



Climate protection potentials of the use of Video conferencing and when working from home

Results of a representative survey of business travellers

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Imprint

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Project

Climate Protection Potentials of the Digital Transformation: Micro- and Macroeconomic Evidence on the Role of Demand Effects and Production Shifts in the Use of ICT (CliDiTrans)

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1 Summary

Due to travel restrictions during the Corona lockdown in spring 2020 and the compelling need for physical distancing, many business appointments had to be consistently cancelled. By mid-March 2020, many organisations were forced to consider alternative concepts for working at a distance, and video conferencing continues to dominate business meetings in the winter of 2020/2021. As part of the project "Climate Protection Potentials of Digital Transformation (CliDiTRans)", the Borderstep Institute conducted a survey focusing on business travellers. In the first half of November 2020, 500 German business travellers who had taken at least one business trip in 2019 were surveyed online about their views on video conferencing and when working in the 'home office'.

Video conferencing and working from home became the norm during this period, at least for managerial employees. While 68 % of respondents had little or no experience of using video conferencing by the beginning of 2020, this figure had fallen to 27 % by November 2020. Over 60 % of respondents now conduct video conferences at least two days a week. The situation is similar for working from home. At the beginning of 2020, 64 % of respondents still had little or no working from home experience; in November 2020, this figure has also dropped to 27 %. 67 % of respondents worked from home at least two days a week in November.

The results show that there is a group of users who are extremely satisfied with both video conferencing and working from home. The satisfied ones see considerable future possibilities of use for both videoconferencing and working from home and consider the disadvantages to be far less detrimental than the majority, which remains rather dissatisfied in some aspects.

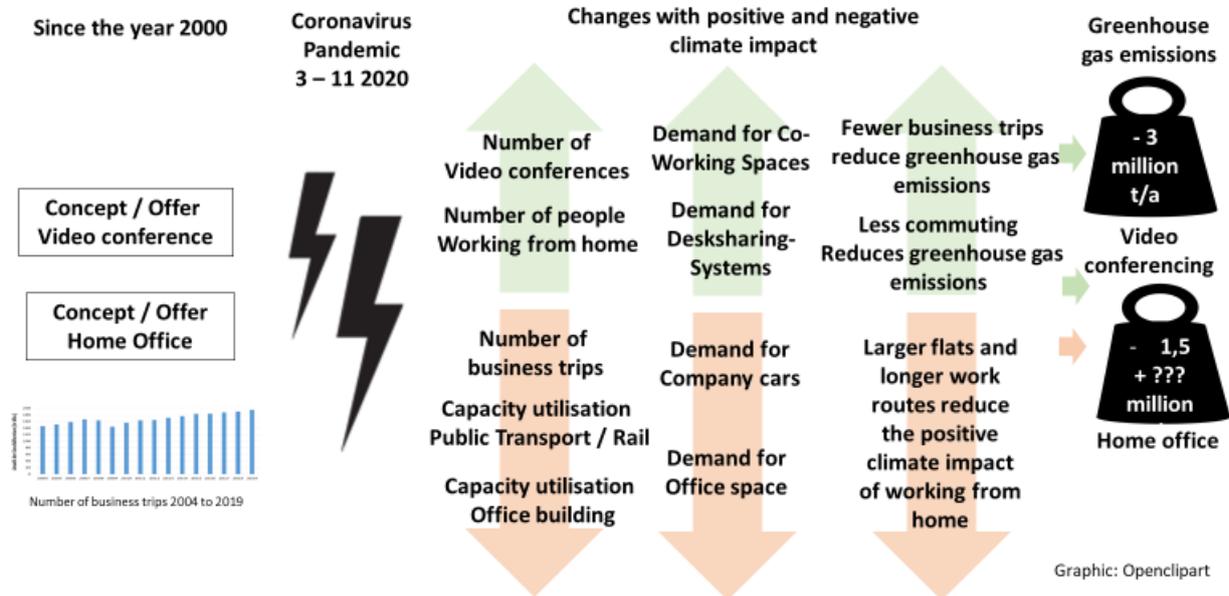
For all respondents, a central advantage of both video conferences (instead of business trips) and working from home (instead of travelling to the office) lies in time savings. These lead to significantly more free time as well as a gain in available working time. In addition to the gain in time, even the majority of those who were more dissatisfied overall also experienced a better work-life balance as a result of working from home. This can be attributed to the increased flexibility in distributing working time throughout the day, making it easier to balance work, household work and family. Interaction with colleagues as well as the team spirit is experienced as worse or even much worse, especially by the group of dissatisfied employees. Regarding external contact with customers or other external parties, 43 % of those surveyed said that contact was worse and 32 % of those in sales complained about poorer sales success. This contrasts with 16 % who point to even better sales success online.

If, as expected by the respondents, the changes in business travel behaviour are maintained proportionally after the pandemic and no significant climate-relevant rebound effects occur, there could be a permanent reduction of 28 % in rail traffic, 35 % in car traffic and 22 % in air traffic. A reduction in greenhouse gas emissions from business travel of approx. 3 million t CO₂eq/year can then be expected. The share of passenger cars in the total distance travelled in Germany would decrease by almost 9 billion km. With an average mileage of just over 13,000 km per car documented by the German Federal Motor Transport Authority, this corresponds to the total mileage of just under 700,000 cars.

The total commuting distance in Germany could be reduced by 8.1 % from 197 billion km to 181 billion km through additional work from home days, but at the same time the modal split could change to the detriment of rail and public transport. The two effects of reduction of distance and changed modal split could together lead to a reduction in greenhouse gas emissions from commuting in Germany of about 1.5 million t CO₂eq/year. This figure represents the saved effort for travelling to work. In order to assess the validity of this savings expectation, it is necessary to gain additional knowledge on a number of possible re-bounce effects and supporting effects. Such effects could be:

- necessary additional journeys that used to be done during commuting,
- a possible additional expense for heating the office at home,
- renting larger flats in the medium term to have space for the home office,
- choosing a place of residence further away from the workplace, as commuting distance becomes less important,
- the possible medium-term savings of providing (heated) office space by the employer.

Figure 1: Effects of the spread of videoconferencing and working from home



Source: Borderstep Institute

Overall, this study shows that the impetus from the Coronavirus pandemic has led to a significantly accelerated diffusion of working from home and video conferencing. This will lead to a reduced need for office space (outside of homes) and company cars in the medium term, but will also increase the need for co-working spaces and desk-sharing systems. Both video conferencing and working from home will thus become the subject of a policy of climate protection through traffic avoidance. Approaches for climate policy in use of the changed situation can be derived from the survey.

With regard to the substitution of business trips by video conferences, a strong stabilisation effect can be assumed, which is driven by the considerable time saved for business travellers, and by the equally considerable costs saved for corporate business trips. Rebound effects could result from additional video conferences, but their climate impact is rather small compared to business travel. In terms of climate policy, the situation can be used to once again question the controversial German tax regulations on company cars. Furthermore, in the wake of the pandemic, a campaign may be necessary to restore confidence in the health safety of public transport and rail. The further development of satisfaction with videoconferencing, the advantages and disadvantages as well as the cost-reducing effects and new positive experiences and solutions should be scientifically accompanied, documented and made accessible to companies. Policy-makers should pursue the goal of stabilising and maintaining Corona-induced changes in routine, as far as these benefit companies and the environment. Federal travel expense law could enshrine that the need for "real travel" must be justified. Claiming costs for video conferencing technology should be made possible as an alternative to claiming travel expenses.

A greater spread of working from home could trigger numerous effects that are only partially desirable in terms of climate policy and not all of which can be influenced politically. Bitkom (2021) reports that if most people worked from home, around 20 % of all professionals would move further out into the countryside, to a more attractive city or closer to friends and family. This could mean that commuting would be less frequent, but considerably further. It is conceivable that a share of the demand for housing would shift from the city to the countryside, which in turn would relieve the housing market in conurbations. It is also conceivable that the demand for office buildings in conurbations would decrease and instead the demand for decentralised co-working spaces and desk-sharing facilities would increase. A permanent overall effect on the reduction of greenhouse gas emissions through working from home cannot be estimated in view of the numerous expected secondary changes in mobility behaviour.

2 Introduction

The COVID-19 pandemic has led to major changes in how teams work and collaborate with external parties, both in Germany and globally. Due to nationwide travel restrictions during the lockdown in early 2020 and a compelling need for physical distancing, many business appointments such as conferences, trade fairs, business meetings at home and abroad, but also regular team meetings had to be consistently cancelled. By mid-March 2020, many organisations were forced to consider alternative concepts for collaboration.

Amidst these developments, the module "Video Conferences and Online Collaboration in Companies" in the project "Climate Protection Potentials of the Digital Transformation" (CliDiTrans) had already begun to investigate the spread and acceptance of virtual meeting formats. Since 2000, the telecommunications industry has already provided an increasing variety of possibilities for informing each other, discussing with each other and making decisions online in smaller or larger groups. However, there were a number of very effective barriers to making use of these possibilities. A first inventory within the framework of CliDiTrans was published in summer 2019:

- Clausen, J., Schramm, S. & Hintemann, R. (2019): Virtuelle Konferenzen und Online-Zusammenarbeit in Unternehmen: Effektiver Klimaschutz oder Mythos? (Virtual conferences and online collaboration in companies: Effective climate protection or myth?) CliDiTrans Werkstattbericht 3-2. Berlin: Borderstep Institut.

At the end of 2019, the call "Under 1000 I won't do it" was issued, calling on the scientific community to refrain from short air travel. From this project, still in the pre-COVID-19 era, we compiled a range of experiences with administrative approaches to reducing air travel and contrasted these with a range of options for virtual conferences:

- Clausen, J. & Schramm, S. (2019): Wege zu einer neuen Konferenzkultur. Reisen erschweren - Teleconferencing entwickeln. (Towards a new Conference Culture. Curbing travel - developing teleconferencing) CliDiTrans Werkstattbericht 3-2. Berlin: Borderstep Institut.

However, telephone conferencing, which was still prevalent up until 2019, generally presents a number of weaknesses. These became clear in the series of interviews conducted from autumn 2019 to spring 2020. It showed that in conference calls, communication is reduced to listening, which is perceived as a serious disadvantage. Presentation possibilities or visual perception of the counterpart are omitted. If this is compounded by a lack of experience, e.g. if all participants leave their microphones switched on and a variety of background noises can be heard, the reasons why telephone conferences are often perceived as "second best" become clear.

Despite the availability of hardware and software for video conferencing (Publicare Marketing Communications GmbH, 2019), its use has been limited to a few groups, e.g. management and IT departments. Many businesses were lacking the necessary hardware (cameras, microphones, bandwidth). Software was often not available, not approved by the IT department (e.g. Zoom, Teams, Skype) and no prior experience with the software had been gathered. While for start-ups or students of the FridaysForFuture movement, it was completely normal to coordinate online even before the onset of

the coronavirus crisis, older people remained reserved, especially at corporate management level. There was also a lack of experience in using such tools, which fueled continued travelling.. The interview series results were again published as a workshop report in view of the topicality of the subject:

- Clausen, J., Schramm, S. (2020). Persönliche Treffen und virtuelle Konferenzen: Gelebte Praktiken und Erfahrungen in Unternehmen. Auswertung einer Prä-Corona Interviewreihe. (Face-to-face meetings and virtual conferences: Lived practices and experiences in companies. Evaluation of a pre-corona interview series) CliDiTrans Werkstattbericht. Berlin: Borderstep Institut.

In mid-March 2020, the situation changed abruptly with the start of the lockdown. While the IT industry had already offered a wide range of virtual conference tools before, the coronavirus pandemic acted as a force of change, triggering the use of communication tools that had been available for some time.

Video conferencing and working from home experienced a steep upswing. With support from the funding body, the research project seized the opportunity to examine this development on the basis of already existing pre-crisis work.

In the summer of 2020, work began on a literature study that would provide an overview of the numerous studies and surveys that had been published in a short period of time on changing communication and conferencing behaviour.

- Schramm, S. (2020). Effekte der COVID-19-Pandemie auf berufsbedingten Verkehr, geschäftliche Meetings, Homeoffice und Klimabilanz. (Effects of the COVID-19 pandemic on work-related transport, business meetings, home office and carbon footprint) CliDiTrans Werkstattbericht. Borderstep. Berlin.

The second step of research work in the post-lockdown phase is the representative survey of business travellers documented here.

In this translated text, we will use the term 'home office' instead of the English term 'working from home' in regard of limiting translation work. We trust in the reader to understand the text nevertheless.

3 Method

3.1 Research questions

The work in the module "Video Conferencing and Online Collaboration in Companies" in the project "Climate Protection Potentials of the Digital Transformation" (CliDiTrans) aims to understand the changes in travel behaviour due to the possibility, which has been increasingly available for 20 years, of initially conducting telephone conferences, but increasingly also video conferences. It should be investigated which drivers promote the use of digital communication formats and which obstacles slow down their diffusion.

However, the Coronavirus crisis now makes it possible to also investigate the effect of a social crisis on occupational mobility behaviour and to assess the temporary and permanent effects on climate protection. The following additional research questions could be posed and answered:

- How is the use of home office and video conferencing changing among professionals in private and public companies in Germany in the course of the Corona crisis? ¹
- What are the experiences of professionals with home office and video conferencing in the time of crisis and how will this affect future work and mobility routines?
- How do these changes affect greenhouse gas emissions and what permanent or temporary effects can be expected?
- What are the options for action to permanently reduce greenhouse gas emissions in Germany through efficient home office and teleconferencing concepts?

This partial report on this work documents the results of a survey of business travellers conducted in November 2020.

3.2 Survey method

The survey was aimed at professionals who undertook at least one business trip in the course of 2019. This subgroup of the approximately 13 million business travellers who travel at least once a year for business (VDR, 2020, p. 9) represents the basic population.

Since the survey was carried out as an online survey, only employed persons with an internet connection could participate. By formulating the questions in German, the target group is further focused on people who speak German. Participants from a German-speaking online panel were therefore invited.

¹ It should be noted that due to the rapid change in behaviour in March 2020, on the one hand, no rebound effects are to be feared during the lockdown, and on the other hand, the changes in air, rail and automobile traffic, but also in internet use for teleconferencing, have been statistically recorded and thus offer a unique opportunity to assess the possible climate protection contribution.

