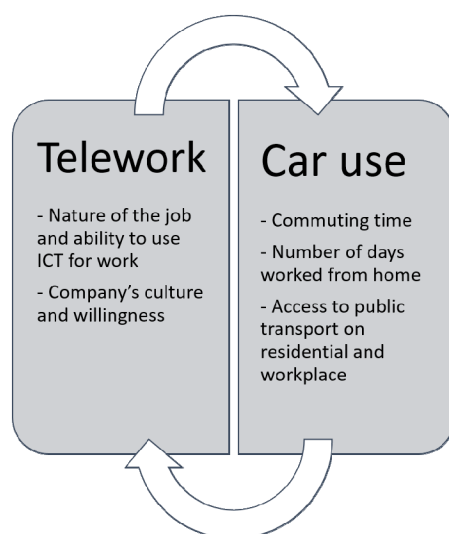
the framework to connect the potential of telework with sustainable mobility, the study area, and the data. Anchored in a case study in the suburban area of the Hannover region in Germany, Burgwedel, we illustrate the potentials and threats of telework as a game-changer for sustainable mobility transition in suburban areas, and the role of workplaces from a socio-spatial perspective in sustainable mobility and their future impact on companies in peripheral locations. Section 3 illustrates the results of the empirical study. Section 4 presents a discussion about the role of telework for sustainable mobility transitions in suburban areas.

## 2. Materials and Methods—Telework and Mobility in an Integrated View

### 2.1. Framework: From Telework to Sustainable Mobility

The study is based on Baruch and Nicholson's framework, which describes factors to explain the use of telework [34]. The factors here are "the individual", "the job", "the family and home" and "the organization". The individual factor is about personal qualities and needs, often connected with gender issues in the current research [3,27]. "The job" describes the job's nature, activities and ability to use ICT for work. This ability today links to the individual educational level [18,27]. The last factor, which links to the employees, is "the family and home". This factor connects to the quality of family relations (e.g., having children) and the availability of physical space for telework. The next factor represents the side of the employer. "The organization" illustrates the company's culture and the support of telework. The number of related studies has grown in the wake of the pandemic [3,8,18,28].

With a view to sustainable mobility, the effect of telework correlates with a reduction in travel [15–17,19]. In this paper, we describe this diminished commuting, along with car use, commuting time and access to public transport at places of residence and the workplace. To this end, we connect the topic of sustainable mobility with the factors that influence telework because of the nature of a job or a company's culture and use such factors as individual competences or family and home relations to describe these. Thus, the framework consists of relations between "telework" and "commuting" (Figure 1). To analyse this relation, we use a mixed-methods approach [35,36]: qualitative interviews with local employers and quantitative data from a survey of employees. Finally, we determine three groups of employees to study the commuting patterns: (1) teleworkers, (2) non-teleworkers because of the nature of the job and (3) non-teleworkers because of company's culture.



**Figure 1.** Framework: from telework to sustainable mobility (own illustration).

## 2.2. Case Study

The city of Burgwedel (20,369 inhabitants) is a city in the suburban area of the Hannover region [37] in the north of Germany. The unemployment rate in Burgwedel is very low, at 3.7% (in 2019), and the purchasing power of the residents is above average as well (purchasing power index per inhabitant: 124.8, average of the Hannover region: 103.1 [38]). As a result of prosperity, the city is characterized by a lack of affordable housing. The dispersed built environment is quite fragmented due to its historical development and the growth of single villages. In addition to the main town of Großburgwedel (9658 inhabitants), the communality of Burgwedel consists of six local districts [38]: Wettmar (3371 inhabitants), Kleinburgwedel (2414 inhabitants), Fuhrberg (2160 inhabitants), Thönse (1496 inhabitants), Engensen (1479 inhabitants) and Oldhorst (164 inhabitants). They are situated between 2 to 10 km from the main town.

Burgwedel is a city of commuters, which is one of the main reasons for the high volume of traffic. In 2019, 7649 workers commuted to Burgwedel, whereas 5346 people commuted out of the communality [37]. The reason for the high commuting rate is the large number of companies in the city, together with a shortage of affordable housing. Two central work locations in Burgwedel are Großburgwedel and Kleinburgwedel. While Großburgwedel is the location of leading national and international companies such as IKEA, Rossmann, Fiege and Kind, the industrial estate in Kleinburgwedel has grown over the years. In the summer of 2020, the city of Burgwedel as a commercial location was home to more than 1500 registered companies. Two-thirds of the commercial areas will be expanded within the next few years, partly to expand existing businesses, but also by establishing newcomers. According to the city administration, more than 400 new employees will be hired in Burgwedel by 2023.

