MI-LINK

Travel to Milton Park through and beyond the COVID-19 Pandemic

Impacts on working patterns and propensity to use public transportation

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Executive Summary

The MultiCAV research and development project, co-funded by Innovate UK and the Centre for Connected and Autonomous Vehicles, was established to deliver sustainable transport services in a 'Mobility as a Service' environment. The centrepiece of the project was a series of three phases of electric autonomous bus service trials, first operating on public roads within Milton Park Technology and Science Park, Didcot (Oxfordshire) and later linking to Didcot Parkway railway station. The demonstration services took place in 2023 and were branded to the public as part of the Mi-Link[1] suite of transport services. The project was conducted by a consortium which brought together First Bus as lead, Milton Park, Oxfordshire County Council, Nova Modus, Fusion Processing[2], Zipabout, and the University of the West of England (UWE Bristol).

The project started in 2018, but the emergence of the Covid-19 pandemic in the first quarter of 2020 created a changed context for the project linked to the physical separation measures introduced to reduce spread of the virus. A work-from-home directive was issued in March 2020 and people were also advised to avoid using public transport systems. This changed context was of particular relevance to the Mi-Link project, as understanding the market potential for *shared* autonomous transport modes was a core aim of the project.

Hence, the project plan was revised to include a research work-package designed to examine how employee working patterns and perspectives on using shared autonomous transport systems changed over the course of the pandemic. The following research questions were posed:

1. How and why did ways of accessing employment at Milton Park (including commuting and working from home) change over the course of the pandemic and its aftermath?
2. To what extent were employees willing to:
    i. use a public transport vehicle shared with other people (in the context of a pandemic)?
    ii. use an autonomous vehicle with or without a safety driver on board?
3. How did willingness to use shared and autonomous transport change over time?

Responses to these questions were obtained through the administration and analysis of a three-wave panel survey, and analysis of data from four iterations of a cross-sectional annual travel-to-work survey of employees conducted by Milton Park.

Key findings from the two surveys

1. The Covid-19 pandemic prompted a profound and sustained increase in working from home amongst Milton Park employees:
    - The percentage of respondents working from home at least one day a week or more doubled from 24% before the pandemic to 48% of travel-to-work survey respondents in September 2022 (n=914).
    - The majority of respondents reported not facing difficulties with working from home (such as interruptions, lack of space, issues with internet connectivity) during the early stages of the pandemic, but the majority of respondents also reported missing talking to colleagues when working from home.

[1] See https://www.mi-link.uk/ for the public-facing website
[2] Initially a subcontractor to the project appointed through a procurement exercise, later a full project partner.

- The overall post-pandemic picture is one in which many Milton Park workers could be said to be balancing the best of both worlds - working from home more frequently than before the pandemic, but mixing this with commuting to the workplace throughout the week to complete work activities that require attendance at the workplace and to maintain social contacts. However, the extent to which the behaviour arises from choice and constraint was not clarified by the research.

2. Willingness to use shared public transport reduced significantly during the early stages of the pandemic, but confidence in using shared public transport services has largely recovered over time:
   - In July 2020, at the start of the pandemic, just 7% of panel survey respondents (n=283) noted that they would be willing to use a bus or train that was nearly full.
   - By September 2022 this had increased to 50% of travel-to-work survey respondents (n=854).

3. However, crowded public transport services remain undesirable to a significant number of employees:
   - In September 2022, 35% of travel-to-work respondents (n=854) still reported *not* being willing to use public transport services that were nearly full.
   - It is not known whether this is because the perceived risk of viral transmission remained or because crowded public transport services are undesirable in general.

4. Aside from the impact of the pandemic on working patterns, there has been a notable reduction in car commuting and an increase in bus commuting to Milton Park over the period:
   - The car commute mode share was 81% of travel-to-work survey respondents in 2019 (n=1004) compared to 62% of travel-to-work survey respondents in 2023 (n=1168).
   - The bus commute mode share was 5% of travel-to-work survey respondents in 2019 (n=1004) compared to 20% of travel-to-work survey respondents in 2023 (n=1168).

   The introduction of a low-cost (£20) annual bus pass for Milton Park employees in 2020 is likely to be a key factor explaining this change.

5. With respect to willingness to use autonomous vehicles, at this stage in the technology's development, respondents preferred a service model of autonomous buses having safety operators on board for use to be acceptable:
   - A majority - between 64% (in 2020, n=283) and 82% (in 2023, n=1054) of respondents agreed that they would be willing to use an autonomous ('driverless') vehicle with a safety operator on board. This compares to a lower share of between 40% (in 2020) and 45% (in 2022, n=863) of respondents agreeing that they would be willing to use an autonomous ('driverless') vehicle with no safety operator on board.
   - It is not clear if i) this will be a persistent view in practice, in which case it would have implications for the staffing of autonomous buses in the future, or ii) is a hypothetical view when people are asked 'in principle' and represents an ideal scenario but would not prevent them from using an autonomous bus without a driver in practice, or iii) is the view the reflects the early stage of implementation and that would decline swiftly with experience.

6. Exposure to real autonomous vehicle services and their marketing appears to be associated with more people becoming willing to use an autonomous vehicle with a safety operator on board.
   - Before the Mi-link autonomous bus trials, 74% of travel-to-work survey respondents reported willingness to use an autonomous vehicle with a safety operator on board (2022,

n=863). After the Mi-link autonomous bus trails, 82% of travel-to-work survey respondents reported willingness to use an autonomous vehicle with a safety operator on board (2023, n=1054).

- This increase in the proportion of respondents reporting a willingness to use autonomous vehicles with a safety operator on board comparing the before and after surveys is statistically significant (chi-square=22.1, df=2, p=0.000016) i.e. it is very unlikely that this level of difference in willingness to use autonomous vehicles would have been observed between the two samples if there had been no change in perspectives amongst the wider population of Milton Park employees.