In this respect, the study is representative of employees with internet access and good German language skills who were employed in 2019 and who undertook at least one business trip in 2019. Chapter 4 shows that all age groups, both genders, different hierarchical levels, sectors and areas of responsibility were successfully addressed. The realised sample can therefore be considered representative of the population described above.

The online survey was conducted between 4 and 16 November 2020. Within an online panel, 3,839 people were invited, of whom 1,146 opened the link and 533 completed the questionnaire in full. After adjustment, the sample size was 500. The average time for answering the questionnaire was 23:18 minutes.

The survey was subcontracted to imug Beratungsgesellschaft, Hanover.

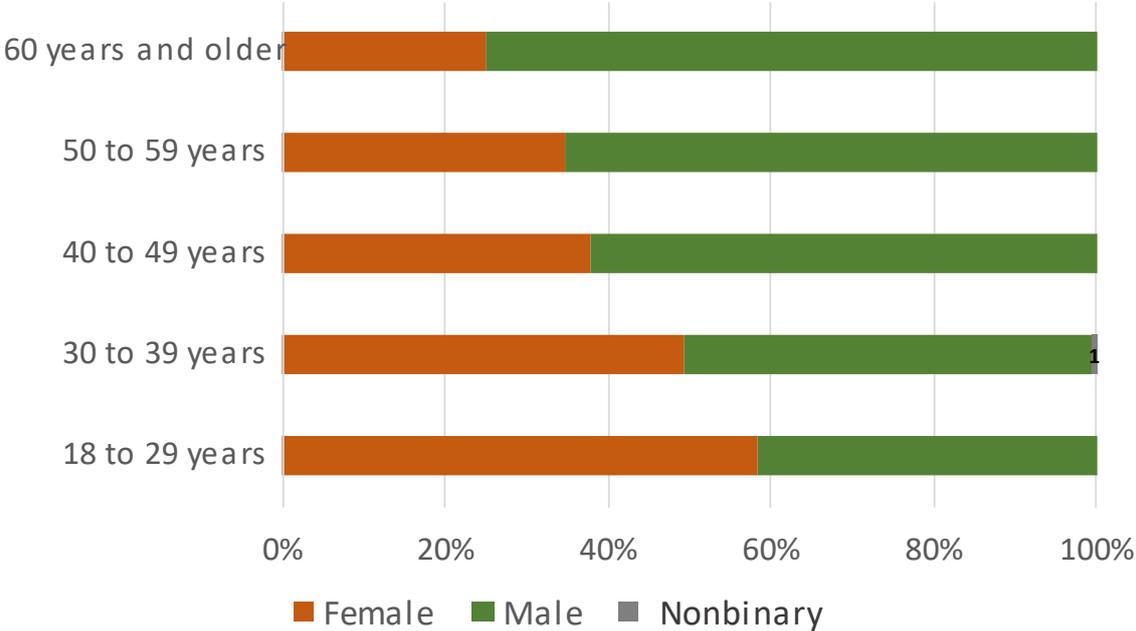
The programmes Excel and SPSS were used to analyse the data, as well as the programme MAXQDA for the methodological procedure in the summary analysis of open responses.

The questionnaire (see appendix) is based on the work on home office and video conferencing presented in chapter 2. It was tested in a first version with the participation of the three partner companies in the CliDiTrans project (87 responses) and further developed on the basis of the literature study published in autumn 2020.

4 Characterisation of the sample

500 people took part in the survey, 43 % of whom were female and 57 % male. The age distribution spans the entire age spectrum of working people.

Figure 2: Age distribution of the sample



Source: Borderstep, n = 500

27 % of respondents live alone, 63 % in two-person households, 6 % in three-person households, 3 % in four-person households and 1 % in households with five or more people. They represent a broad mix of sectors. The respondents were 16 % in upper management, 38 % in middle management, 19 % in lower management and 24 % had no management responsibility (3 % no or other mentions). Their professional activities take place in numerous fields of activity.

24% of respondents work in small companies with up to 49 employees. Another 24% work in medium-sized companies with up to 249 employees. 47 % of respondents work in larger companies with 250 or more employees. 4% did not provide any information.

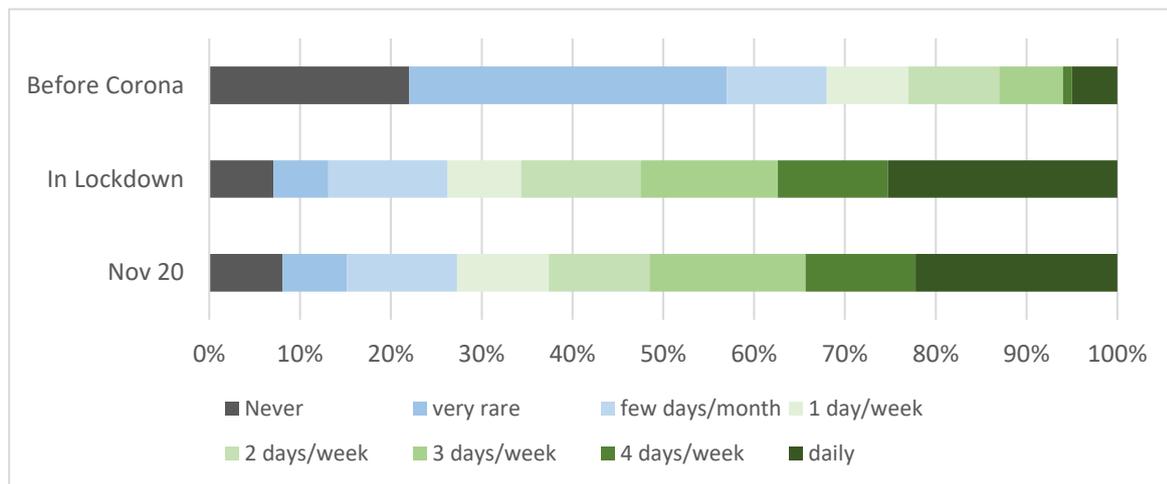
Assuming that no business trips are made during the annual holiday period (six weeks), the respondents (n = 439) indicate approx. 24,500 km of business trips per person per year before Corona. Based on the average 70 km per working day typical for employed persons (Nobis and Kuhnimhof, 2018, p. 104), which approx. 10 % of travellers cover, only approx. 14,700 km would be expected on average for business travellers. The sample drawn thus proves to be particularly travel-intensive.

5 Video conferencing

5.1 Use of video conferencing

Before Corona, only 6 % of respondents used video conferencing four or five days a week. 32 % used video conferencing at least once a week. In November 2020, 34 % of respondents use videoconferencing four or five days a week, and 72 % participate in videoconferencing at least once a week. The share without any application experience with video conferencing has dropped to 8 % in November 2020.

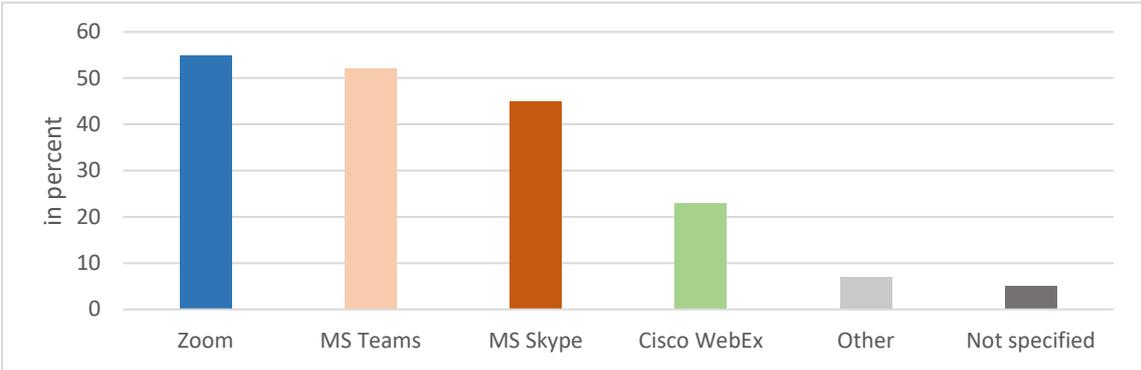
Figure 3: Frequency of use of videoconferencing



Source: Borderstep, n = 500, lockdown March to May 2020

55 % of the respondents have application experience with Zoom, 52 % with Microsoft Teams and 45 % with Skype. 23 % of the respondents have already worked with Cisco WebEx. 35 other respondents have experience with GoToMeeting (14), WhatsApp (3), Jitsi (3), BigBlueButton (3), Google Meet (2), teamviewer, Slack, RingCentral Meetings, IServ, Cisco Jabber, Circuit Meeting Room, Blizz, Adobe Create and Miro.

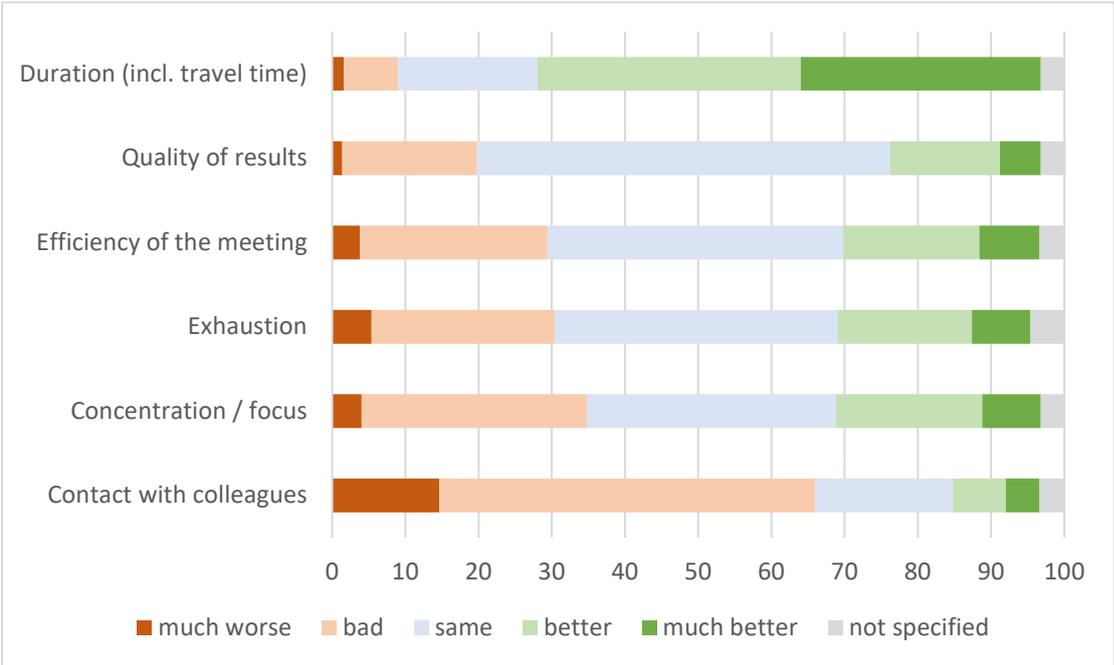
Figure 4: Working experience with software for conducting videoconferences



Source: Borderstep, n = 500, multiple answers possible

The evaluation of videoconferencing in comparison to real meetings shows a balanced assessment for many criteria with numerous respondents who rate both types of meetings similarly. Two criteria are exceptions here. A large majority perceives the shorter duration of video meetings as positive, since no time is required for travelling. However, respondents rate the contact with colleagues as worse (51 %) or even much worse (15 %).

Figure 5: Experiences with corporate video meetings compared to face-to-face meetings



Source: Borderstep, n = 500, in percent, question: "What is your experience with video meetings internally compared to face-to-face meetings with regard to the following criteria? "

Video meetings with customers or other external parties are assessed similarly. The majority of respondents perceive an advantage due to shorter meeting durations, but 43 % of the respondents fear that contact with the respective counterpart will be worse. 7 % even see the contact as much worse. 24 % fear a worse, 2 % even a much worse sales success.

The time advantage is somewhat less pronounced for internal meetings than for business trips, both in terms of working time and free time. Saved working time is reported more often than added free time.