Concerning the mobility system, Burgwedel provides good access to the regional road network (Autobahn) and at the same time limited access to the public transport system. The low frequency of local trains (hourly) and bus lines and the peripheral location of the train station are characteristic of public transport in the suburban city. Access by bicycle is possible, but not attractive. There is a lack of infrastructure (cycle lanes, parking spaces, etc.) in the local districts of the city. The lack of public transport connections between local districts of Burgwedel is a major challenge for the employees, especially for the direct connections between companies, commercial areas and the train station. This explains the high percentage of car use and a strong dependency on this mode of travel with typical challenges: local companies under parking pressure on their properties, traffic jams at rush hours, influences on regional and local trips and the poor accessibility of companies for people without a car.

## 2.3. Data

### 2.3.1. Data Collection

The basis of the data is structured interviews with local companies ( $n = 10$ , conducted in October 2021), and an employee survey in Burgwedel ( $n = 367$ , duration November–December 2021, Supplementary Materials available). The research design of the empirical study consists of two main thematic blocks: work organisation and mobility patterns of employees.

In October 2021, we conducted 10 interviews with leaders of local companies of different sizes according to the annual average number of employees (Table A1). Five were headquarters of large European companies (with more than 300 employees); four were medium-sized (with 50–200 employees), and one was small (with less than 10 employees). In the one-hour interviews with the leaders, we elaborated on the organisation and digitalization of work, the company's culture, mobility of employees and important spatial relations in Burgwedel, as well as alternatives to car usage. These interviews serve to understand future transitions of work, the potential of teleworking and the current threats of being located in a suburban, peripheral area. Subsequently, the interviews were transcribed and coded.

Based on experiences from the interviews, we developed an online survey addressing employees living in the city of Burgwedel. The questionnaire consisted of three thematic sections and personal information to get further insights on work organization, commuting behaviour and spatial relations, like the role and connection to the train station or the inner city of Burgwedel. The online survey has not been publicly available and was distributed by the companies themselves. We contacted all companies registered in the regional company board in Burgwedel ( $n = 263$ ) via e-mail to invite them to participate in the survey and to share the online link with their employees. After six weeks, 367 employees of 28 companies participated in the survey.

### 2.3.2. Data Analysis

The coding of the interviews led to a systematically structured dataset [39] (p. 103). First, based on the interview questions, deductive content code sets were determined (Figure A1). These were: the future of work, digitalization, telework, everyday means of transport and obstacles and solutions in the field of mobility. Subsequently, the following inductive codes were added: younger generation, location constraints (e.g., location of the railway station, access to public transport, expensive housing), supporting telework and shortage of skilled workers. After coding, the expressions were compared with regard to importance (e.g., a shortage of skilled workers despite automation), theoretical interest (e.g., a younger generation lacking interest in owning a car) and empirical frequency (e.g., the positive evaluation of car use).

The quantitative data have been prepared and cleaned from invalid datasets. From 367 questionnaires, 325 were suitable for further analysis. The data were cleaned in three steps by: (1) identification of incorrect or corrupt data, (2) verification the accuracy of the data and (3) revision for duplicate data. The statistical data analysis consisted of two components. First, descriptive statistics were conducted. Here, frequency analyses were carried out on the socio-spatial characteristics of the employees and on their commuting patterns. Secondly, the concluding statistics were calculated based on the results from the descriptive statistics. Because the variables were mostly categorical, we used cross-tabulations to describe their interrelationships. The focus here is on the three groups of employees: (1) part-time teleworkers; (2) non-teleworkers, because of the nature of the job, and (3) non-teleworkers, because of their company's culture, which are described with socio-spatial characteristics and transport use. For further interpretation of the quantitative data, the interviews with leaders of local companies play a major role.

## 3. Results

### 3.1. Companies' Challenges and Experiences

#### 3.1.1. Companies' Challenges in Suburban Areas

The interviews with the companies' leaders exemplified that the peripheral location and poor public transport connections influence their companies substantially, as seven out of ten companies stated. It is difficult to remain attractive for workers because *"we [ ... ] are not exactly so accessible for people here that you would actually have to think about [something] to get skilled workers"* (in. 8). The increasing automation turns out to be a solution as such for the problem of the shortage of skilled workers. Only half of the interviewed companies focus on automation. It turns out, that in these companies different aspects show that automation alone will not lead to less employees in all cases and that it will be used mainly as a supplement: *"So in the administrative area, I can imagine it, in the nursing area rather not and also not in the medical area. We have a shortage of skilled workers, and this will probably not be solved by then, so it would be good for me to be able to keep the staff that is there now, and also have appropriate assistance systems"* (in. 1).