1. Introduction

The Mi-Link research and development project, co-funded by Innovate UK and the Centre for Connected and Autonomous Vehicles, was established to deliver sustainable transport services in a 'Mobility as a Service' environment. The centrepiece of the project was a series of three phases of electric autonomous bus service trials, first operating on public roads within Milton Park Technology and Science Park, Didcot (Oxfordshire) and later linking to Didcot Parkway railway station. The demonstration services took place in 2023 and were branded to the public as part of the Mi-Link[3] suite of transport services. The project was conducted by a consortium which brought together First Bus as lead, Milton Park, Oxfordshire County Council, Nova Modus, Fusion Processing[4], Zipabout, and the University of the West of England (UWE Bristol).

The project started in 2018, but the emergence of the Covid-19 pandemic in the first quarter of 2020 created a changed context for the project linked to the physical separation measures introduced to reduce spread of the virus. A work-from-home directive was issued in March 2020 and people were also advised to avoid using public transport systems. This changed context was of particular relevance to the Mi-Link project, as understanding the market potential for *shared* autonomous transport modes was a core aim of the project.

Hence, the project plan was revised to include a research work-package designed to examine how employee working patterns and perspectives on using shared autonomous transport systems changed over the course of the pandemic. The following research questions were posed:

1. How and why did ways of accessing employment at Milton Park (including commuting and working from home) change over the course of the pandemic and its aftermath?
2. To what extent were employees willing to:
    i. use a public transport vehicle shared with other people (in the context of a pandemic)?
    ii. use an autonomous vehicle with or without a safety driver on board?
3. How did willingness to use shared and autonomous transport change over time?

Responses to these questions were obtained through the administration and analysis of a three-wave panel survey, and analysis of data from four iterations of a cross-sectional annual travel-to-work survey of employees conducted by Milton Park (see Table 1):

Table 1: Milton Park survey types and dates

Survey type	Survey dates	Sample size
Cross-sectional annual travel-to-work survey	September 2019	1004
Panel survey wave 1	16th Jul 2020 – 1st Sep 2020	306
Panel survey wave 2	25th Nov 2020 – 4th Dec 2020	173
Panel survey wave 3	14th Jul 2021 – 2nd Aug 2021	110
Cross-sectional annual travel-to-work survey	September 2021	756
Cross-sectional annual travel-to-work survey	September 2022	914
Cross-sectional annual travel-to-work survey	September 2023	1169

[3] See https://www.mi-link.uk/ for the public-facing website
[4] Initially a subcontractor to the project appointed through a procurement exercise, later a full project partner.

This report presents findings in relation to the research questions noted above, drawing on both the panel survey and the travel-to-work surveys. The next section provides further detail on the two survey methods. Findings are then presented in Section Three and conclusions in relation to the research questions are summarised in Section Four.

2. Survey methods

The panel survey was administered through an online questionnaire issued through three survey waves, which took place in July 2020 (Wave 1), November 2020 (Wave 2) and July 2021 (Wave 3). The pandemic response involved quite a rapidly changing sequence of rules and regulations relating to whether and how people were allowed to travel to work. Table 2 provides a timeline of key pandemic events and shows how the panel survey waves (indicated in grey shading) coincided with different pandemic periods. The content of each survey questionnaire is also summarised in Table 2.

Table 2: Key events in the Covid-19 pandemic response and timing of panel and travel-to-work surveys

Date	**Event**
23rd March 2020	UK full lockdown "Stay at home" order commenced
10th May 2020	People who cannot work from home are allowed to return to work. Government advises against using public transport
1st June 2020	Phased re-opening of schools in England
15th June 2020	Non-essential shops re-open in England
4th July 2020	Local lockdowns are introduced by area
16th July 2020 to 1st September 2020 - Wave 1 Panel Survey n=306 Included questions on: • Travel to work before the pandemic • Travel to work / working from home during the first 'work from home' order (period to 10th May) • Travel to work now (after some Lockdown 1 restrictions were eased) • Willingness to use shared public transport • Willingness to use autonomous vehicles with and without a safety driver	
14th August 2020	Lockdown restrictions eased – theatres, bowling alleys, soft play re-open
14th September 2020	Social gatherings limited to no more than 6 people
22nd September 2020	Work from home order is re-introduced. 10pm hospitality curfew
14th October 2020	A three-tier system of Covid-19 restrictions introduced
5th November 2020	Lockdown 2 introduced
25th November 2020 to 1st December 2020 - Wave 2 Panel Survey n=173 Questions on: • Travel to work between survey Wave 1 and Lockdown 2 work from home order (Period between Sep 2020 and Nov 2020) • Travel to work or working from home now (during Lockdown 2 work from home order) • Willingness to use shared public transport • Willingness to use autonomous vehicles with and without a safety driver • Experiences of and adaptations to working from home	
2nd December 2020	Lockdown 2 ends and three-tier system re-introduced
8th December 2020	Covid-19 vaccine roll-out begins

Date	Event
19th December 2020	Tier four 'Stay at home' alert issued to London and Southeast
6th January 2021	Lockdown 3 introduced
8th March 2021	Schools re-open
12th April 2021	Non-essential retail opens
17th May 2021	Outdoor social gatherings limited to 30; Indoor gatherings limited to 6
19th July 2021	Most legal limits on social contact removed
14th July 2021 to 2nd August 2021 - Wave 3 Milton Park Panel Survey n=110 Questions on: • Travel to work during Lockdown 3 period • Travel to work now (after lockdown restrictions eased) • Willingness to use shared public transport • Willingness to use autonomous vehicles with and without a safety driver • Attitude to use of face masks on public transport • Experience of working from home	
10th December 2021	Face masks become compulsory in most indoor venues
27th January 2022	Mandatory face masks no longer required, but face mask wearing remains advisory. Working from home advice also dropped
September 2022 - Milton Park Annual Travel-to-work Survey n=914 Questions on: • Travel to work now • Working from home frequency before and after the pandemic • Willingness to use shared public transport • Willingness to use autonomous vehicles with and without a safety driver • Attitude to use of face masks on public transport	
March 2023	Service 001 electric autonomous minibus trial
June – July 2023	Service 002 electric autonomous minibus trial
September 2023 - Milton Park Annual Travel-to-work Survey n=1169 Questions on: • Travel to work now • Level of use of the electric autonomous minibuses at Milton Park • Willingness to use autonomous vehicles with and without a safety driver	
Timeline Sources: Institute for Government (2022) Jackson and O'Connor (2022)	

2.1 Recruiting survey participants

Employees working at Milton Park were recruited to take part in the panel survey via an invitation email which was sent to a contact list (of about 1000 employees) drawn from the 2019 annual Milton Park travel-to-work survey. This generated a sample size of 306 employees for the Wave 1 survey. These same respondents were invited (by email) to complete the Wave 2 and Wave 3 surveys, with the panel survey response reducing to 110 employees by Wave 3. The panel survey was then closed,

given the small remaining sample size. The annual Milton Park travel-to-work surveys (in September 2022 and September 2023) were then used to include a small number of consistent questions on frequency of working from home (WfH), willingness to use autonomous vehicles, and willingness to use shared public transport.