Table 1: Impact of virtual meetings on work and leisure time

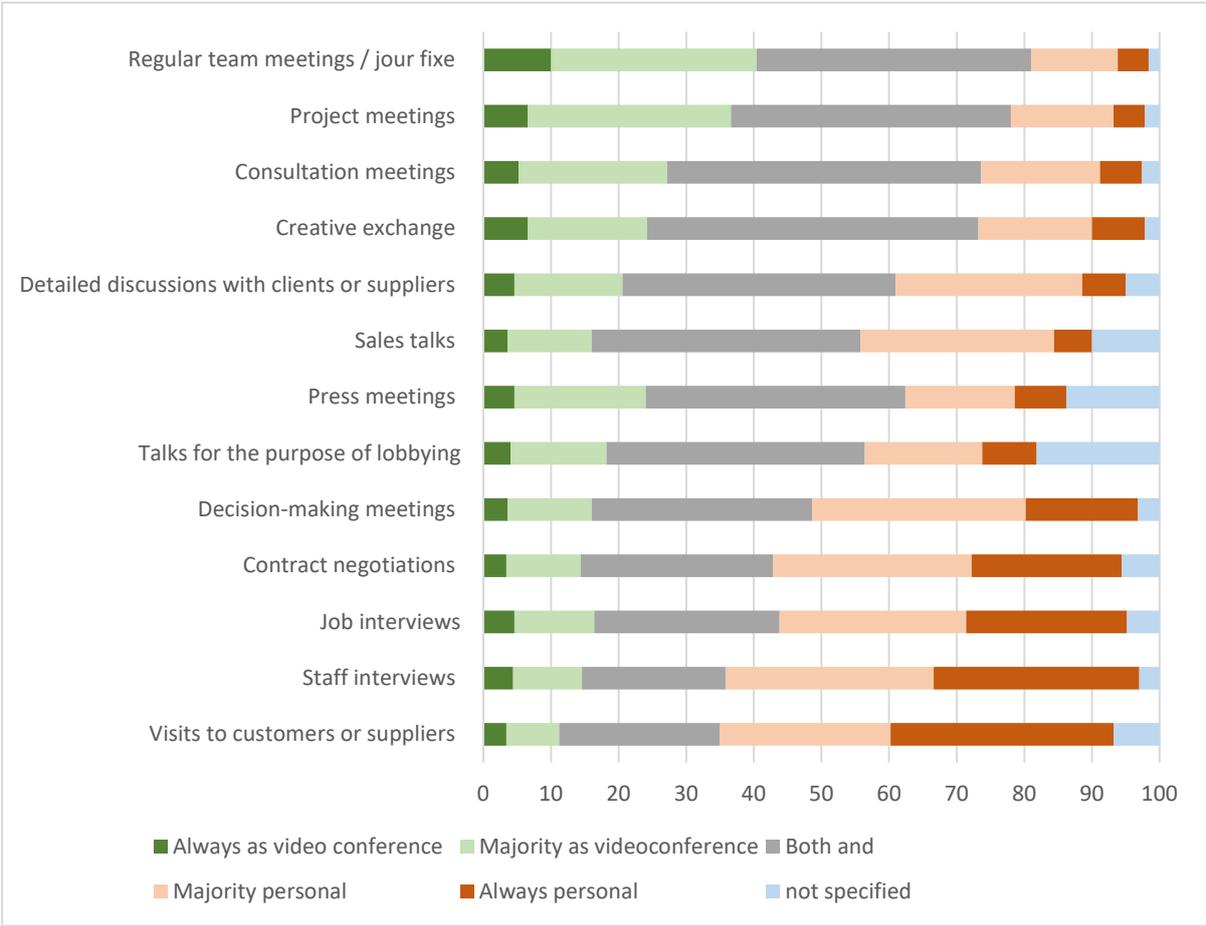
Effects on working time						
	Not specified	I work much more	I work a little more	Little changes	I save a little working time	I save a lot of working time
Virtual instead of internal meeting	5	2	7	25	35	27
Virtual meeting instead of business trip	5	2	2	16	22	52
Effects on leisure time						
	Not specified	I have much less free time	I have a little less free time	Little changes	I have a little more free time	I have much more free time
Virtual instead of internal meeting	6	2	4	35	35	19
Virtual meeting instead of business trip	7	1	2	30	29	31

Source: Borderstep, n = 500, figures in percent

5.2 Views on video conferencing

When it comes to the question of whether meetings can be held virtually in the majority of cases or even always, regular appointments with teams that already know each other come out on top. The more important and personal appointments are, the smaller the proportion of those who can already imagine these appointments virtually today.

Figure 6: Preferences for video meetings and face-to-face meetings by conversation type



Source: Borderstep, n = 500, in percent

Basically, the question of whether one has to meet in person or can also meet virtually cannot be answered. 14 % of respondents think virtual communication is too impersonal, 12 % think virtual exchange is usually enough. Some respondents plausibly distinguish the necessity of face-to-face meetings from the possibility of virtual meetings ²(verbatim quotes, translated):

- *With the appropriate technology that is interactive (example Microsoft Teams with Surface Hub 2), I am even better equipped than in analogue meetings with flipcharts, which are photographed after the meeting.*
- *Day events can be held online in a short and concentrated way. It gets difficult for events lasting several days, during which I prefer direct exchange and contact.*
- *Often you only discuss a few points that could also be clarified by phone or video. Business trips or on-site meetings are really only necessary if you have to examine something concretely that cannot be examined via phone or video.*

² Question 20 was: "In your view, are personal or analogue meetings (and thus business trips) dispensable?"
 Question 21: "In your view, which business trips or personal meetings are unavoidable? "

- *In 80-90% of cases [the virtual form is sufficient] because physical contact is usually not necessary for informal and administrative meetings. Analogue meetings are preferable for sales and negotiations of particularly expensive or complex products and services or for intensive group work/workshops.*
- *Not all business trips are dispensable, but some definitely are. Until now, key decision-makers have resisted video conferencing. With the new routine of using the available technology, they too will agree to video conferencing.*
- *Contacts and exchange over a larger distance are only effective when business partners really know each other.*
- *Because transfer of knowledge and exchange do not require physical presence.*

Essential travel was most frequently associated with the following four travel purposes:

Distribution and sales: contract negotiations and conclusion (44 mentions), product presentation (23), trade fair visit (16) as well as sales talks and handling (8)

Personnel and team building: workshops / team building measures (35), project meetings for teams from different locations (14), staff appraisals (11), staff meeting (4),

Site visits: Plant tours / site visits (18)

Networking: (Professional) Conferences (14)

In addition, court dates and examinations were each mentioned twice. For networking and making new contacts (getting to know each other, new customers, job applications), face-to-face meetings are often considered more promising (verbatim quote, translated).

- *Workshops on team building/ in case of conflicts in the team/ retrospectives, all cases, in which difficult interpersonal issues can arise or team feeling is to be created. Practical, interactive part of training sessions, exercises, teaching techniques.*

Already today, a lot speaks for video conferencing. More than half of the respondents "agreed" or "fully agreed" with the following statements:

Video conferencing:

... enables effective verbal as well as non-verbal communication.

... is an adequate substitute for face-to-face meetings.

... works technically without problems.

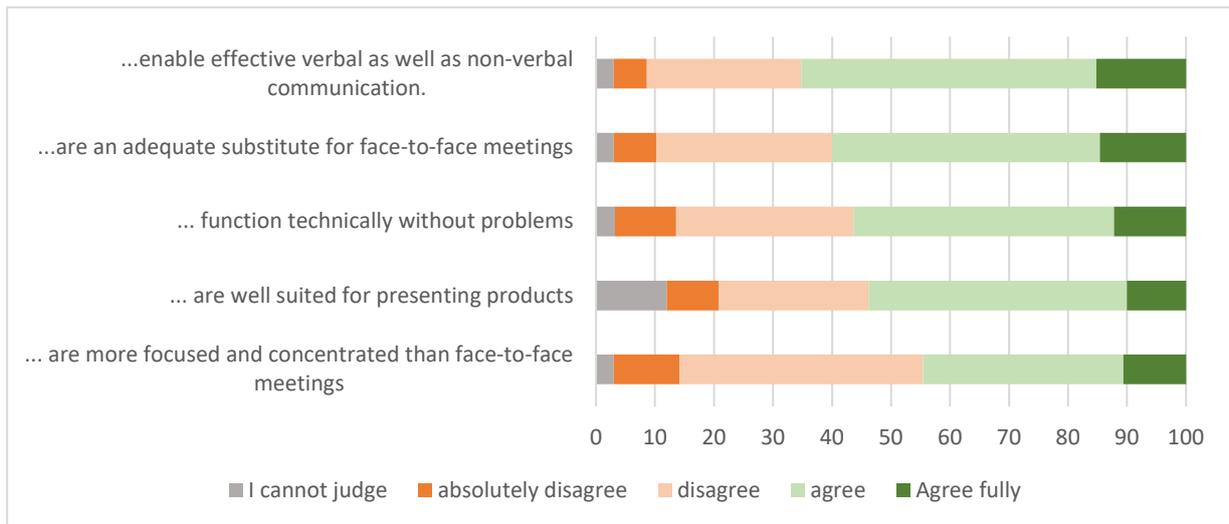
... is well suited for presenting products as well.

... is more focused and concentrated than face-to-face meetings.

With a high proportion of respondents who cannot assess it, even the possibility of product presentation via video is viewed positively by the majority (by 61% of those who can assess it).

Figure 7: Positive evaluations of videoconferencing based on lockdown experiences

Video conferences ...

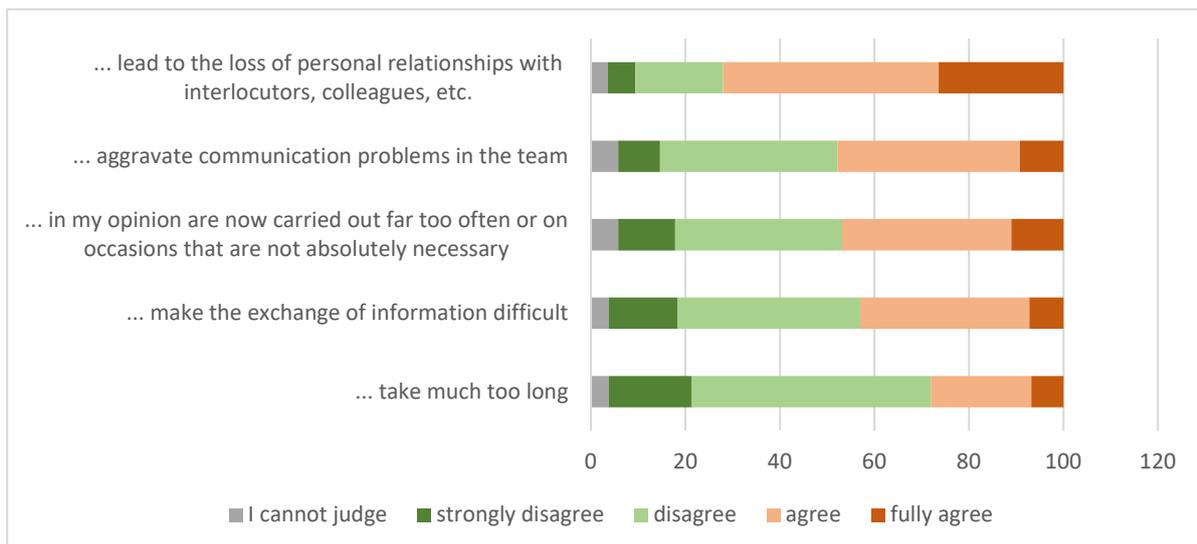


Source: Borderstep, n = 500, in percent

In addition, critical evaluations of videoconferencing were asked for.

Figure 8: Critical assessments of videoconferencing based on lockdown experiences

Video conferences ...



Source: Borderstep, n = 500, in percent

The statement that video conferences take far too long was only "agreed with" or "fully agreed with" by 29 % of the respondents. The assumption that they make the exchange of information more difficult was also rejected by 55 % of the respondents. Opinions were evenly balanced on the questions of whether video conferences "exacerbate communication problems in the team" and whether they

are "now carried out far too often or on occasions that are not absolutely necessary". A clear majority, on the other hand, fears the loss of personal relationships in the long term.

In response to the open question "What unexpected benefits do you currently see from the increased use of video conferencing? What exactly will add value to your work in the future?", 142 respondents mentioned saving time. Some respondents pointed out that travel could be avoided (36), costs could be saved (35), more flexible scheduling was possible (31) and that work could be done more efficiently or with more focus (26). Ten respondents also pointed to advantages in climate protection. The following statements were made by individual respondents (verbatim quotes, translated):

- *Well, I've been doing videoconferencing in a global company for about seven years. It just works.*
- *I would not have expected this level of increase in efficiency. Greater discipline of the participants. It is much easier to organise appointments, no need for a free meeting room, no time needed to change rooms, independence of location.*
- *Communication between different locations has been greatly simplified. This can save some travel costs and colleagues from different locations can benefit from increased exchange.*
- *The participation rate of people in higher positions at internal meetings was higher than at on-site meetings before Corona. More focused joint work when the screen is shared and everyone notes something than when only the beamer projection is looked at. It feels like it is easier to catch one's breath between appointments.*
- *Online meetings give me the opportunity to talk to several clients and internal colleagues on the same day and to switch quickly between projects. With on-site meetings, you focus on one client + travel time for a whole day. In addition, minimised travel saves costs.*
- *Less traffic and environmental pollution, thus also fewer accidents.*

In response to the open question "What disadvantages or obstacles do you see - also for yourself personally - in conducting video conferences?" 176 respondents pointed to the danger of losing personal contact. For 68 respondents, technical problems with participants were an obstacle. Smaller numbers of respondents mentioned limited non-verbal communication (40), less social exchange (37), decreasing efficiency and concentration (32), problems with understanding and comprehension (32) and problems with data protection/privacy (19). The following statements (verbatim quotes, translated) came from individual respondents:

- *It's a bit more abstract, of course. I wouldn't say more impersonal. It always depends on the design of the meeting. Of course, it's difficult when you have new clients. But even then, it makes sense to first communicate via video and get to know each other. You can always establish personal contact in a local meeting at a later point in time. I find it rather disconcerting to sit in the room at such a distance in a real meeting on site. In my opinion, this also creates enormous problems with personal contact.*
- *Some people have a terrible internet connection. Sometimes, the sound is horrible. At other times, you have to adjust to people you haven't seen in person before - and therefore, don't know how*

they will react to casual remarks or the like. In sales, this is problematic, because prices and conditions have to be discussed, – what if someone is listening in who is actually not involved ...? In addition, in some companies' data protection is also a sensitive issue when it comes to videoconferencing. Imagine a CEO's credit negotiations with his bank advisor and people sitting behind the monitor who cannot be seen or heard.

- *Doing other work at the same time (checking emails, etc.) is distracting.* ³
- *In the case of new employees, you don't develop a relationship with them, you don't even get to know them.*
- *I would find this rather difficult with new customers; getting to know them personally, even with a visit to the customer, would be more advantageous, as you can get a picture of the company.*
- *Can be conducted spontaneously, therefore often carried out unnecessarily and/or with too many participants.*
- *Misunderstandings arise more easily. It feels more difficult to invite the right number of participants. If not everyone is present, it may seem to colleagues that it has not been approved by everyone. More follow-up meetings are carried out and results from meetings become more vague.*
- *I cannot personally hand over samples to customers to try out. In addition, we often test and try out our products in team meetings at work and exchange ideas. This is difficult to do in the form of video conferences.*
- *Loss of networking during breaks, hard to assess other people, easier to get distracted.*

Predicting the future dynamics of the spread of video conferencing after the pandemic remains difficult. The advantage of saving time and, from a company's point of view, the favourable costs of online communication compared to real travel speak in favour of a continuing and still increasing spread. It is also difficult to make a prediction, because the views on videoconferencing are by no means uniform.