The younger urban generation in particular is more often not interested in owning a car, which means that they are even more dependent on public transport. The medium-sized and large companies in particular have problems keeping people because of their company's location and the often less attractive public transport options: *"In the evening,*

*they wait endlessly for the bus to get to the train station and the train comes only once an hour [that is not optimal], we then try to make many people an offer to work for us” (in. 6). Currently, the experiences of the large companies with new mobility offers are scarce and rather negative: “we once had a leasing offer for e-bikes here, that was not good at all [ . . . ] that the leased bikes then did not come back, that you have to go to court to get an e-bike out again [ . . . ] that was really not ideal” (in. 9).*

### 3.1.2. Company’s Experiences with Telework

Most leaders of the medium-sized and large companies said that the “*pandemic has moved a lot forward*” (in. 3) regarding telework. However, their position towards the future of telework is ambiguous. Some leaders of local companies state that the experiences, especially in certain areas of work (e.g., in the administrative or training areas) are positive. They have seen that telework can offer a better work-life balance and many employees are highly willing to work from home. Companies in Burgwedel see great potential in telework. Despite locational disadvantages, they can attract skilled workers, especially younger ones from technical professions: “*technical professions are all hard to get, and if you can say to them: mobility is a bit different here, but you can telework, you can come one day a week, [then it can work]*” (in. 3).

For the majority of companies, telework is an ongoing exception despite positive experiences. They find digital work also in the administrative job sector “*critical*” (in. 9) and state that “*actually, working in person is simply better*” (in. 8). These companies claim that telework is a “*disadvantage for the company*” and “*not requested by the General Board*” (in. 9). Even in the pandemic period, telework was not supported here: “*everyone has to work from home [ . . . ] we didn’t actually do that, so we had a pandemic protection concept here*” (in. 9). The companies argue that for some work phases, such as price negotiations, personal consultation or initial meetings, digital formats are not suitable. With regard to traffic avoidance, telework is also viewed critically by these companies: “*I consider working on mobility solutions rather more important than trying to avoid mobility*” (in. 2).

It is obvious that telework is only possible in certain job sectors such as administration, communication or IT. Even then, almost all interviewed companies in Burgwedel are facing major challenges: There is a lack of technical and organisational conditions and “*no universally valid set of rules*” (in. 9) with a view to safety at work and the security of data. The missing digitalisation of systems, documents and data does not facilitate telework in some large companies in Burgwedel either. In any case, employees need mobile equipment and possibilities for cloud solutions. The companies underline that telework will only be possible if “*everyone just has the laptop at his/her hand*” (in. 3). The lack of managers’ ability to lead and coordinate remote teams is mentioned as the most important point. This influences social integration, because all employees should have the feeling that “*they are still part of the team and not just working alone*” (in. 3). New requirements for communication is one of the most difficult challenges for the companies in Burgwedel, as they perceive a loss of efficiency: “*if you work office to office, then you can also act faster [...] e-mail traffic is always tedious*” (in. 5).

### 3.2. Three Groups of Employees and Their Socio-Spatial Profiles

As shown in Table 1, approximately 50% of the 325 people surveyed are female, and 56% of them are between the ages of 26 and 50. A total of 59% of the employees work in administration, which is the most frequently mentioned sector; 19% work in production areas and 16% work in sales and public relations. Most of them work in a company with more than 100 employees (64%). About 68%, the majority of respondents, commute to Burgwedel: about 30% from the Hannover region, 20% from a district outside the Hannover region and 18% from the city of Hannover. About 32% of the respondents live directly in Burgwedel, with 46% of them living in the district of Großburgwedel. More than 80% work in Großburgwedel and about 15% in Kleinburgwedel, while the remaining 5% work in other districts of the town.