2.2 Sample composition

The survey sample compositions for the panel survey and travel-to-work surveys are shown in Table 3. The panel survey sample is composed of highly-educated, office and laboratory workers with high incomes. This is not fully representative even of Milton Park, which contains significant activities such as distribution and warehousing as well as many science and technology jobs. The results on travel preferences reported in Section 3 need to be interpreted as being representative of this specific demographic, rather than for the UK population in general. The travel-to-work survey samples contain a higher proportion of younger employees (in the age categories below 45) than the panel survey, although missing values in the age variable for the panel survey may account for some of this difference.

Table 3: Survey sample compositions

	Panel survey Wave 1		**Travel-to-work surveys**			
			2022	**2022**	**2023**	**2023**
Characteristic	**n**	**%**	**n**	**%**	**n**	**%**
Age						
<25	7	2	89	10	84	7
25-29	36	12	194	21	218	19
30-44	119	39	398	44	504	43
45-59	99	32	209	23	293	25
60 plus	10	3	22	2	33	3
Missing	35	11	2	0	36	3
Total	**306**	**100**	**914**	**100**	**1168**	**100**
Gender						
Female	160	52	420	46	610	52
Male	118	39	480	53	505	43
Prefer not to say	3	1	9	1	10	1
Prefer to self-describe	0	0	2	0	6	1
Missing	25	8	3	0	37	3
Total	**306**	**100**	**914**	**100%**	**1168**	**100**
Work environment before COVID						
Office	244	80				
Warehouse	2	1				
Manufacturing	2	1				
Laboratory	47	15				
Amenity service	1	0				
Missing	10	3				
Total	**306**	**100**				
Work situation at Wave 1						
Full-time	262	86				

	Panel survey Wave 1		Travel-to-work surveys			
			2022	2022	2023	2023
Characteristic	**n**	**%**	**n**	**%**	**n**	**%**
Part-time	31	10				
Furloughed	1	0				
Other	2	1				
Missing	10	3				
Total	**306**	**100**				
Qualifications						
Degree	221	72				
Other higher ed below degree	18	6				
A-level (level 3)	21	7				
GCSE (level 2)	11	4				
Other	1	0				
Prefer not to say	5	2				
Missing	29	9				
Total	**306**	**100**				
Gross household income						
£13k-£18.9k	1	0				
£19k-£25.9k	7	2				
£26k-£31.9k	24	8				
£32k-£47.9k	46	15				
£48k-£63.9k	46	15				
£64k-£95.9k	71	23				
>£96k	35	11				
Prefer not to say	45	15				
Missing	31	10				
Total	**306**	**100**				
Born in the UK						
Yes	225	74				
No	49	16				
Prefer not to say	4	1				
Missing	28	9				
Total	**306**	**100**				
Ethnicity						
Asian or Asian British	7	2				
Black, African, Black British or Caribbean	1	0				
Mixed or multiple ethnic groups	4	1				
White	254	83				
Other ethnic group	2	1				
Prefer not to say	10	3				
Missing	28	9				
Total	**306**	**100**				
Disability that affects travel						

	Panel survey Wave 1		Travel-to-work surveys			
			2022	2022	2023	2023
Characteristic	**n**	**%**	**n**	**%**	**n**	**%**
Yes	11	4				
No	263	86				
Prefer not to say	3	1				
Missing	29	9				
Total	**306**	**100**				
No. of household adults						
1 adult	50	16				
2+ adults	224	73				
Missing	32	10				
Total	**306**	**100**				
Children in the household						
No offspring under 19	184	60				
Have children under 5 only	18	6				
Have children under 5 and 5-18	10	3				
Have children 5-18 only	57	19				
Missing	37	12				
Total	**306**	**100**				
Had Covid-19 infection						
Yes	3	1				
Maybe	22	7				
No or not to my knowledge	252	82				
Missing	29	9				
Total	**306**	**100**				
Had Covid-19 test						
Yes	37	12				
No	240	78				
Missing	29	9				
Total	**306**	**100**				
Household protection from Covid-19						
Same protection	235	77				
Greater protection	37	12				
Prefer not to say	5	2				
Missing	29	9				
Total	**306**	**100**				
Environmental help needs to fit in with lifestyle						
Yes I believe this	142	46				
No I do not believe this	125	41				
Prefer not to say	11	4				
Missing	28	9				
Total	**306**	**100.0**				