5.3 Satisfied and dissatisfied users

When looking at which users particularly appreciate video conferencing, there are hardly any significant correlations at first glance. The upper levels of management find video conferences somewhat better than the lower management levels (weak correlation, Kendal-Tau-b = 0.113, significant at the 1 % level⁴) and perceive somewhat less that contact with colleagues is deteriorating (very weak correlation, Kendal-Tau-b = 0.077, significant at the 5 % level). They also perceive declining concentration as less problematic (weak correlation, Kendal-Tau-b = 0.113, significant at the 1% level). Women

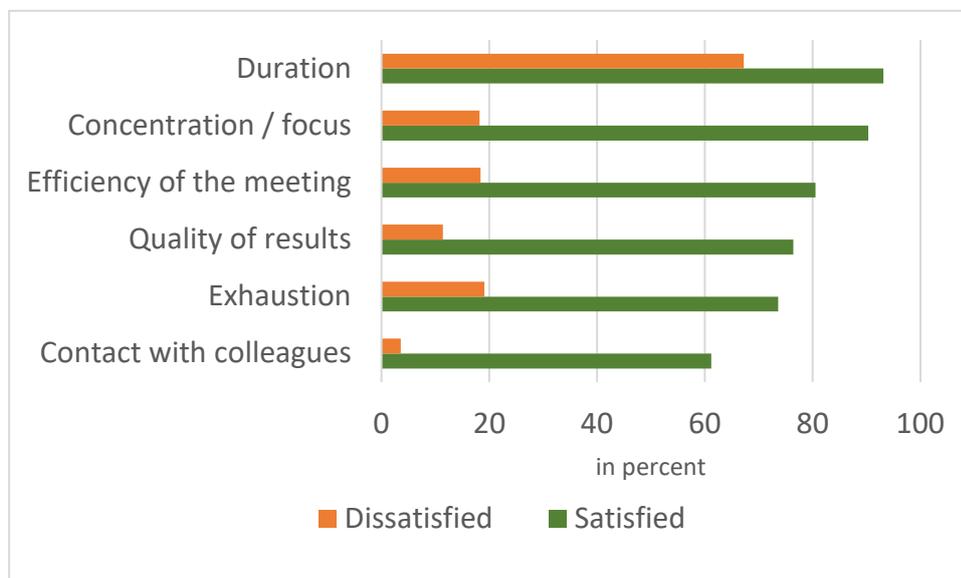
³ However, the opportunity for carrying out other work at the same time was also listed as an advantage by some respondents, e.g. if one was only invited "pro forma" and did not see any possibility to decline the invitation.

⁴ Kendall's tau is a measure of the correlation between the observations of two at least ordinaly scaled characteristics x and y.

perceive the shorter duration of virtual meetings as slightly more advantageous than men (very weak correlation, Kendall-Tau-b = 0.082, significant at the 5 % level).

Overall, all answers regarding experiences with internal meetings with the team as well as external video meetings with customers or other external parties correlate significantly with each other (medium and strong correlations, significant at the 1 % level). A cluster analysis of the answers to the question about "experiences with internal company video meetings compared to face-to-face meetings" (Figure 5) with the formation of two clusters shows two user groups whose experiences with video conferencing differ significantly. The group of "satisfied adopters" can be assigned 72 participants of the survey, the group of rather "dissatisfied adopters" 412 respondents (16 respondents cannot be assigned because they did not give any information). The answers to the questions about experiences with videoconferencing already shown in Figure 5 turn out to be extremely different for both groups. The following figure shows the answers "better" and "much better" of the satisfied smaller group and the answers of the less satisfied in comparison.

Figure 9: Experiences with video meetings internally compared to face-to-face meetings by usage group (proportion of mentions "better" or "much better" of the 72 satisfied and the 412 dissatisfied)



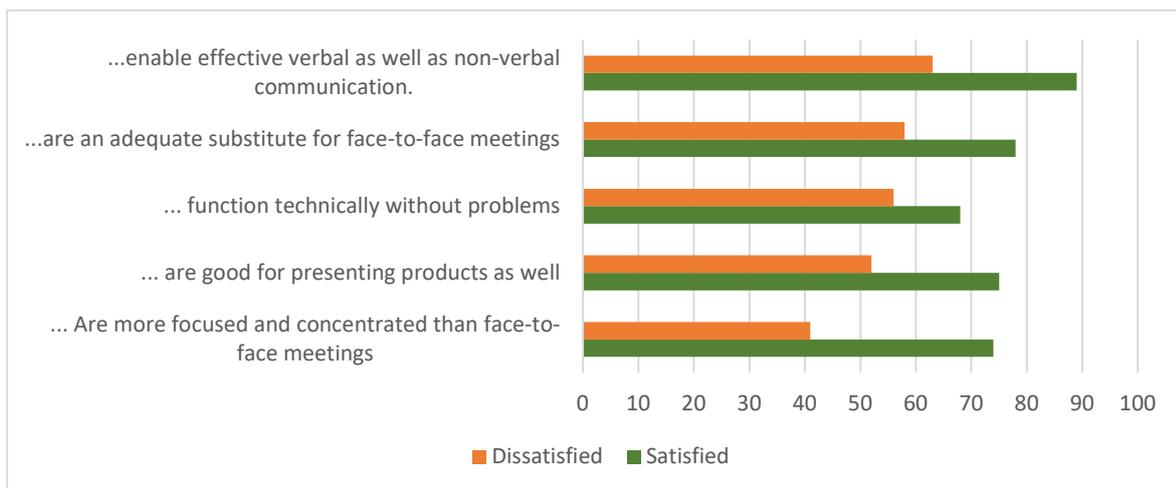
Source: Borderstep n = 484, in percent, satisfied n = 72, dissatisfied n = 412

With the exception of the advantage in terms of time, which is also perceived by the majority of the "dissatisfied" (67 %), only approx. 10 % to 20 % of the dissatisfied perceive a slight or significant improvement. Depending on the factor, a majority of 75 % of this group perceive a deterioration as a result of virtual communication formats; with regard to contact and exchange with colleagues, this number even rises to over 90 %. In contrast, the group of satisfied respondents perceives improvements in the range of 60 % to 90 %, depending on the factor.

However, the dissatisfied do not express this highly critical view in the context of all questions. In response to the following question about rather good experiences with video conferences in the lockdown, the dissatisfied respondents also express surprisingly positive views.

Figure 10: Ratings of videoconferencing based on lockdown experiences (proportion of mentions "agree" or "completely agree" of the 72 satisfied and the 412 dissatisfied)

Video conferencing ...

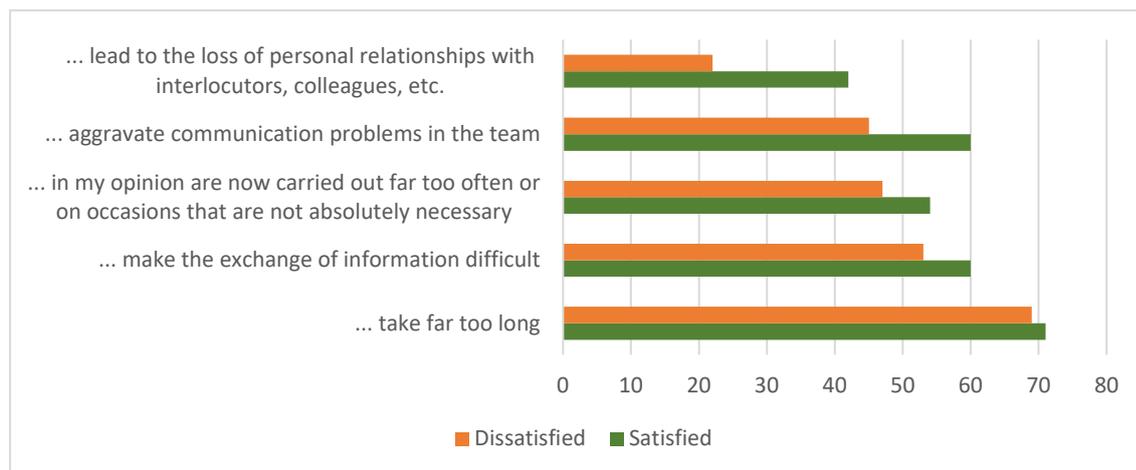


Source: Borderstep n = 484, in percent, satisfied n = 72, dissatisfied n = 412

When asked about rather negative experiences, many of the "dissatisfied" also disagree with the statements. Similar to the "satisfied", about 70 % think that video conferences do not take too long and, depending on the group, 53 % or 60 % do not think that they make the exchange of information more difficult. Only with regard to communication problems in the team and the danger of losing personal relationships do the "dissatisfied" rate video conferences significantly more critical.

Figure 11: Ratings of videoconferencing based on lockdown experiences (proportion of mentions "disagree" or "absolutely disagree" of the 72 satisfied and the 412 dissatisfied)

Video conferences ...



Source: Borderstep n = 484, in percent, satisfied n = 72, dissatisfied n = 412

The assignment to the clusters correlates overall neither with demographic characteristics nor with characteristics of the organisation. There is also no correlation with the performance of the internet connection or the frequency and distance of business trips before or after the onset of the pandemic. A significant correlation is only found with regard to the desire to increasingly work from home in the future (weak correlation, Kendal-Tau-b = 0.105, significant at the 5 % level). Ultimately, there is a group of individuals across genders, age groups, hierarchies and activities in the company who clearly see video conferencing as an opportunity and experience it positively. On the other hand, a group more than five times as large is rather (still?) critical of the new form of conferencing, although this critical position is not universally evident in all answers. In the empirical format "focus group", which is still planned, as well as in the second wave of the survey, an attempt will be made to find out more about the group of the "satisfied" as well as the "dissatisfied".

The disadvantages still felt by the group of the dissatisfied could also lose impact over time as larger groups gain more experience with the new meeting format. In this process, the "satisfied" group will play a key role in sharing their good experiences and getting others excited about the new format.

The hope for such a future dynamic is very nicely illustrated in the following quote: *"Until now, important decision-makers have resisted videoconferencing. With the new routine of using videoconferencing technology, they too will agree to videoconferencing."*

5.4 Climate protection potential of changing business travel behaviour

Many experiences with videoconferencing are positive. The fact that they significantly reduce the time spent attending meetings indicates a very favourable cost-benefit ratio of video conferences compared to real meetings. Moreover, they also reduce expenditure-related costs whenever they replace a business trip. In these cases, the time saved is also particularly large (cf. Table 1). On the

other hand, there has been the obstacle of necessary behavioural changes. In order to use videoconferencing, cultural barriers had to be overcome and path dependencies broken. But since March 2020, the pandemic has forced a change in behaviour. Based on findings from diffusion research, it can thus be expected that the change in behaviour could be retained to a high extent due to its material benefits (Clausen and Fichter, 2019; Fichter and Clausen, 2021)

In order to estimate the possible climate protection potential of an increased use of video conferencing systems as an alternative to business travel, the following approach is taken:

The starting point is the average distance travelled for business trips for the entire working population, which has been the norm up to now. According to Nobis and Kuhnimhof (2018, p. 104), working people in Germany⁵ cover a distance of 7 km every working day for business trips (Nobis and Kuhnimhof, 2018, p. 104) However, not everyone travels. Only about one in ten employees travels an average of 80 km on business on an average working day (Nobis and Kuhnimhof, 2018, p. 104). With approximately 45 million people in employment nationwide (Statistisches Bundesamt, 2020a), 360 million km in total distance for business trips can be expected on each working day. With approx. 209 working days per year⁶, this results in a total distance of approx. 75 billion km travelled by business trips.

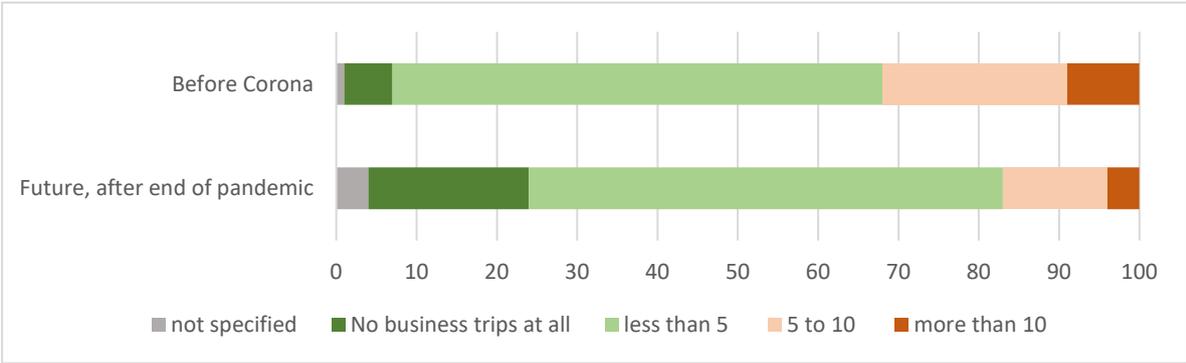
The calculation of CO₂ emissions from the use of the various means of transport for these business trips is carried out on the basis of data from the Federal Environment Agency (UBA, 2020).

Data on the modal split on business trips before the Corona pandemic and the expected change in route in the post-Corona period was collected as part of the survey. Regarding their travel behaviour before Corona, 434 people provided complete information (monthly travel distance as well as modal split). Five responses were removed from the sample due to implausibly high travel distances. The monthly travel distance was reported to be about 1,445 km on average for all respondents, with about a quarter of the total distance attributable to a group of twelve extreme travellers who travel between 10,000 and 30,000 km on a monthly basis. The distance travelled is distributed across different modes of transport as shown in Figure 13. 20 % of the respondents state that they will not have to make any business trips at all in the future. Overall, the number of business trips expected in the future is clearly decreasing compared to the time before Corona.

⁵ Here, business trips are explicitly classified as a different category than the way to work. People who travel on business are thus business travellers for the purposes of this study.

⁶ The assumption is based on an average of 250 potential working days per year and deducts 30 days of holiday. In addition, an average of eleven sick days are taken into account (Statistisches Bundesamt, 2020b).