**Table 1.** Socio-spatial profiles of employees.

Socio-Economic Profile		(1) Teleworkers *	(2) Non-Teleworkers Because of the Nature of the Job	(3) Non-Teleworkers Because of Company's Culture	Total
Age:	until 25	11%	18%	23%	16%
	26–50	63%	45%	63%	56%
	from 51	26%	37%	13%	28%
Gender:	female	56%	41%	57%	50%
	male	42%	59%	42%	49%
	divers	2%	-	1%	1%
Education **:	Level 1	30%	35%	32%	10%
	Level 2	30%	39%	46%	60%
	Level 3	40%	26%	22%	30%
Job's nature:	Administration, IT	87%	41%	45%	59%
	Sale, PR	6%	16%	35%	16%
	Production	4%	34%	17%	19%
	Care, gastronomy	3%	9%	3%	6%
Residential place:	City of Burgwedel	27%	41%	26%	32%
	City of Hanover	25%	14%	14%	18%
	Hanover Region	23%	31%	37%	30%
	Outside the Hannover Region	25%	14%	23%	20%
Total:		39%	41%	20%	100%

\* Full-time and part-time teleworkers. \*\* Explanation of education levels in Table A2.

A total of 39% of respondents telework from time to time. This is in line with the German average, where 32% of employees worked from home in May–June 2020 [40]. Both the nationwide survey and the survey in Burgwedel took place at the time of the COVID-19 pandemic, which allows for their comparability. Thereby 5% are full-time home-based teleworkers. Most employees telework 1–3 days per week (56%). 23% telework 1–3 days per month and 16% less than monthly. 60% of teleworkers could imagine working in a coworking space in their residence place. About 41% of the respondents, on the other hand, perform a job that cannot be done from home, which applies to the areas of production, for instance. The last group of employees examined in this paper are employees who cannot telework because of their company's culture. They represent 20% of the respondents.

The socio-spatial profile of home-based teleworkers in Burgwedel (39% of employees) reflect the characteristic composition found in discussions in the literature. A total of 40% of the home-based teleworkers have a tertiary qualification. Compared to non-teleworkers, that is close to twice as many employees with a higher educational level. Most of the teleworkers (87%) work in the administration sector or IT (Table 1). There are also slightly more women than men who work at home. The residential places of teleworkers here are not necessarily located in urban areas: 25% of teleworkers live in the city of Hannover and 50% in the Hannover region (Burgwedel included). However, these data illustrate urbanity to a limited extent. In the group who are non-teleworkers because of their company's culture, we see the potential to telework on the basis of the nature of their job. A total of 45% of employees here work in the administrative or IT sectors (Table 1). Regarding the age of the employees, there is an opportunity to increase companies' attractiveness in suburban areas for the younger generation through telework. For example, in the group who are non-teleworking employees due to their company's culture, 23% are younger than 25. Furthermore, only 56% of teleworkers work from home on a weekly basis. Here lies a potential to create opportunities to telework more often and avoid travel to work.

### 3.3. Three Groups of Employees and Their Commuting Patterns

Almost 86% of employees use the car as one of their means of transport for commuting. Around 60% drive to work by car (Table 2). The bicycle is the second most used means

of transport for commuting in Burgwedel: 31% cycle to work along with other means of transport, 3% commute only by bicycle. The bicycle infrastructure, especially outside the local districts, is rated positively by 74% of employees. Furthermore, 20% of the employees use a combination of car and bicycle for their travels, not necessarily in direct combination but on a day by day basis. Only 8% of employees use the train for parts of their commute. On average, the commuting distances are rather short, as most of the respondents come from the immediate area. A total of 41% of the respondents travel no more than 15 min, of which 42% only use a car. About 31% of the respondents live at a distance of 15 to 30 min from their place of work, which means that a total of about 72% commute no more than half an hour (Table 2).

**Table 2.** Commuting patterns of employees.

Commuting Patterns		(1) Teleworkers *	(2) Non-Teleworkers Because of the Nature of the Job	(3) Non-Teleworkers Because of Company's Culture	Total
Car use:	Only car	61%	55%	65%	60%
	Car or bicycle	12%	21%	23%	20%
Commuting time:	Not more than 15 min	28%	50%	40%	41%
	15–30 min	34%	31%	29%	31%
	30–60 min and more	38%	19%	31%	28%
Distance ** from home to train stop:	Not more than 15 min	43%	36%	26%	37%
	15–30 min	26%	29%	37%	29%
	30–60 min and more	31%	35%	37%	34%
Distance ** from home to bus stop:	Not more than 15 min	95%	96%	91%	95%
	15–30 min	3%	3%	7%	4%
	30–60 min and more	2%	1%	2%	1%
Total:		39%	41%	20%	100%

\* Part-time teleworkers. \*\* Walking distance.