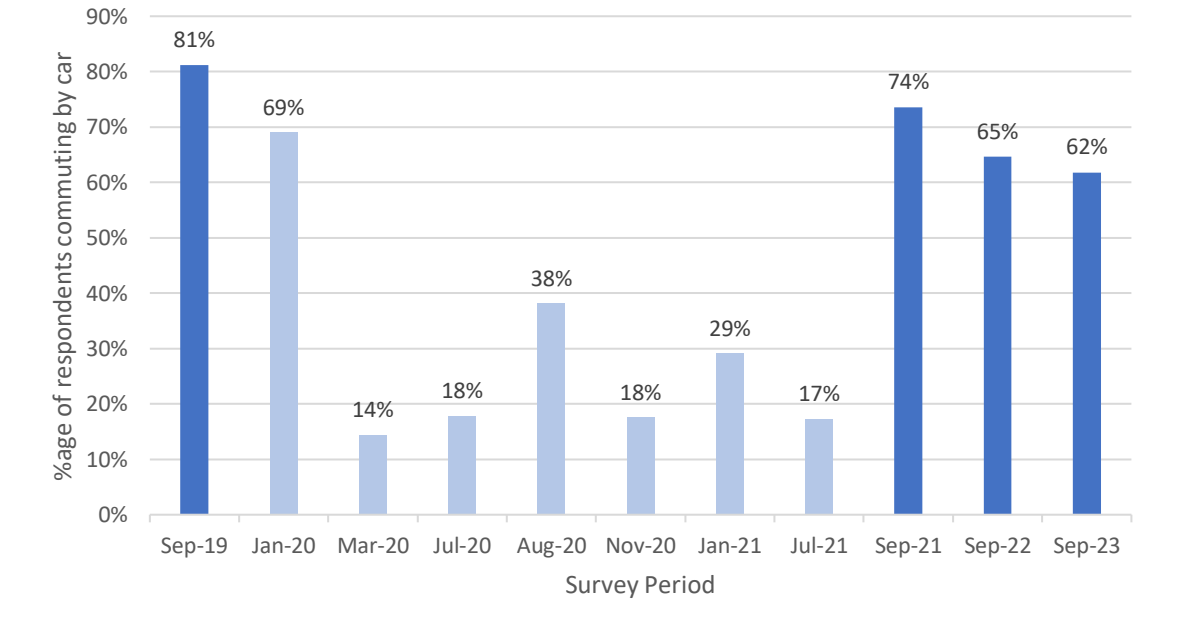
3. Results

The results from the panel and travel-to-work surveys are now summarised in relation to the following themes:

1. Trends in commuting to Milton Park;
2. Trends in working from home before and after the pandemic;
3. Willingness to use shared public transport; and
4. Willingness to use autonomous vehicles.

3.1 Trends in commuting behaviour

Table 4 (overleaf) summarises the trend in commute mode share to Milton Park from September 2019 through to September 2023. It is observed that there has been a long-term decline in the share of commuting to the business park by car, reducing from 81% of travel-to-work survey respondents in September 2019 (n=1004) to 62% of travel-to-work survey respondents in September 2023 (n=1168, illustrated graphically in Figure 1). The lower share of car commuting in 2023 compared to 2019 has largely been accounted for by a corresponding higher share in bus use – 5% of respondents to the 2019 travel-to-work survey commuted by bus (n=1004), compared to 20% of respondents to the 2023 travel-to-work survey (n=1168, see Table 4).



Dark shading indicates results are drawn from annual travel-to-work survey n~1000
Light shading indicates results are drawn from the Covid-19 panel survey n~300

Figure 1: Trend in percentage of employees commuting to Milton Park by car. September 2019 to September 2023

Although the research did not directly study the mechanism for this change, it is likely that the shift from car to bus commuting is in large part explained by the introduction and then broadening of the availability of a low-cost bus pass for Milton Park employees. The £20 annual bus pass initially allowed employees to travel from Didcot Parkway train station to Milton Park and so was of most use to rail commuters. In 2020, the bus pass catchment area was extended to cover the whole of the Didcot area and in 2021 the catchment area was extended again to include the nearby villages of

Drayton and Steventon. Hence, from 2020 the use of the low-cost bus pass became a viable option for many more employees living locally.

Table 4: Time trend in commuting to Milton Park pre and post pandemic: September 2019 to September 2023

			Travel to work main transport mode															
			Car/motorcycle		Bus		Train		Cycle		Walk		WfH		Other		Missing
Survey period	**Note**	**n**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Sep-19	Annual travel-to-work survey	**1004**	787	81%	51	5%	51	5%	69	7%	12	1%	-	-	-	-	34
Jan-20	Pre-lockdown 1	**306**	196	69%	28	10%	20	7%	28	10%	2	1%	1	0%	9	3%	22
Mar-20 to May-20	Lockdown 1	**306**	38	14%	3	1%	0	0%	5	2%	1	0%	217	82%	0	0%	42
Jul-20	Some restrictions eased	**306**	51	18%	3	1%	0	0%	14	5%	2	1%	205	72%	11	4%	20
Aug-20 to Oct-20	Some restrictions eased	**173**	66	38%	8	5%	5	3%	13	8%	1	1%	76	44%	4	2%	0
Nov-20	Lockdown 2	**173**	30	18%	4	2%	1	1%	5	3%	1	1%	123	72%	7	4%	2
Jan-21 to May 21	Lockdown 3	**110**	32	29%	2	2%	3	3%	6	5%	2	2%	64	58%	1	1%	0
Jul-21	Most legal restrictions eased	**110**	19	17%	2	2%	0	0%	5	5%	2	2%	74	67%	8	7%	0
Sep-21	Annual travel-to-work survey	**756**	532	74%	87	12%	41	6%	50	7%	13	2%	-	-	-	-	33
Sep-22	Annual travel-to-work survey	**914**	578	65%	154	17%	62	7%	91	10%	9	1%	-	-	-	-	20
Sep-23	Annual travel-to-work survey	**1168**	696	62%	225	20%	97	9%	94	8%	14	1%	-	-	-	-	42

Grey shaded cells indicate results are drawn from the three panel survey waves
Non-shaded cells indicate results are drawn from the annual travel-to-work surveys (cross-sectional samples of Milton Park employees)

3.2 How access to work changed during the pandemic period

Table 4 also shows how working from home patterns changed over the course of the pandemic (see the WfH column and the rows shaded grey which correspond to the panel survey results). The majority (82%) of panel survey respondents (n=306) had switched to working from home in March 2020 when the Covid-19 'stay-at-home' order was issued. This is to be expected since the panel respondents were largely office-based knowledge workers, with the capacity to work from home. Working from home reduced to 44% of panel survey respondents during the summer of 2020 (n=173), when many of the restrictions were eased, but then most (72%, n=173) of respondents had returned to working from home during the December period when restrictions were re-introduced.