Figure 12: Number of monthly business trips before and after Corona

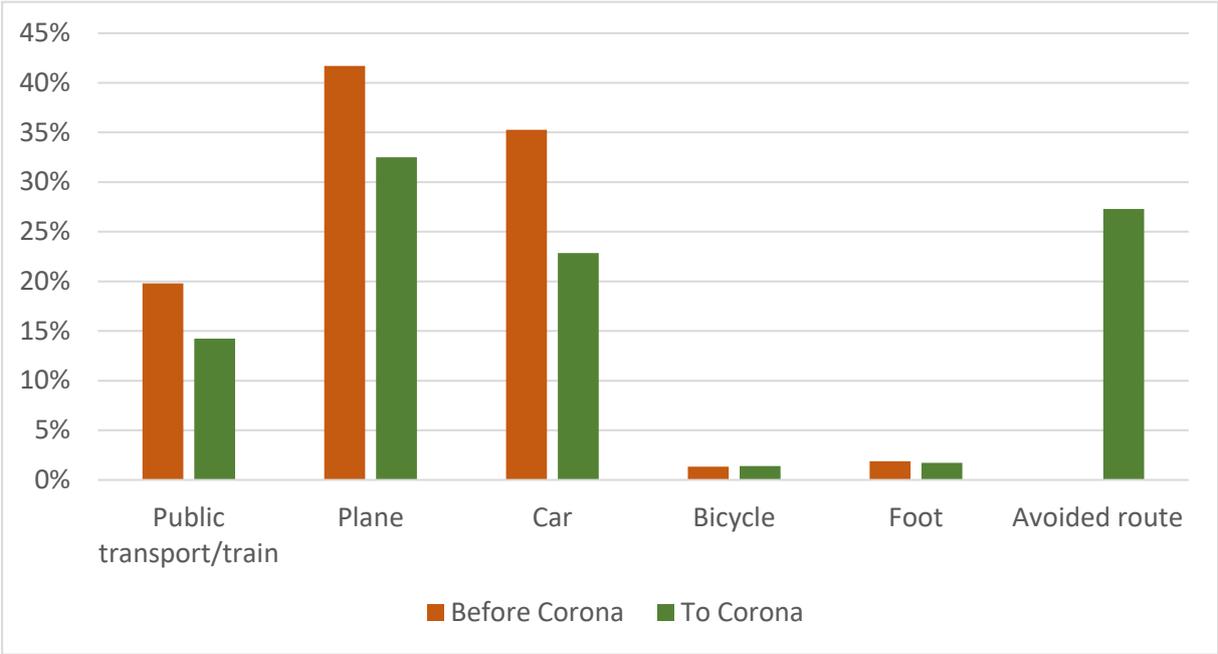


Source: Borderstep, n = 500, data in percent

The expected travel distance for business trips after the end of the pandemic was provided by 390 people with an average of 1,038 km. The number of respondents who said they would travel between 1,000 km and 5,000 km per month dropped significantly from 16 % to 9 %. For distances between 500 km and 1,000 km, the share also declined from 17 % to 9 %. Distances of more than 5,000 km per month were previously travelled by 5 % of the respondents, in the future it will only be 4 %.

The distance travelled decreases significantly for public transport/train, air and car, while it remains almost the same at a low level for cycling and walking. The modal split of transport performance shifts towards avoided transport.

Figure 13: Modal split of transport performance on business trips before and after Corona



Source: Borderstep, n = 434 (before Corona) and n= 390 (after Corona)

From the information provided by the respondents on past and future travel distance and the modal split used in each case, the monthly travel kilometres can be calculated separately by mode of transport for all respondents who provided information on both questions. The greenhouse gas emissions from using the means of transport for business trips can then be estimated as follows:

Table 2: Emission factors and CO₂ savings by mode of transport

Means of transport	Emission factor	before Corona Greenhouse gas emissions in million t/a	by Corona Green- house gas emissions in million t/a
Car	0.15 Kg CO ₂ eq/ Pkm	3,97	2,58
Airplane	0.23 Kg CO ₂ eq/Pkm	7,19	5,61
Rail - long-distance traffic	0.032 Kg CO ₂ eq/ Pkm	0,48	0,34
Total		11,64	8,53

Source: Borderstep, emission factors UBA (2020)

It can be seen that the expenditure in the transport system and the associated greenhouse gas emissions will decrease significantly due to the expected permanent shift to virtual meetings.

But the expenses for conducting virtual conferences must also be taken into account. Schramm (2020, p. 37) shows that holding a four-hour video conference with four participants, if done with desktop PCs and monitors, is associated with CO₂ emissions of 1.08 kg CO₂⁷. If notebooks are used, the CO₂ emissions are somewhat lower at 0.74 kg CO₂. In comparison, the CO₂ emissions of a flight of two people over approx. 1,000 km are approx. 920 kg CO₂, and if the distance is covered by train, it is approx. 128 kg CO₂ (Schramm, 2020, p. 37). Looking at a separate journey of two people by car over 200 km, 120 kg of CO₂ emissions are calculated for the arrival and departure. The ecological break-even point for a four-hour video conference with four participants using notebooks is 23 km by train, 12 km by public transport or 5 km by car, in each case divided between two people travelling to the conference. Even in the case of two people travelling from Berlin Steglitz to Berlin city centre (approx. 12 km), the virtual meeting would be mathematically advantageous. In relation to the average business trip length of 80 km (Nobis and Kuhnimhof, 2018, p. 104), a saving of approx. 96 % is calculated. The gross savings shown in Table 2 thus reduced from approx. 3.11 million t CO₂ to approx. 3 million t CO₂. Even if the number of video conferences increases due to rebound effects compared to real travel, this should not reduce the positive effects to a significant extent.⁸

⁷ This takes into account the use of PCs, monitors, wireless network, internet and data centre. The emission factor for the electricity mix is estimated at 468 g CO₂/KWh (Icha, 2020)

⁸ In principle, it is also conceivable that a trend towards the formation of "global companies" with staff distributed across all continents, which has been observed for some time, will continue, as has already been described (Clausen et al., 2019, p. 14). The extent to which such a development can be attributed to globalisation or the availability of video conferencing tools, which already existed before 2020, can only be determined in a few years.

If, as expected by the respondents, business travel behaviour changes significantly in the aftermath of the pandemic, there are no significant climate-impacting rebound effects, and there is a permanent reduction of 28% in rail traffic and 35% in car traffic for business travel, and a reduction of 22% in air traffic, then a reduction in greenhouse gas emissions from transport of about 3 million t CO₂eq/year can be expected.

The share of passenger cars in the total distance travelled would decrease by just under 9 billion km. With an average mileage of just over 13,000 km per car documented by the German Federal Motor Transport Authority, this corresponds to a total mileage of just under 700,000 cars.

In terms of climate policy, the situation can be used to once again call into question the already controversial German tax regulations on company cars. Furthermore, in the aftermath of the pandemic, a campaign may be needed to restore confidence in the health safety of rail travel.

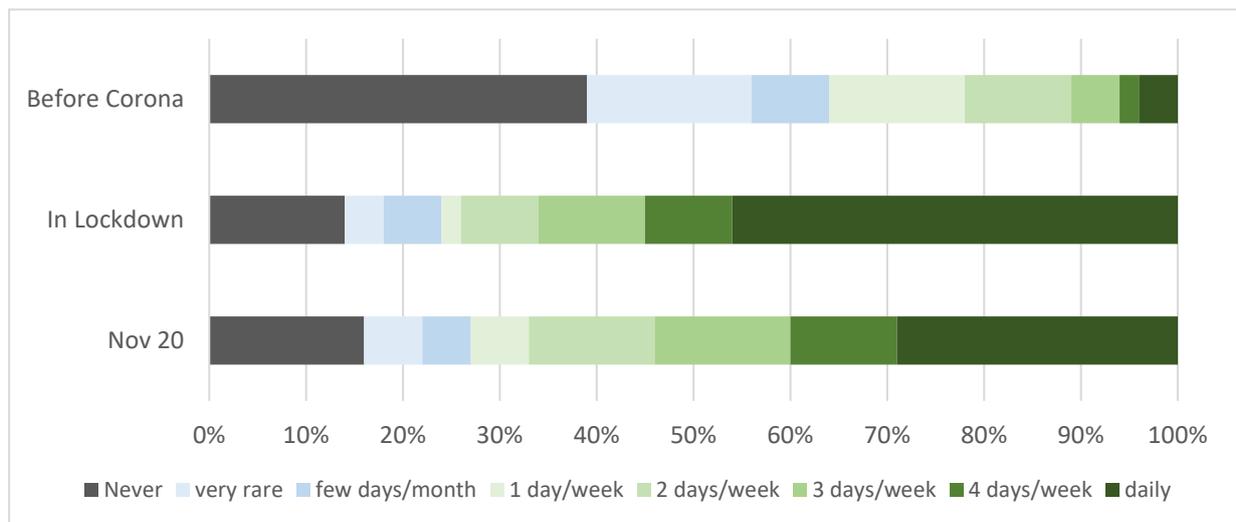
6 Home office

6.1 Use of the home office

With regard to the results of this survey on the topic of home office, it should first be pointed out that the population of the survey is aimed at people who make business trips and to that extent are entrusted with management and administrative tasks to a greater extent than would be the case for the population of employed persons. This becomes clear, for example, in the fact that according to Stürz, Stumpf and Mendel (2020), 57 % of all employed persons in the lockdown did not work from home at all; in the sample here, this value is only 14 %.

Before Corona, the proportion of respondents with a pronounced home office practice of four or five days per week was 6%, which increased to 40% in November 2020. While at the beginning of 2020, 64 % of respondents had no or only little home office work experience, this value dropped to 27 % in November 2020.

Figure 14: Frequency of home office work by business travellers in Germany

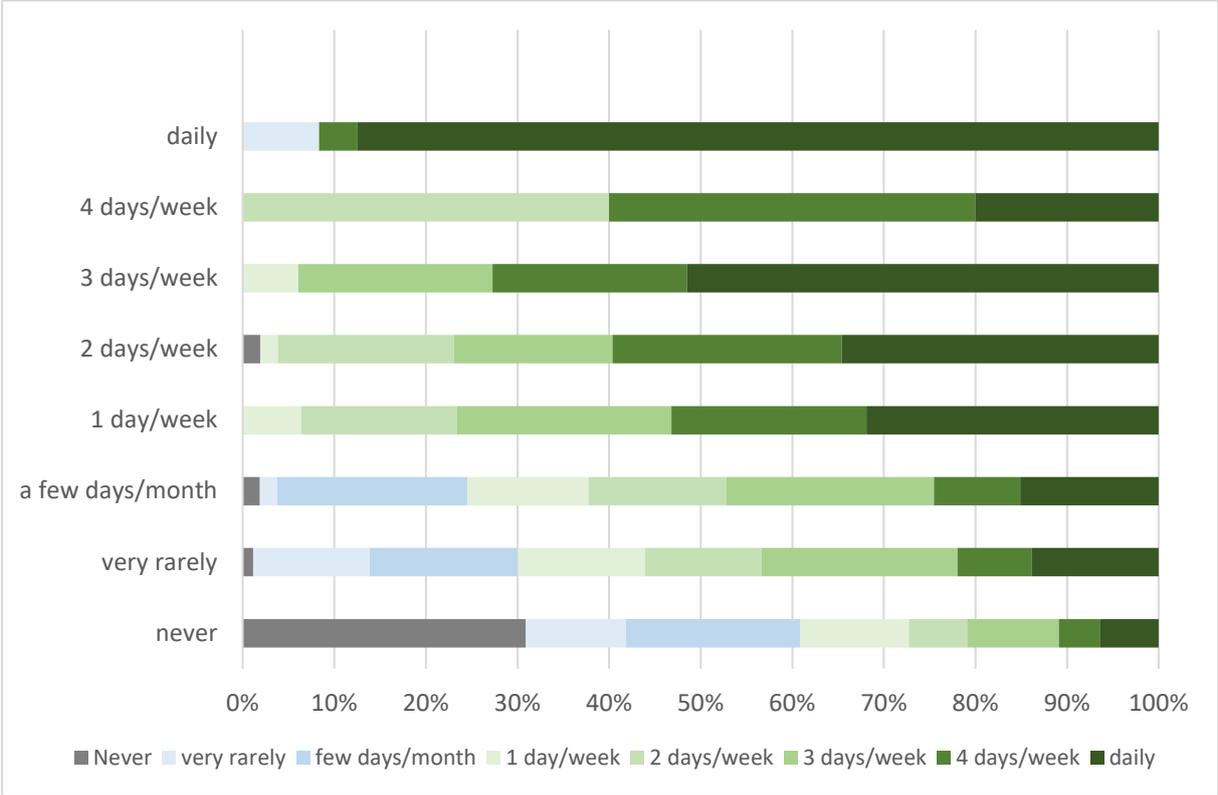


Source: Borderstep, n = 500

The bandwidth of the internet connection differs significantly among the respondents. Of the respondents, 8% had up to 16 Mbps, 24% had up to 50 Mbps, 30% had up to 100 Mbps, 13% had up to 250 Mbps and 12% had more than 250 Mbps. 12% made no statement.

The frequency of home office use in November 2020 correlates significantly at the 1% level with the frequency of home office use in the period before the pandemic. The more frequently the home office was used in the past, the higher the number of days in the home office has now increased.

Figure 15: Days in the home office of business travellers in Germany in November 2020 depending on pre-pandemic use



Source: Borderstep, n = 497 (reading aid: frequency of use before the lockdown (y-axis), use in November 2020 (x-axis))

At least those business travellers who frequently work in a home office are likely to have suitable equipment at their disposal at present. 88% of those working in a home office have a stable internet connection, and about 80% are equipped with hardware and software and have access to company data. The weak point is the workroom. Only 55% of the business travellers surveyed have a separate workroom at home.

The frequency of home office use is related to available technical equipment and correlates with the presence of a workroom (weak correlation, Kendal-Tau-b = 0.111, significant at the 1% level), the availability of company data (weak correlation, Kendal-Tau-b = 0.165, significant at the 1% level) and good software (weak relationship, Kendal-Tau-b = 0.116, significant at the 1% level) as well as a stable internet connection (weak relationship, Kendal-Tau-b = 0.102, significant at the 5% level). Interestingly, no correlation can be seen with the available hardware or the bandwidth of the internet connection. In terms of bandwidth, this leads to the conclusion that all the usual bandwidths are sufficient for exchanging data with the company as well as for video conferencing, which is frequent in the home office, and that high-speed internet is more important for leisure uses such as video streaming or gaming.