The quite good access to public transport at the residential places of the employees offers a great potential for climate-friendly mobility behaviour. Some 37% of the respondents need no more than 15 min to reach the next train stop, while 95% can even reach a bus stop in the same time (Table 2). The connection by bus can thus represent an alternative—contingent on the frequency and attractiveness of the offer. Despite the relatively good access to local public transport at residential places of employees, it is hardly used for commuting. About 54% of the respondents name a lack of public transport as the biggest transport problem at the workplace in Burgwedel, which can be seen as one of the reasons why employees currently prefer to use their own cars.

In accordance with the results above, we see potential for car-use reduction for commuting at certain points. Firstly, the number of telework days by part-time teleworkers is significant. Following Büttner and Breitzkreuz [41], extending telework days by one more day would lead to a 5% CO<sub>2</sub> saving by reducing traffic volume (if leisure routes are kept the same). Two extra telework days result in 11% CO<sub>2</sub> emissions savings. This means that companies should support telework on more days per week to reduce emissions. Secondly, those who are non-teleworkers because of their company's culture are an important focus group for car-use reduction. In Burgwedel, this represents 20% of all surveyed employees (Table 2). Supporting the managers' ability to lead and coordinate remote teams can help companies to increase the number of teleworkers. Lastly, the data show that 41% of commuting distances are short (less than 15 min; Table 2). This offers the potential to use bicycles for commuting. Supporting bicycle use by companies and further development of the bicycle infrastructure by the city and region can contribute to reducing car use for commuting.

#### 4. Discussion

The findings show major transitions in work as well as the potential for telework in suburban areas. The experiences of companies in suburban areas with telework are manifold and evaluated differently from the employers' side. The pandemic has contributed to the increase in telework in Burgwedel's companies. However, most companies are critical regarding digital forms of work even in the administrative sector, although they have not had many negative experiences. The major obstacles that companies face on the way to telework are a lack of technical and organisational arrangements and a need to lead and coordinate remote teams. Telework can certainly be an essential tool for those companies with poor access to public transport. It can help to attract new workers for medium-size and large companies, especially younger people in technical professions. This group of workers usually has no interest in owning and driving a car on a daily basis. The company's culture plays a major role for telework. The possibility for the development of telework among employees with digitally based working practices depends on the management and aspirations of digital change in the company's culture.

We identified three groups of employees according to their abilities to implement telework defined by the nature of their job and company's culture from the literature: teleworkers, those who are non-teleworkers because of the nature of the job and those who are non-teleworkers because of their company's culture. The data show that 39% of employees in Burgwedel telework from time to time. Most of the teleworkers (87%) work in the administration sector or IT. A total of 40% have a tertiary qualification. These results reflect the current scientific discussion about home-based telework. A total of 41% cannot telework because of the nature of the job and 20% because of their company's culture. Regarding the relation of these groups of employees to sustainable mobility transitions, teleworkers already contribute to avoiding travel (by telework) and to switching to more sustainable modes of travel, whereas non-teleworkers only contribute to the latter. From a planning perspective, those who are non-teleworkers because of their company's culture illustrate high future potential for increasing telework and therefore car-use reduction. A quantity of 45% of these non-teleworkers work in digitally based sectors such as administration or IT. At the same time, more than half of them (65%) commute by car. Another finding is that the commuting patterns of respondents are characterized by short distances. About 72% have a commute of less than half an hour. There is particular potential among those who are non-teleworkers because of the nature of their job. Fifty percent of these employees commute no more than 15 min. Support for bicycle use and the promotion of regional and local bicycle infrastructure can certainly lead to car-use reduction.

#### 5. Conclusions

This study shows that teleworking might be a game-changer for sustainable mobility, depending on how local companies accept these forms of distance work. Therefore, the game-changing factor today more closely resembles the potential of telework and not yet its already-existing advantages. With a view to Baruch and Nicholson's framework, "the organization" is the key factor influencing telework in this study. Those who are non-teleworkers because of their company's culture are the important focus group to address. With the support of companies in addressing digital working culture, we report a potential for 59% of employees in Burgwedel to allow a reduction in car traffic through telework. Also central to the debate are part-time teleworkers. Only 5% of all teleworkers are full-time home-based teleworkers in this study. A total of 56% of employees telework 1–3 days per week; others 1–3 days per month or less than monthly. Two extra telework days result in 11% CO<sub>2</sub> emissions savings. Increasing the number of days worked from home will certainly have a positive effect on traffic reduction. The location-specific data are a main limitation of this study. However, the exemplary socio-spatial analysis of suburban areas could help to understand regional differences between cities in suburban areas and to use these findings for sustainable mobility transitions. Burgwedel is the home

of many leading national and international companies' headquarters, a crucial prerequisite to understanding the high amount of work commuting especially. Nevertheless, such suburban areas serving not only as housing locations but also workplaces in the regional scale can be found in nearly every metropolitan area—as such Burgwedel serves as role model for other, similar cities.