Restrictions were still in place in January 2021 through to May 2021 and it is notable that the working from home share was lower at this timepoint (58% of Wave 3 panel respondents, n=110) than during the first part of the pandemic (82%, n=306). The panel sample size is very small by Wave 3, but cross-checking with the 94 employees that responded at both Wave 1 and Wave 3 shows that 21 of the 79 respondents that were working from home in March 2020 had returned to commuting to Milton Park during January 2021. It is possible that after eight months of disruption, some organisations may not have been able to sustain a continued absence from the workplace for some employment roles.

3.3 Trends in working from home before and after the pandemic

It is interesting then to examine whether the pandemic has triggered a sustained shift in the frequency with which some Milton Park employees are working from home. In the September 2022 travel-to-work survey, respondents were asked how frequently they were working from home 'now' (i.e. in September 2022) and before the pandemic. This provided a straightforward means of comparing working-from-home frequency before and after the pandemic for the same individuals - a sample of 914 employees. The results are summarised in Table 5.

Table 5: Working from home frequency before and after the pandemic

Work-from-home frequency	**Before the pandemic**		**After the pandemic (Sep 2022)**	
	n	**%**	**n**	**%**
One day a week or more	217	23.7%	434	47.5%
Every day	*65*	*7.1%*	*24*	*2.6%*
4+ days a week	*23*	*2.5%*	*98*	*10.7%*
3 days a week	*22*	*2.4%*	*101*	*11.1%*
2 days a week	*48*	*5.3%*	*124*	*13.6%*
1 day a week	*59*	*6.5%*	*87*	*9.5%*
Less than that, but occasionally	142	15.5%	205	22.4%
Never	541	59.2%	261	28.6%
Missing	14	1.5%	14	1.5%
	914	**100%**	**914**	**100%**

Source: September 2022 travel-to-work survey

This shows that the introduction of the Covid-19 lockdown restrictions does appear to have triggered a very significant increase in the frequency with which Milton Park employees are working from home:

- The percentage of respondents working from home at least one day a week or more doubled from 24% before the pandemic to 48% in September 2022 (n=914, Table 5).
- The biggest change was in the proportion of respondents working from home 2 to 4 days per week, which increased from 17% of respondents before the pandemic to 35% of respondents after the pandemic (n=914).

3.4 Experiences of working from home

The smaller sample of panel survey respondents were asked in Panel Wave 2 (November 2020, n=139) about their experiences of working from home during the early part of the pandemic, rating their agreement or disagreement with a range of WfH statements (summarised in Table 6 and Figure 2).

Table 6: Perspectives on working from home

		Agree		Neutral		Disagree	
Statement	**mean**	**n**	**%**	**n**	**%**	**n**	**%**
I have had no problems with working from home	**5.3**	104	75%	3	2%	32	23%
I prefer to work in a different location to my home	**3.8**	51	37%	30	22%	58	42%
I am interrupted too often when I work from home	**2.6**	19	14%	15	11%	105	76%
I have adequate space to work at home	**5.2**	102	73%	5	4%	32	23%
I have had problems with internet connectivity when I work from home	**3.0**	41	29%	7	5%	91	65%
I miss talking with colleagues when I work from home	**5.4**	113	81%	8	6%	18	13%
Working from home is less productive than working at MP	**2.8**	19	14%	29	21%	91	65%