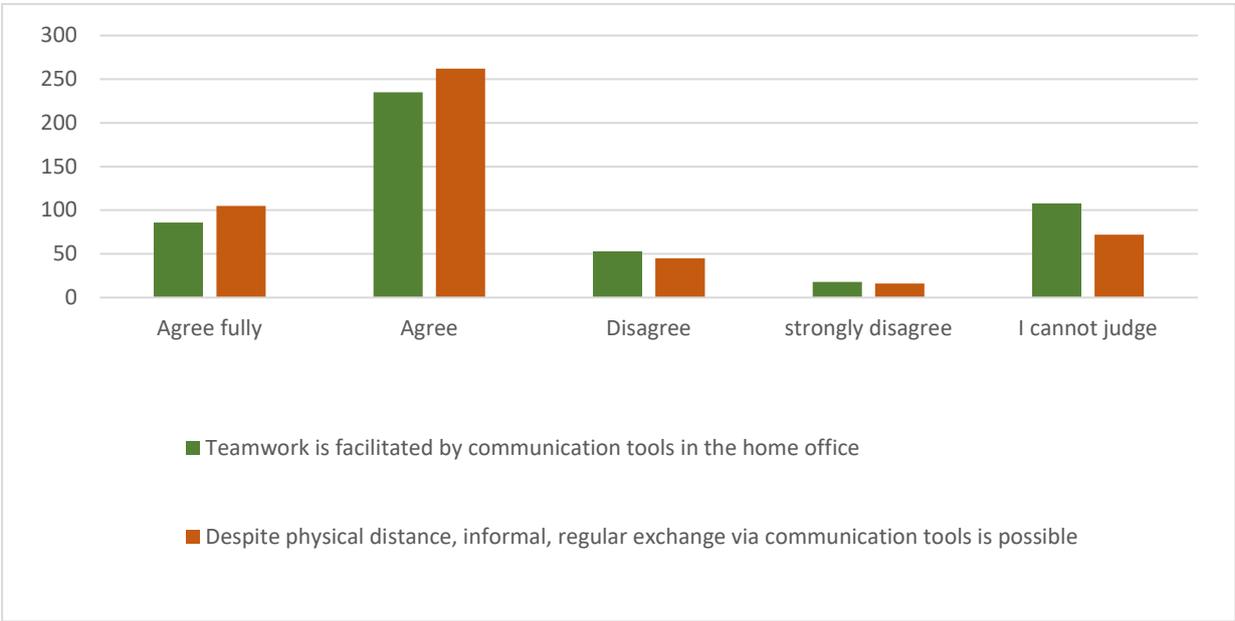
Table 3: Equipment in the home office of business travellers in Germany

Equipment feature	Yes	No	No answer
I have a stable internet connection at home.	88	12	1
The IT software equipment is sufficient at home.	82	15	3
The IT hardware equipment is sufficient at home.	81	17	2
I have access to company data at home.	80	17	3
I have my own workspace at home.	55	43	2

Source: Borderstep, n = 500, in percent

Communication tools such as Slack or Trello are seen as supporting collaboration. 17 % of the respondents fully agree, 47 % agree, 11 % disagree and 4 % absolutely disagree with the statement "Collaboration in the team is facilitated by communication tools in the home office". 22 % cannot assess this. 21 % of respondents fully agree with the statement "Despite physical distance, informal, regular exchange via communication tools is possible", while 52 % agree, 9 % disagree and 3 % absolutely disagree here.. 14 % cannot assess this.

Figure 16: Assessment of communication tools by business travellers in Germany



Source: Borderstep, n = 500

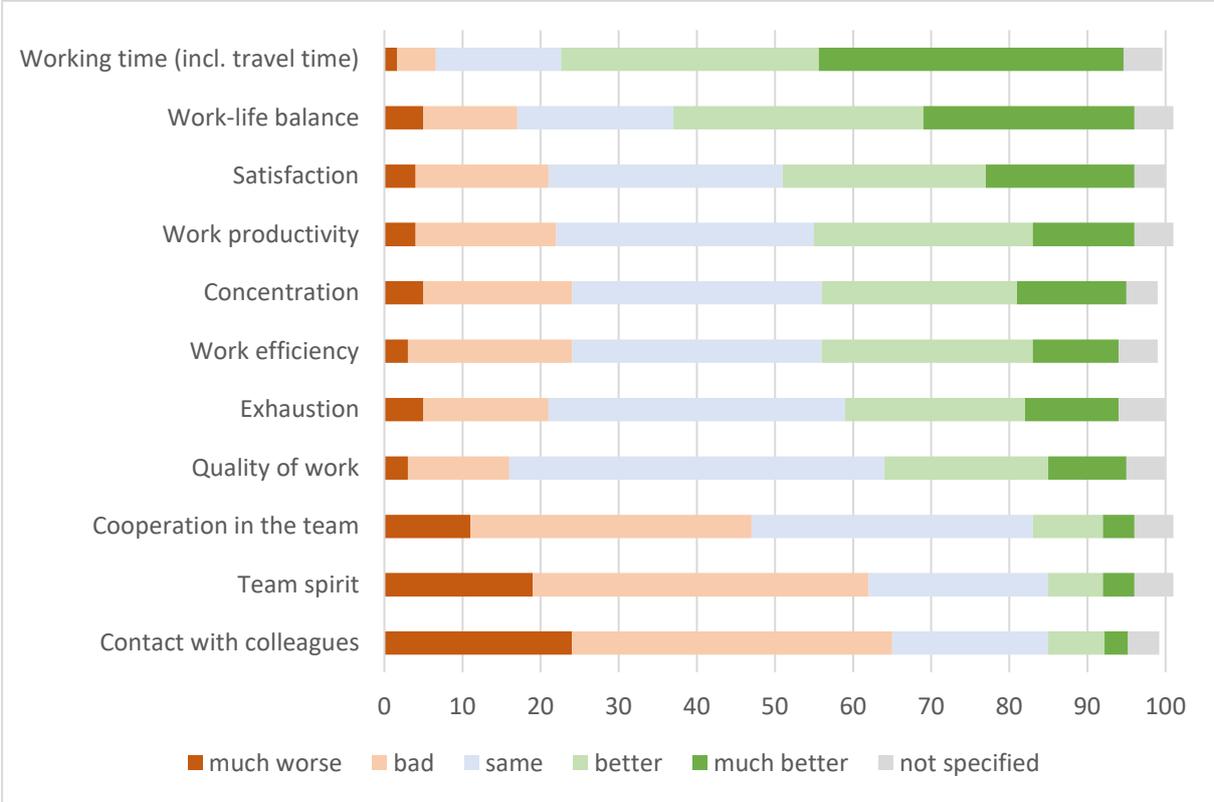
From the perspective of senior management, cooperation in the team is facilitated somewhat more by communication tools (weak correlation, Kendal-Tau-b = 0.105, significant at the 1% level). There are no correlations with age or gender.

The experiences in the home office are divided. While working and travelling time are significantly reduced and the work-life balance and satisfaction are improved for most respondents, the majority perceive a significant deterioration in teamwork, team spirit and contact with colleagues. With regard to their own work and the criteria of work productivity, concentration, work efficiency and ex-

haustion, about 35% to 40% see improvements and 20% to 25% see deteriorations. In these assessments, there are no significant differences in the assessment by management on the one hand and employees working in lower management levels on the other.

While 16% perceive a poorer quality of work, 31% see the quality of work in the home office as better.

Figure 17: Business travellers' experiences with home office compared to working in the company



Source: Borderstep, n = 500, in percent

The time advantage is also very clear when working in a home office and has just as intensive an effect on saved working time as on added free time.

Table 4: Impact of home office work on work and leisure time of business travellers in Germany

Effects on working time						
	Not specified	I work much more	I work a little more	Little changes	I save a little working time	I save a lot of working time
Home office in relation to presence in the company	5	3	8	29	29	27
Effects on leisure time						
	Not specified	I have much less free time	I have a little less free time	Little changes	I have a little more free time	I have much more free time
Home office in relation to presence in the company	5	2	5	30	33	24

Source: Borderstep, n = 500, figures in percent

It is surprising that a correlation between the daily commuting distance and the working time or free time saved cannot be established. However, with increasing commuting distance to the office, teamwork from the home office (cf Figure 17) is also perceived as somewhat better (weak correlation, Kendal-Tau-b = 0.096, significant at the 1 % level).

6.2 Views on the home office

In response to the open question "What unexpected **benefits** do you currently see from working from home? What do you think speaks in favour of using this option more often in the future?", time savings were mentioned by 124 respondents. For many respondents, greater flexibility in organising their work was also important (90), as was the possibility to work more efficiently or with greater concentration (81). An improved work-life balance (80), the elimination of travel to the place of work (66) and the associated cost savings (35). Environmental benefits were (only) mentioned by seven respondents. The following statements (verbatim quotes, translated) came from individual respondents:

- *That [the advantageousness] depends 100 % on the task at hand. I mostly sat alone in the office anyway and worked away, occasionally I went next door to ask something or to get a coffee or to have a chat. If you have to work hand in hand with colleagues or do tasks in different work areas, you have real problems. For example, you could do away with half of all offices at universities, where assistants or professors almost always sit alone at their desks anyway. An online connection to the secretary is enough. But it's also a question of character. Some people need a permanent drive and contact with colleagues. Other people manage fine on their own and can structure their working day well.*
- *I have been doing home office for 7 years. It just works.*
- *I work more efficiently and with less distraction. I don't have to maintain personal contact with colleagues I don't like to work with. I can organise my working time much better throughout the*

day and it is also easier to work flexible hours. You can also have [private] appointments during the day and then work longer in the evening.

- *You don't start the day with stress, e.g. because of the journey (to work). I can accept parcels now and don't have to collect them from the post office the following day in the evening.*
- *Further training opportunities can be better utilised.*
- *I/we could all prove how well our work is also done from home. By not having to travel to work, we can all work in a much more relaxed and efficient way; and at our own bio-rhythm.*
- *Being able to work from home, especially when the children are sick, would be really good. You wouldn't have a guilty conscience towards both the children and the employer.*
- *The "set-up times" are shorter, i.e. travel time, putting on a suit/tie, etc. You just start working in the morning.*
- *Time savings, as well as the possibility to do household chores at home during breaks. But above all, it is an immense cost saving: instead of the expensive canteen or nearby restaurants, you can cook something at home cheaply, because unlike in the office, a complete kitchen is available.*
- *I can work in peace and don't constantly have a colleague standing next to me who needs help. Everyone is now forced to work independently. More free time, because about 2 hours of travel time are saved. I can sit in front of the screen in comfortable clothes and take a midday nap. Since I get my work done faster in the home office, I can still do housework in between.*

In response to the open question "What disadvantages or obstacles do you see - also for yourself personally - to working from home? What do you think speaks against using this option more often in the future?", 135 respondents pointed to the danger of losing personal contact. For 43 respondents, distracting surroundings are a problem (43), because it is difficult to separate private and professional life (35). Some also think that team spirit is lost (36), internal communication suffers as a result of home office (30) and personal isolation is also feared (27). Only rarely is the lack of equipment in the home office a problem (21). The following statements (verbatim quotes, translated) came from individual respondents:

- *Contact with colleagues disappears. Supervisors only recognise you as a production machine and no longer as a human being. In some projects, misunderstandings can arise that would be discovered immediately in direct contact (desk to desk, so to speak). You get sloppy, because dressing smartly doesn't really happen in the home office. Hoodies and jeans are quite comfortable, but they give you more of a leisure feeling. Since the home office can be reached in 1 minute, there is a great danger that after the "Tatort" show, you will still be doing tasks in the evening that would otherwise have been on your agenda on Monday morning.*
- *The people I know with home offices finish at 4 p.m. on the dot and the extra work is done the next day. Everyone logs in about half an hour earlier in the morning because no one sees that they are still having breakfast or a shower. As a single person, I also see the social distance. Locked up in the flat all day without social contact. Since I'm not from this city myself, I have neither family nor many friends. I also miss the exercise that I at least get in the office. My working*

hours would shift to the late evening, as I'm not a morning person. So it's all rather counterproductive.

- *One is more quickly tempted to work longer than the daily working hours allow. It's harder to finish work because you can always go back to the PC quickly. Unfortunately, I can also be reached by phone after work in the home office, which is not the case in the office when I leave it. When I leave the office, I'm off work. That's hard to do in the home office.*
- *I can't concentrate that well. The advantage of accepting parcels, for example, quickly becomes a disadvantage again when you have to get to grips with an issue all over again.*
- *Bad concentration as there is no office of one's own. Contact with colleagues is not the same as personal contact*
- *Reachability of team colleagues, asking a quick question on the fly. Team cooperation is almost lost. Short informal contacts in the corridor or over coffee are missing. Going to the canteen with the boss and catching up on decisions on the side is missing. Many informal processes of an organisation are lost through isolation in the home office and cannot be replaced by software, because e-mail, notes, etc. always give it an official character.*
- *You are alone too much. If you are single, you are extremely lacking in social contacts. You only stay in your flat and move from your workplace to the couch.*
- *Connecting with the team and other work colleagues on site - that's where the home office is a killer of any kind of exchange and communication on a personal level.*
- *Home office requires a high degree of self-discipline and self-motivation. Also, the office equipment may not be as ergonomic as in the office (height-adjustable desk or ergonomic desk chair).*
- *Networking falls completely flat. What used to be possible as a small exchange of information over coffee or in the corridor is now only possible via appointments with a conference. The communication overhead is much greater. Teamwork definitely suffers.*
- *The boss thinks home office is only "a goodie" for trusted employees. She seems to be more worried about losing control. This has an impact on appraisals.*