Additionally, the role of companies in supporting, enabling and fostering telework is not to be underestimated. Digitalisation and its influence on a company's culture is not yet to be foreseen, not only regarding digital work, but also all other areas of concern (data and data availability, new leadership, etc.). A shift in traditional approaches might be necessary to get access to qualified employees in peripheral locations in the future. A strong cooperation of companies with the city and on a regional level could then be helpful as a precondition for the implementation of new local workplaces such as coworking spaces located close to employees' places of residence. Coworking spaces have the potential to manage current vulnerabilities on the way to everyday mobile work. Working in a well-managed coworking space can contribute to digital and smart solutions and innovations, regarding technical equipment, social integration and employees' productivity in a stimulating environment. Coworking spaces located close to employees' places of residence also help to reduce travels and contribute to the objective of a "15-min city" for sustainable cities where all residents can meet their daily needs within a short walking or cycling trip from their home.

This leads to a discussion where telework is not only considered as a potential game changer for sustainable mobility, but further, as a game changer for a sustainable way of life and environment. Following up on the challenges more rural areas are facing especially, the shift of where people live their lives plays a major role for these cities. Telework has the potential not only to decrease traffic and travel, but with more time spent in these areas, they can become points of social exchange and social life again—with shopping facilities, cultural offers or simply places to exchange and meet. The potential of these changes and what this entails when fostered in a community sense has not been part of any investigation yet—but remains necessary to consider when discussing a game changing experience.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://mobil-ans-werk.de/> (accessed on 31 May 2022, German).

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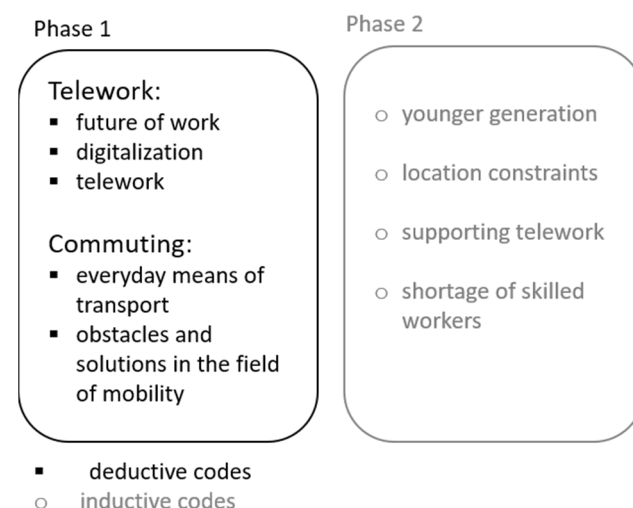
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## Appendix A

**Table A1.** Overview of interviews with leaders of local companies in Burgwedel.

Number of Interview	Employee Numbers	Interview Date
Interview 1	more than 300 employees	11 October 2021
Interview 2	more than 300 employees	11 October 2021
Interview 3 <sup>1</sup>	50–200 employees	11 October 2021
Interview 4	50–200 employees	12 October 2021
Interview 5	less than 10 employees	12 October 2021
Interview 6	more than 300 employees	12 October 2021
Interview 7	50–200 employees	13 October 2021
Interview 8	50–200 employees	13 October 2021
Interview 9	more than 300 employees	13 October 2021
Interview 10	more than 300 employees	29 October 2021

<sup>1</sup> Interview with three leaders of the company.



**Figure A1.** Phases of coding of the interviews.

**Table A2.** Education levels <sup>1</sup>.

Education Levels	Title 2
Level 1: Basic	Primary education Lower secondary education
Level 2: Intermediate	Upper secondary education Post-secondary non-tertiary education
Level 3: Advanced	Short-cycle tertiary education Bachelor's or equivalent level Master's or equivalent level Doctoral or equivalent level

<sup>1</sup> Level distribution is based on International Standard Classification of Education (ISCED).

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