Source: Panel Survey Wave 2; November 2020, n=139

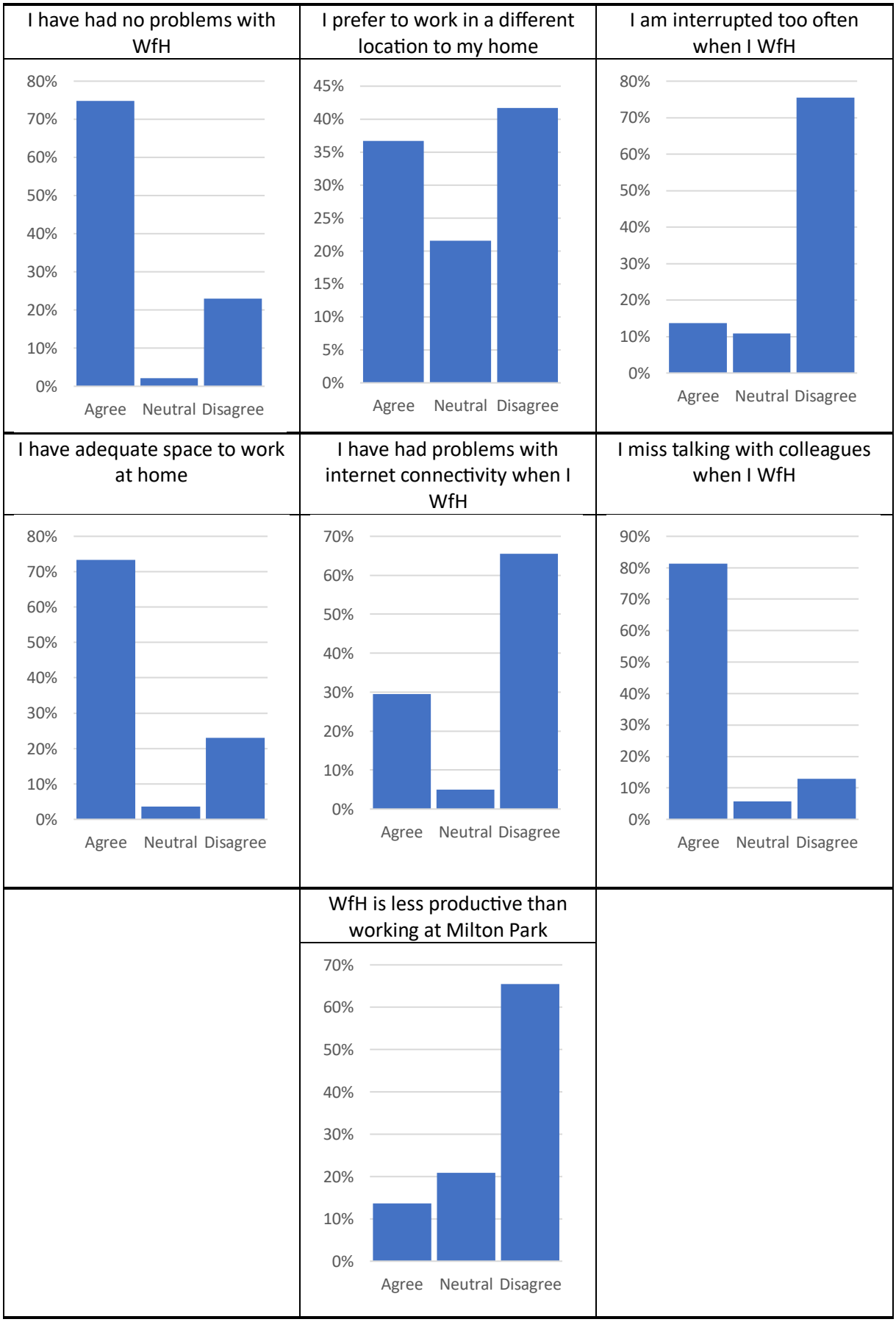


Figure 2: Perspectives on working from home. Panel survey November 2020; n=139

The majority of respondents indicated that they were not experiencing difficulty working from home. For example:

- 75% agreed that they had “no problems with working from home”;
- 76% agreed that they were “not interrupted too often” when working from home;
- 73% agreed that they had “adequate space” to work from home;
- 65% agreed that they had “no problems with internet connectivity”; and
- 65% agreed that working from home is “not less productive” than working at the workplace.

Although the prevailing experience of working from home appeared to be positive, it should also be recognised that there were significant minorities in this small sample that did experience difficulties working from home. For example:

- 23% disagreed with the statement “I have enough space to work from home”; and
- 29% agreed that they “had problems with internet connectivity when I work from home”.

The relevance of this finding is that employers developing working from home policies and practices need to consider the support and upgrades employees would need to work effectively from home.

The majority (81%) of respondents also reported “missing talking with colleagues” when working from home. And there were divergent views on whether it was preferable to work from home or at the workplace, potentially connected to this sense of increased social isolation. 42% of respondents said that they preferred working from home and 37% of respondents said that they preferred working in the workplace.

3.5 Adaptations to working from home

The same small sample of Milton Park workers (n=139) were also asked how they had *adapted their homes* to enable working from home during the period of lockdown restrictions that were in place during the early part of the pandemic (Table 7). Most respondents had made only modest adjustments in the short term. For example:

- 69% had re-arranged furniture;
- 38% had bought new furniture; and
- 32% had bought IT equipment.

Only 22 respondents had upgraded their broadband package (16%) and 4 respondents had invested in or planned to invest in additional space like a garden office or extension. Such significant adjustments to people’s homes (like extensions), if they are at all necessary, may require a longer-term process of deliberation and adaptation to the observed increased frequency in working from home.

Table 7: Adaptations to enable working from home

Adaptation to enable working from home	n	Yes n	Yes %	No n	No %	Plan to n	Plan to %
Invested in new furniture	139	53	38%	75	54%	11	8%
Re-arranged my home so that I have space to work	139	96	69%	40	29%	3	2%
Invested in additional space like a garden office or extension	139	3	2%	135	97%	1	1%
Upgraded my broadband package	139	22	16%	113	81%	4	3%
Invested in IT equipment	139	45	32%	92	66%	2	1%

Source: Panel Survey Wave 2; November 2020, n=139

The overall post-pandemic picture then is one in which many Milton Park workers can be described as 'balancing the best of both worlds' - working from home more frequently, but mixing this with commuting to the workplace throughout the week to complete work activities and to maintain social contacts. The assumption here is that they are actively choosing this pattern as a preference. There may also be behavioural responses to constraints, which mean the observed pattern is not only arising from preference. For example, if the availability of high-quality space to work within the office environment has changed, then workers may feel they will be less productive in the office, even if they would prefer to be there.

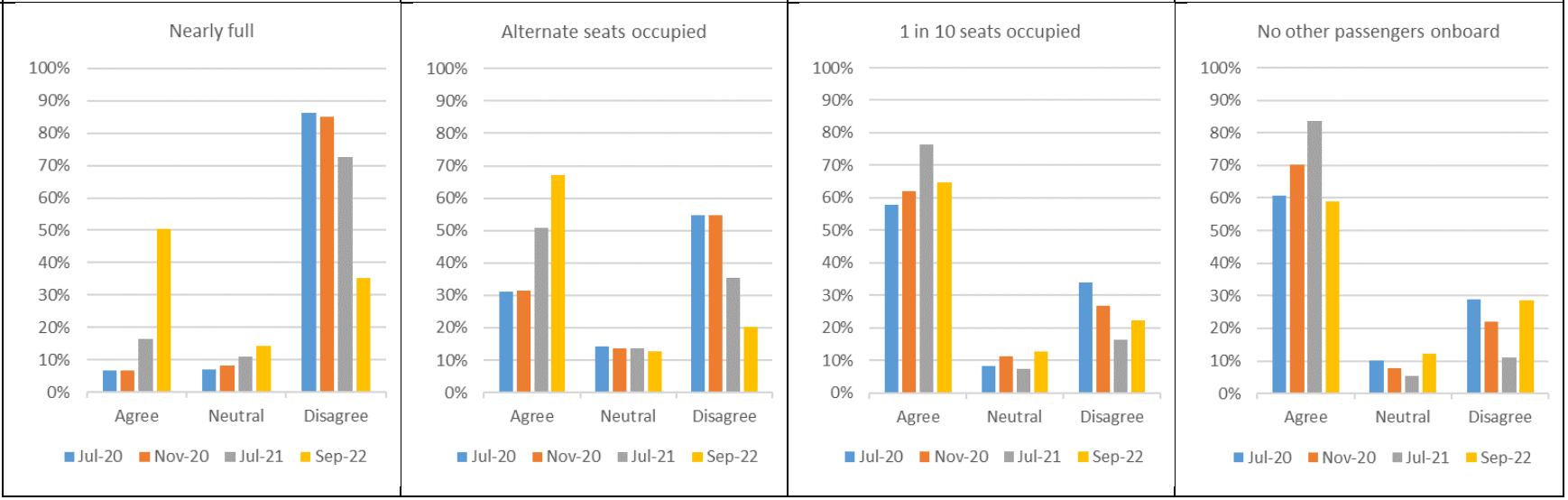
3.6 Willingness to use shared public transport

The pre-vaccine pandemic response involved reducing the amount of contact between people and social distancing, particularly within indoor spaces where, compared to outdoor spaces, the risk of transmission was higher due to lower ventilation levels. Indeed, the government advised essential workers to avoid using public transport for this reason. Public transport service levels were also significantly reduced given the low levels of travel demand during the lockdown periods. This greater (perceived and real) risk of viral transmission on shared public transport therefore had the potential to cause a long-term reduction in public transport demand and service levels. This was of relevance to the Mi-Link project, as understanding the market potential for *shared* autonomous transport modes was a core aim of the project.