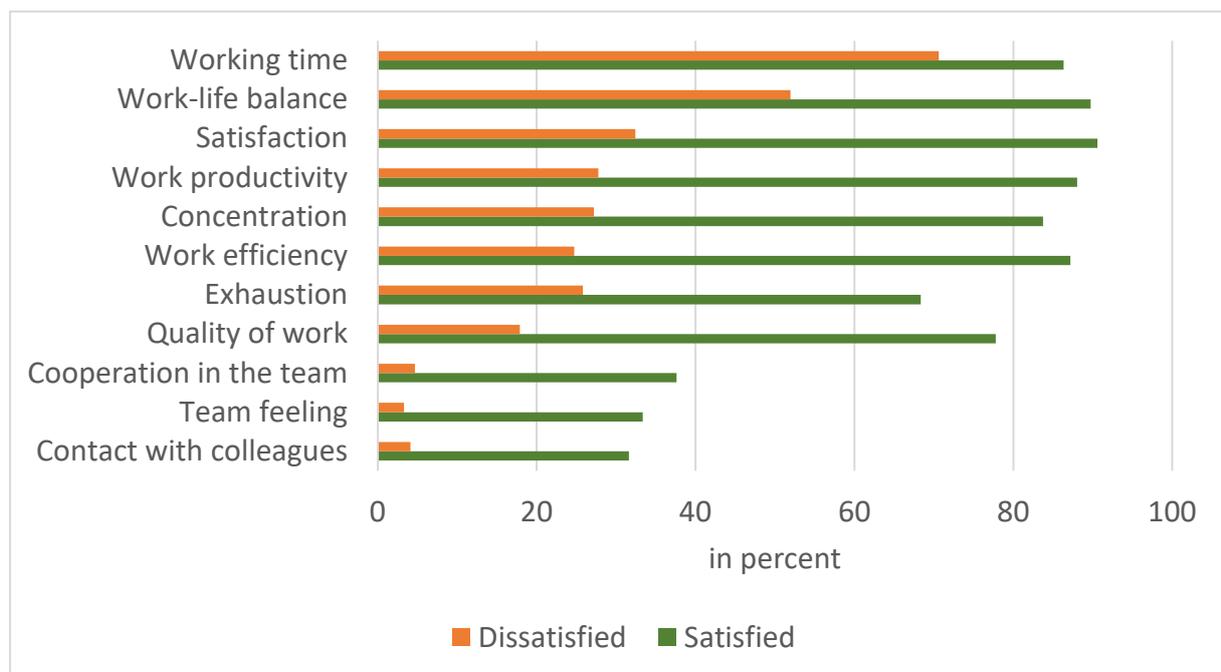
A lot of respondents from the group of business travellers would like to spend more working time in the home office in the future. 22% would like to use it every day, 44% two to three days a week, 26% now and then and only 7% not at all. The desire for more home office proves to be independent of gender and the number of adults or children in the household. It is somewhat more pronounced among younger people than among older people (weak correlation, Kendal-Tau-b = 0.082, significant at the 5% level). A higher daily commuting distance shows no correlation with the desire for more home office.

6.3 Satisfied and dissatisfied users

Overall, all answers on experiences with home office correlate highly with each other (medium and strong correlations, significant at the 1 % level). A cluster analysis of the answers to the question

about "experiences with home office compared to work in the company" (Figure 17) with the formation of two clusters shows two groups of users whose experiences with home office differ significantly. 117 participants in the survey can be assigned to the group of "satisfied adopters", 364 respondents to the group of "dissatisfied adopters" (19 respondents cannot be assigned because they did not provide any information). The answers to the questions already shown in Figure 17 very greatly for both groups. The following figure shows the answers "better" and "much better" of the satisfied smaller group and the answers of the less satisfied in comparison.

Figure 18: Experiences with home office of business travellers compared to work in the company according to usage group (proportion of mentions "better" or "much better" of the 117 satisfied and the 364 dissatisfied)



Source: Borderstep, n = 481, in percent, satisfied n = 117, dissatisfied n = 364

With the exception of the advantageousness of working hours and the work-life balance, which are also perceived by the majority of the "dissatisfied" (72 % and 52 %), the answers of the dissatisfied only show a proportion of approx. 20 % to 30 % who perceive a slight or significant improvement. Among the satisfied, it is 70 % to 90 %, depending on the factor.

However, these percentages are significantly lower for the questions on cooperation in the team. For the three factors "cooperation in the team", "team spirit" and "contact with colleagues", only 30 % to 40 % of the satisfied perceive improvements. In the dissatisfied group, only 3 % to 5 % perceive improvements.

The assignment to the clusters correlates with gender. Women tend to be in the dissatisfied cluster (very weak correlation, Kendal-Tau-b = 0.092, significant at the 5 % level). No correlation can be seen with the other demographic characteristics or the characteristics of the organisation. However, there is a correlation with the performance of the internet connection (weak correlation, Kendal-Tau-b = -

0.105, significant at the 1% level) as well as with the daily commuting distance (very weak correlation, Kendall-Tau-b = -0.088, significant at the 5% level). A significant correlation is also found with regard to the desire to work more in a home office in the future (weak correlation, Kendall-Tau-b = 0.195, significant at the 1% level). 45% of those who are satisfied would like to use it every day, another 44% on two or three days a week. Among the dissatisfied, 15 % would like to have a permanent home office and an astonishing 44 % would like to use it two or three days a week.

Ultimately, there is a group of individuals across age groups, hierarchies and jobs in the company who obviously see the home office as an opportunity and experience it as positive. A group that is more than three times as large associates various disadvantages with the home office. But even in this group, about 60 % would like to use the home office two or three days a week or more often. In the planned empirical format "focus group" as well as in the second wave of the survey, attempts should be made to learn more about these groups.

6.4 Climate protection potential through increased use of the home office

Calculating the climate protection potential of more days in the home office is not easy. Basically, it would have to take into account:

- (1) The saved effort for travelling to the workplace,
- (2) necessary additional journeys that used to be done during commuting,
- (3) a possible effort for heating the home office, if this is additional,
- (4) renting larger flats in the medium term to have space for the home office,
- (5) choosing a place of residence further away from the workplace, as commuting distance becomes less important⁹,
- (6) medium-term savings in the effort of providing (heated) office space by the employer.

At this point, only the saved effort for travelling to the workplace can be estimated on the basis of the data collected. With a view to the planned second wave of the survey, it seems necessary to ask about points 2 to 4. In order to estimate the possible climate protection potential of an increased use of home office as an alternative to face-to-face working time in the company, the following procedure is used:

The starting point is the average commuting distance for the entire working population¹⁰. Working people in Germany cover a distance of 21 km every working day to commute to work (Nobis and

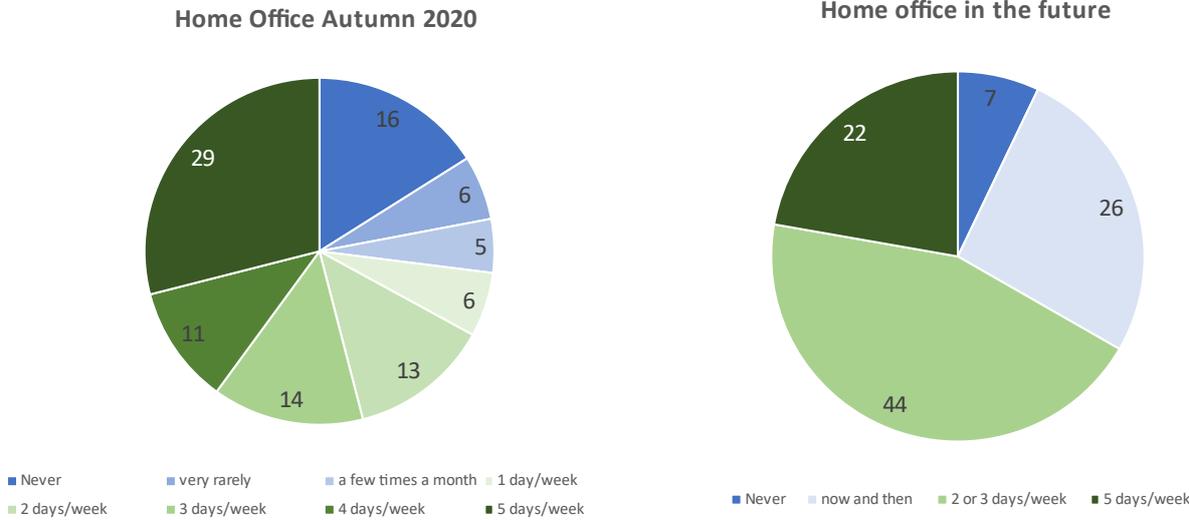
⁹ Bitkom (2021) reports that in the case of predominantly working from home, about 20 % of all professionals would move to the countryside, to a more attractive city or closer to friends and family. This could significantly reduce the commuting distances saved, as people would travel less frequently, but further.

¹⁰ It is assumed that the daily commuting distance is independent of whether a person makes business trips or not.

Kuhnimhof, 2018, p. 104). With approximately 45 million people in employment nationwide (Statistisches Bundesamt, 2020a), a total distance of 945 million km can be expected to be travelled to work each working day. With approx. 209 working days per year, this ¹¹ results in a total distance of approx. 197 billion km per year. This total distance already includes the fact that home offices have also been used in the past. According to the Federal Statistical Office, before Corona 5.5 % of all employed persons used the home office daily or at least half of their working time. Another 7.3% worked from home on less than half of the working days (Destatis, 2020). If we assume 3 days of home office per week for the first group and one day per week for the second, we would expect that home office was already used on approx. 4.8 % of all working days.

The number of days in the home office is likely to increase in the future, the survey shows. The group of business travellers surveyed would like to see almost as many days in the home office in the future as in November 2020, about 40 % of all working days.

Figure 19: Days in home office currently (November 2020) and wish for the future



Source: Borderstep 2020 survey with 500 responses

Source: Borderstep, n = 500, figures in percent

When assessing the figure "40 % of all working days in the home office", two aspects need to be considered. Firstly, it must be taken into account that according to Stürz, Stumpf and Mendel (2020), 57 % of all employed persons did not work in a home office at all during the lockdown. The perceptions of the group of business travellers surveyed here will therefore primarily refer to those approx. 43 % of employees who have also sometimes worked in a home office in the past. If we relate the 40 % days in the home office to only 43 % of all employed persons, this results in approx. 17 % of all working days in the home office. If the desire for 40 % days in the home office cannot be realised due to

¹¹ The assumption is based on an average of 250 potential working days per year and deducts 30 days of holiday. In addition, an average of 11 sick days is taken into account (Statistisches Bundesamt, 2020b)

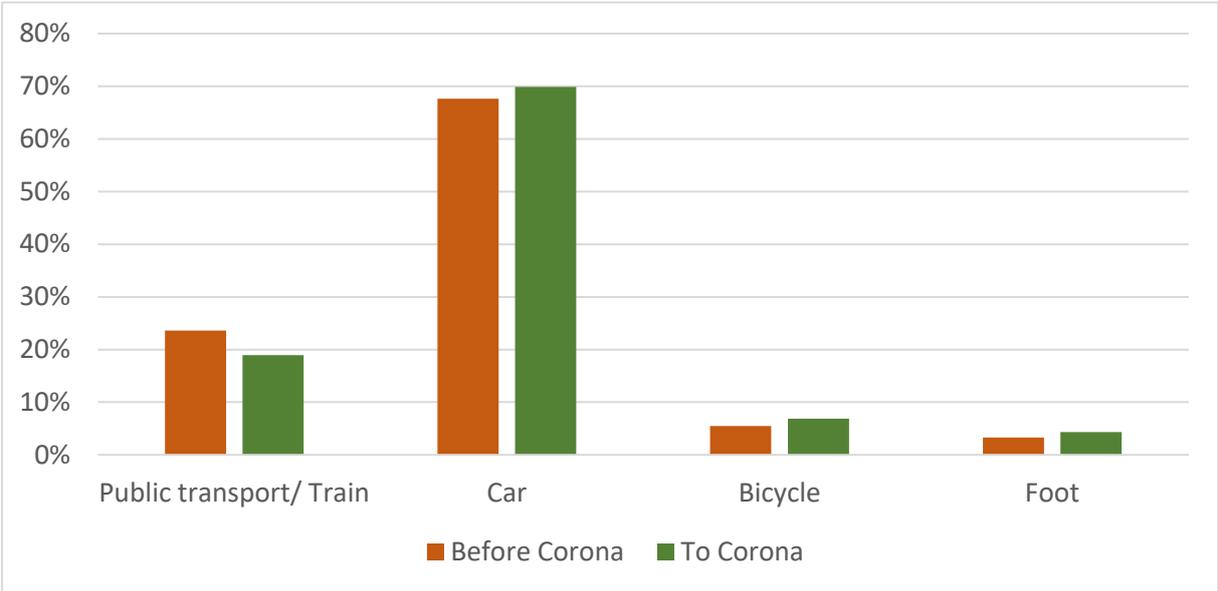
the requirements of the work processes or other ideas of the employer, then the resulting level will be lower. If we assume that a level of 30 % days in the home office manifests itself in work reality, then this results in approx. 12.9 % of all working days of all employees in the home office. If we also take into account the previous level of 4.8 % of home office days estimated on the basis of the Federal Statistical Office (Destatis, 2020), this results in an increase of 8.1% of all home office working days.

The total distance for commuting to work of approx. 197 billion km/a calculated above would thus be reduced by 8.1 % or 16 billion km/a.

The calculation of greenhouse gas emissions from the use of the various means of transport for these journeys is carried out on the basis of data from the Federal Environment Agency (UBA, 2020).

Data on the modal split for commuting before the Corona pandemic and the expected change in the modal split in the post-Corona period was collected as part of the survey. 443 people provided complete information (commuting distance as well as modal split) on their commuting behaviour before Corona. The daily single commuting distance was given as approx. 17.8 km and distributed among the modes of transport as shown in Figure 20. For the expected commute in the time after Corona, 430 people gave complete information. The daily commuting distance remains the same.

Figure 20: Modal split of commuting performance before and after Corona



Source: Borderstep, n = 443 (before Corona) and n= 430 (after Corona)

Total commuting distance could be reduced by 8.1% (see above) from 197 billion km/a to 181 billion km/a through additional days in the home office as shown above. Together, both change the CO₂ emissions from commuting.

Table 5: Estimated change in modal split and greenhouse gas emissions due to commuting

	Distance before Corona in billion km/a	Greenhouse gas emissions before Corona in million t CO ₂ eq/a	Distance after Corona in billion km/a	Greenhouse gas emissions after Corona in million t CO ₂ eq/a
Public transport/train	44,9	1,44	33,2	1,06
Car	128,6	19,30	122,6	18,38
Aeroplane	6,7	1,54	5,6	1,29
Bicycle	10,4	0,00	11,9	0,00
On foot	6,3	0,00	7,6	0,00
	197	22,27	181	20,73

Source: Borderstep, based on n = 443 (before Corona) and n= 430 (after Corona)

Despite a decreasing total distance, the respondents expect that the absolute distance travelled by bicycle and on foot will also somewhat increase.