Panel survey respondents were asked in all three waves whether they would be willing to use a bus or train with four different occupancy levels – ranging from "no other passengers onboard" to "nearly full". This same question was also asked of the 2022 travel-to-work survey respondents. The responses are summarised in **Error! Reference source not found.**.

Figure 3: Percentage of respondents agreeing with the statement: "I would be willing to use a bus or a train…"

	…that was nearly full				…with alternate seats occupied				…with 1 in 10 seats occupied				…with no other passengers onboard			
Rating	**Jul-20**	**Nov-20**	**Jul-21**	**Sep-22**	**Jul-20**	**Nov-20**	**Jul-21**	**Sep-22**	**Jul-20**	**Nov-20**	**Jul-21**	**Sep-22**	**Jul-20**	**Nov-20**	**Jul-21**	**Sep-22**
Agree	7%	7%	16%	50%	31%	32%	51%	67%	58%	62%	76%	65%	61%	70%	84%	59%
Neutral	7%	8%	11%	14%	14%	14%	14%	13%	8%	11%	7%	13%	10%	8%	5%	12%
Disagree	86%	85%	73%	35%	55%	55%	35%	20%	34%	27%	16%	22%	29%	22%	11%	29%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
n	283	168	110	854	283	168	110	855	282	168	110	847	283	168	110	850



It is clear that people were concerned about using public transport services in general during the early part of the pandemic and nearly all respondents reported that they would *not* be willing to use public transport services that were nearly full. For example:

- In July 2020, during the early stages of the pandemic, 60% of panel survey respondents were willing to use a bus or train with "no other passengers on board", but this reduced to 7% of respondents being willing to use a bus or train that was "nearly full" (n=283).

There is also a clear trend with confidence in using public transport returning. For example:

- In July 2020, 7% of panel survey respondents (n=283) noted that they would be willing to use a bus or train that was "nearly full" and this had increased to 50% of travel-to-work survey respondents by September 2022 (n=854).

It is striking however, that in September 2022, 35% of travel-to-work survey respondents still reported *not* being willing to use a bus or train that was "nearly full" (n=854). One interpretation is that reluctance to use crowded public transport due to perceptions of increased risk of infectious diseases may have remained, nearly two years after the pandemic started and well after high population-wide vaccination rates were established. However, it is also possible that Milton Park employees were reluctant to use busy public transport services for reasons other than the risk of infectious disease transmission (such as crowded public transport services being uncomfortable in general) and this has not been possible to assess from the data collected.

3.7 Willingness to use autonomous vehicles

Finally, panel survey respondents were asked whether they would be "willing to use an autonomous ('driverless') vehicle with/with no safety operator present in the vehicle" in all three panel survey waves. This same question was included in the 2022 and 2023 travel-to-work surveys making it possible to examine whether there has been a change in willingness to use autonomous vehicles over time. The results are summarised in Figure 4.

At this stage in autonomous vehicle technology development, respondents report a clear preference for there to be a safety operator onboard. The implication is that passenger confidence at the time of study was contingent on a human operator being present:

- A majority - between 64% (in 2020, n=283) and 82% (in 2023, n=1054) of respondents agreed that they would be "willing to use an autonomous ('driverless') vehicle with a safety operator on board".
- This compares to between 40% (in 2020, n=283) and 45% (in 2022, n=863) of respondents agreeing that they would be willing to use an autonomous ('driverless') vehicle with no safety operator on board.

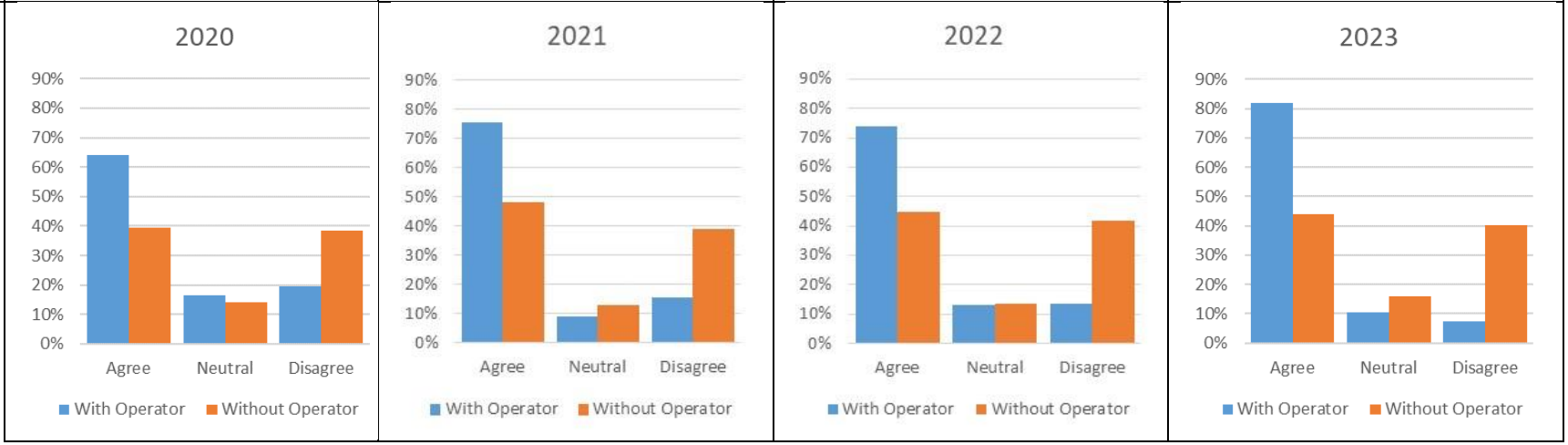
However, it is not clear how far these responses are 'in principle', as the question was not put at the point of use of an autonomous bus. A clearer test of behavioural implications would require a real choice to board an autonomous bus or travel in a different way. It is also not clear how far the requirement for an on-board operator would decline with experience of safe operation, or in the context of a remote operator in a control centre being provided.