Rail and public transport could record a significant decline. Of the drop of 11.7 billion pkm/a, 3.6 billion pkm/a can be explained by the increase in home office, 8.2 billion pkm/a are due to the change in the modal split expected by the respondents.

The share of car journeys decreases by 6 billion km/a in absolute terms. Here, the effect of increased home office, which would reduce the distance travelled by car by 10.4 billion km/a, and the effect of the changed modal split, which would add 4.4 billion km/a, add up.

33 out of a total of 500 respondents (6.6%) also indicate air travel as a means of transport in the modal split of their commute to work. Four of these people state that they (almost) exclusively fly to work, while the others combine air travel with rail, car or cycling as well as walking. Among the respondents who state that they fly to work, at best an increased share of 30% of employees in upper management (share of the total sample 16%) is interesting. Without being able to ask, it is possible that these people belong to the group of long-distance commuters who travel to work "during the week" from their second home and make their way home by plane at the weekend.¹² This group could represent a "shadow" of the extreme commuter group, e.g. including some of the 4,500 Berliners and 2,500 Hamburgers who commute to Munich (DGB Bundesvorstand, 2016).

The two effects of the route reduction and the changed modal split taken together lead to a reduction in greenhouse gas emissions from commuting of approx. 1.5 million t. CO₂eq/a. This figure represents the saved effort for travelling to work, which would be possible from the perspective of the employees. However, these effects can only occur if a large number of employees are enabled by companies to work in a home office in the long term. However, the companies' perspectives also

¹² It is also striking that only nine of these 33 people state "more than 30 kilometres" for the length of their normal commute. This could indicate that the distance between the second home and the workplace was noted as the answer to this question.

stand in the way of this. According to Stettes and Voigtländer (2021), *"currently two-thirds of companies do not aim to enable more employees to work from home after the Corona crisis."* The figures calculated above from the perspective of the employees are therefore very likely to be higher than the development that will result when the interests of the companies and the employees are weighed up.

In order to assess the validity of this savings expectation, it would be necessary to gain additional knowledge on a number of rebound effects and supporting effects. As mentioned above, these include:

- necessary additional journeys that used to be done during commuting,
- a possible effort for heating the home office, if this is additional,
- renting larger flats in the medium term to have space for the home office,
- choosing a place of residence further away from the workplace, as commuting distance becomes less important¹³,
- the possible medium-term savings in the cost of providing (heated) office space by the employer.

On the basis of the survey conducted, it can be estimated that, if it were up to the employees, the spread of home office would increase threefold compared to the pre-Corona period. However, it remains questionable whether this development will actually occur in view of the intentions of numerous companies (Stettes and Voigtländer, 2021) and whether an effective reduction in greenhouse gas emissions will be achieved. However, a number of effects can be assumed beyond this:

The reduction of the distance travelled by cars by approx. 6 billion km/a corresponds to the annual mileage of approx. 500,000 cars. However, a reduction in the number of cars cannot be expected, as this reduction is distributed among vehicles that serve numerous other purposes in addition to commuting (which is still necessary, albeit less frequently).

An increasing share of working days of office employees in the home office from just under 5 % to approx. 30 % could lead to a situation where not every 20th, but every third office workstation remains empty. In theory, companies could react to this by introducing desk sharing and radically reducing office space, which in turn could lead to considerable, but also currently unquantifiable, savings in energy and resource use. A study by the IW (Stettes and Voigtländer, 2021) indicates that a proportion of just under 10% of large companies are already specifically considering to reduce office space by the end of 2020 and over 40% are planning redesigns, e.g. the rededication of group or open-plan offices into smaller office units. The study by Stettes and Voigtländer (2021) makes no statements on the future of desk sharing intentions.

¹³ Bitkom (2021) reports that in the case of predominantly working from home, about 20 % of all professionals would move to the countryside, to a more attractive city or closer to friends and family. This could significantly reduce the commuting distances saved, as people would travel less frequently, but further.

It is also foreseeable that, following the pandemic, one or more campaigns will be needed to raise awareness of the restored "safety" of public transport and rail. If the expected permanent change in the modal split can still be avoided or reversed after some time, the above-mentioned 4.4 billion car-km/a could be won back for public transport, thus saving about half a million tonnes of CO₂ emissions from additional car journeys.

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Annex questionnaire (translated)

Climate protection potentials of the digital transformation (CliDiTrans)

Questionnaire for the online survey in November 2020

Video conferencing and face-to-face meetings

1. How often do you currently use and have used videoconferencing in the past?

	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	A few days a month	Very rare	Never
Before Corona	<input type="checkbox"/>							
In the lock-down	<input type="checkbox"/>							
Current	<input type="checkbox"/>							

2. How are your experiences with video meetings *internally* compared to face-to-face meetings regarding the following criteria?

	Much worse	bad	unchanged	better	Much better
Efficiency of the meeting	<input type="checkbox"/>				
Duration (incl. travel)	<input type="checkbox"/>				
Quality of the results	<input type="checkbox"/>				
Contact with colleagues	<input type="checkbox"/>				
Concentration/Focus	<input type="checkbox"/>				
Exhaustion	<input type="checkbox"/>				

3. How are your experiences with video meetings compared to face-to-face meetings *with clients or other external partners with* regard to the following criteria?

	Much worse	bad	unchanged	better	Much better
Efficiency of the meeting	<input type="checkbox"/>				
Duration (incl. travel)	<input type="checkbox"/>				
Sales success	<input type="checkbox"/>				
Quality of the results	<input type="checkbox"/>				
Contact with clients/external persons	<input type="checkbox"/>				
Concentration/Focus	<input type="checkbox"/>				
Exhaustion	<input type="checkbox"/>				

4. Based on your lock-down experience, how do you rate *video conferencing*? [Multiple answers possible]

Video conferences ...	Fully agree	Agree	Disagree	Fully disagree	I cannot judge
... are an adequate substitute for face-to-face meetings	<input type="checkbox"/>				
... enable effective verbal as well as non-verbal communication	<input type="checkbox"/>				
... are more focused and concentrated than face-to-face meetings	<input type="checkbox"/>				
... are well suited for presenting products as well	<input type="checkbox"/>				
... work technically without problems	<input type="checkbox"/>				
... complicate the exchange of information	<input type="checkbox"/>				
... exacerbate communication problems in the team	<input type="checkbox"/>				
... take far too long	<input type="checkbox"/>				
... are more exhausting than face-to-face meetings	<input type="checkbox"/>				
... lead to the loss of personal relationships with interlocutors, colleagues, etc.	<input type="checkbox"/>				
... are now carried out far too often or on occasions that are not absolutely necessary.	<input type="checkbox"/>				

5. What software do you use to conduct videoconferences?

Microsoft Teams	<input type="checkbox"/>
Zoom	<input type="checkbox"/>
WebEx	<input type="checkbox"/>
Skype	<input type="checkbox"/>
Other, _____	<input type="checkbox"/>

6. Which types of conversations can you imagine in the future via video conference, which should remain face-to-face or when is both possible?

	Always as a video conference	Majority as video conference	Both	Majority personal	Always Personal
Detailed discussions with customers or suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Decision-making talks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Counselling interviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sales talks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visits to customers or suppliers (e.g. their production facilities)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Press dates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Talks for the purpose of lobbying	<input type="checkbox"/>				
Regular team meetings / jour fixe	<input type="checkbox"/>				
Project meetings	<input type="checkbox"/>				
Job interviews	<input type="checkbox"/>				
Staff appraisals	<input type="checkbox"/>				
Creative exchange	<input type="checkbox"/>				
Contract negotiations	<input type="checkbox"/>				

7. What unexpected benefits do you currently see from the increased use of video conferencing? What exactly will offer you added value for your work in the future?

8. What disadvantages or obstacles do you see - also for yourself personally - in conducting video conferences?

Home office

9. How often do you currently work and have you worked in a home office in the past?

	1 day per week	2 days per week	3 days per week	4 days per week	5 days per week	A few days a month	Very rarely	Never
Before Corona	<input type="checkbox"/>							
In the lock-down	<input type="checkbox"/>							
Current	<input type="checkbox"/>							

10. How well equipped are you at home to do your work?

	Yes	No
I have my own workspace at home	<input type="checkbox"/>	<input type="checkbox"/>
I have a stable internet connection at home	<input type="checkbox"/>	<input type="checkbox"/>
I have access to company data at home	<input type="checkbox"/>	<input type="checkbox"/>
The IT hardware equipment is sufficient at home	<input type="checkbox"/>	<input type="checkbox"/>
The IT software equipment is sufficient at home	<input type="checkbox"/>	<input type="checkbox"/>

11. What bandwidth do you have at home?

Up to 16 Mbit/ s	<input type="checkbox"/>
Up to 50 Mbit/ s	<input type="checkbox"/>
Up to 100 Mbit/ s	<input type="checkbox"/>

- Up to 250 Mbit/ s
- More than 250 Mbit/ s
- I do not know

12. How much do communication tools (such as Slack or Trello) help you to work efficiently with your colleagues in the home office?

	Fully agree	Agree	Disagree	Fully disagree	I cannot judge
Teamwork is facilitated by communication tools in the home office	<input type="checkbox"/>				
Despite physical distance, an informal, regular exchange is possible via communication tools	<input type="checkbox"/>				

13. How do you rate your *individual experiences* in the home office compared to working in the company with regard to the following categories?

	Much worse	bad	Unchanged	better	Much better
Work efficiency	<input type="checkbox"/>				
Work productivity	<input type="checkbox"/>				
Quality of work	<input type="checkbox"/>				
Working time (incl. travel time)	<input type="checkbox"/>				
Contact with colleagues	<input type="checkbox"/>				
Team spirit	<input type="checkbox"/>				
Teamwork	<input type="checkbox"/>				
Concentration	<input type="checkbox"/>				
Exhaustion	<input type="checkbox"/>				
Work-life balance	<input type="checkbox"/>				
Satisfaction	<input type="checkbox"/>				

14. How do you assess home office for yourself in the long term?

- I would like to use it every day
- I would like to use it two or three days a week
- I could use it from time to time
- I do not want to use it as a matter of principle

15. What unexpected benefits do you currently see from working from home? What do you think speaks in favour of using this option more often in the future?

16. What disadvantages or obstacles do you see - also for yourself personally - to working in a home office? In your opinion, what speaks against using this option more often in the future?

Mobility: Business trips

17. How many business trips did you make per month before the Corona pandemic? And what is your estimate for the future (after the pandemic)?

	No business trips at all	Less than 5	5 to 10	10 to 20
Before Corona	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Future/ after the end of the pandemic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. How many kilometres did you travel on business trips per month on average before the Corona pandemic? And what is your estimate for the future (after the pandemic)?

Before Corona _____ km

Future/ after the end of the pandemic _____ km

19. Please estimate in percentage terms how much you have chosen and are likely to choose which means of transport for business trips?

	Public Transport / Rail	Car	Aeroplane	Bicycle	On foot
Before Corona	%	%	%	%	%
Future/ after the end of the pandemic	%	%	%	%	%

20. Are face-to-face or analogue meetings (and thus business trips) dispensable in your view?

Yes, because

no

21. (if no) In your opinion, which business trips or personal meetings cannot be dispensed with? What are the reasons?

Business trips:

Reasons:

Mobility: Daily commute

22. Which means of transport do you prefer for your daily commute? Please provide a rough estimate of the means of transport you use(d) on your way to work before the pandemic and after the pandemic.

	Public Transport / Rail	Car	Aeroplane	Bicycle	On foot
Before Corona	%	%	%	%	%
Future/ after the end of the pandemic	%	%	%	%	%

23. How many kilometres do you normally travel to work (per trip)?

- < 5 Km
- 5 to 10 Km
- 10 to 19 Km
- 20 - 29 Km
- 30 and more km

Workplace and time aspects

24. In which industry do you work?

- Construction
- Education
- Chemistry & Pharma
- Services
- Energy industry
- Finances & Insurances
- Health, Medicine & Social Services
- Trade & Consumer Goods
- Craft
- Information and communication technology
- Culture, Entertainment & Event
- Agriculture
- Public administration
- Manufacturing industry
- Textile & Fashion
- Tourism, Hospitality & Leisure
- Traffic, Transport & Logistics
- Science
- Other

25. At what level do you classify your job in your company?

Upper management	<input type="checkbox"/>
Middle Management	<input type="checkbox"/>
Lower management	<input type="checkbox"/>
Without management responsibility	<input type="checkbox"/>

26. In which field of activity do you work for your employer?

Management	<input type="checkbox"/>
Human Resources	<input type="checkbox"/>
Bookkeeping, Accounting, Finance	<input type="checkbox"/>
Procurement	<input type="checkbox"/>
Research & Development	<input type="checkbox"/>
Manufacturing, Production	<input type="checkbox"/>
Quality assurance	<input type="checkbox"/>
PR, Public Relations, Marketing	<input type="checkbox"/>
IT, hardware administration	<input type="checkbox"/>
Sales and customer care	<input type="checkbox"/>
Logistics, Materials Management	<input type="checkbox"/>
Education and training	<input type="checkbox"/>
Health and care	<input type="checkbox"/>
Other*: _____	<input type="checkbox"/>

* Please enter field of activity!

27. How big is your company?

- Up to 49 employees
- Up to 249 employees
- From 250 employees

28. And how do you assess the working time factor in connection with video conferences and home office?

	I save a lot of working time	I save a little working time	Little changes	My working hours have increased slightly	My working hours have increased greatly
Video conferencing compared to business travel?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Video conferencing compared to real meetings	<input type="checkbox"/>				
Home office in relation to presence in the company	<input type="checkbox"/>				

29. And how do you rate the factor of free time in the context of video conferences and home office?

	I have much more leisure	I have some more leisure	Little changes	I have some less Leisure	I have much less Leisure
Video conferencing compared to business travel?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Video conferencing compared to real meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Home office in relation to presence in the company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Demography

30. Please indicate your gender!

- female
- male
- nonbinary

31. How old are you?

- Under 30
- 30 to 39
- 40 to 49
- 50 to 59
- 60 and older

32. How many people live in your household?

Adults / Children