There is also evidence of an increase over time (through the surveys) in willingness to use an autonomous vehicle with a safety operator on board:

- 74% of 2022 travel-to-work survey respondents (n=863) reported willingness to use an autonomous vehicle with a safety operator on board (first bar in each chart in Figure 4), compared to a higher proportion – 82% of travel-to-work survey respondents in 2023 (n= 1054).
- In contrast, the figures for the case of no safety operator on board show notable stability, with 40% in each case being unwilling to use.

Figure 4: Percentage of respondents agreeing with the statement "I would be willing to use an autonomous ('driverless') vehicle with / with no safety operator present in the vehicle"

	2020		2021		2022		2023	
Rating	**With Operator**	**Without Operator**	**With Operator**	**Without Operator**	**With Operator**	**Without Operator**	**With Operator**	**Without Operator**
Agree	64%	40%	75%	48%	74%	45%	82%	44%
Neutral	17%	14%	9%	13%	13%	14%	10%	16%
Disagree	19%	39%	15%	39%	13%	42%	8%	40%
Total	100%	100%	100%	100%	100%	100%	100%	100%
n	**283**	**282**	**110**	**110**	**863**	**859**	**1054**	**1050**



The difference in willingness to use autonomous vehicles comparing the 2022 and 2023 samples is statistically significant (chi-square=22.1, df=2, p=0.000016), suggesting that more employees were willing to use autonomous vehicles with a safety operator on board in 2023 compared to 2022. The Mi-Link autonomous electric minibus trials took place during 2023, between the two travel-to-work surveys. It is plausible that the presence of the minibus in the environment has increased confidence in the use of autonomous vehicles for some amongst the population of Milton Park employees. Indeed, 11% (132) of 2023 survey respondents reported having used the autonomous minibus at least once - about 40% of the 322 survey respondents that reported using bus and train to commute to Milton Park (Table 8).

Table 8: Number of travel-to-work survey respondents using the autonomous minibus

Have you travelled on the autonomous minibus?	**n**	**%**
No	928	80%
Yes, I tried the autonomous buses once or twice	103	9%
Yes, I used the autonomous buses a few times	28	2%
Yes, I used the autonomous buses for most of my journeys when they were operating	1	0%
Missing	107	9%
Total	**1167**	**100%**

Source: 2023 Travel-to-work survey

4. Summary

This study set out to address the following research questions:

1. How and why did ways of accessing employment at Milton Park (including commuting and working from home) change over the course of the pandemic and its aftermath?
2. To what extent were employees willing to:
    i. use a public transport vehicle shared with other people (in the context of a pandemic)?
    ii. use an autonomous vehicle with or without a safety driver on board?
3. How did willingness to use shared and autonomous transport change over time?

The key findings are as follows:

The Covid-19 pandemic has prompted a profound and sustained increase in working from home amongst Milton Park employees:

- The percentage of respondents working from home at least one day a week or more doubled from 24% before the pandemic to 48% of travel-to-work survey respondents in September 2022 (n=914).
- The majority of respondents reported not facing difficulties with working from home (such as interruptions, lack of space, issues with internet connectivity) during the early stages of the pandemic, but the majority of respondents also reported missing talking to colleagues when working from home.
- The overall post-pandemic picture is one in which many Milton Park workers could be said to be balancing the best of both worlds - working from home more frequently than before the pandemic, but mixing this with commuting to the workplace throughout the week to complete work activities that require attendance at the workplace and to maintain social contacts. However, the extent to which the behaviour arises from choice and constraint was not confirmed by the research.

Willingness to use shared public transport reduced significantly during the early stages of the pandemic, but confidence in using shared public transport services has largely recovered over time:

- In July 2020 at the start of the pandemic, 7% of panel survey respondents (n=283) noted that they would be willing to use a bus or train that was nearly full and this had increased to 50% of travel-to-work survey respondents (n=854) by September 2022.

However, crowded public transport services remain undesirable to a significant number of employees:

- In September 2022, 35% of travel-to-work respondents (n=854) still reported *not* being willing to use public transport services that were nearly full.
- It is not known whether this is because the perceived risk of viral transmission remained or because crowded public transport services are undesirable in general.

Aside from the impact of the pandemic on working patterns, there has been a notable reduction in car commuting and an increase in bus commuting to Milton Park over the period:

- The car commute mode share was 81% of travel-to-work survey respondents in 2019 (n=1004) compared to 62% of travel-to-work survey respondents in 2023 (n=1168).
- The bus commute mode share was 5% of travel-to-work survey respondents in 2019 (n=1004) compared to 20% of travel-to-work survey respondents in 2023 (n=1168).

The introduction of a low-cost (£20) annual bus pass for Milton Park employees in 2020 is likely to be a key factor explaining this increase in bus use.

With respect to willingness to use autonomous vehicles, at this stage in the technology's development, respondents preferred a service model of autonomous buses having safety operators on board for use to be acceptable:

- A majority - between 64% (in 2020, n=283) and 82% (in 2023, n=1054) of respondents agreed that they would be willing to use an autonomous ('driverless') vehicle with a safety operator on board. This compares to a lower share of between 40% (in 2020) and 45% (in 2022, n=863) of respondents agreeing that they would be willing to use an autonomous ('driverless') vehicle with no safety operator on board.

Exposure to real autonomous vehicle services and their marketing, appears to be associated with more people becoming willing to use an autonomous vehicle with a safety operator on board.

- Before the Mi-Link autonomous bus trials 74% of travel-to-work survey respondents reported willingness to use an autonomous vehicle with a safety operator on board (2022, n=863). After the Mi-Link autonomous bus trails, 82% of travel-to-work survey respondents reported willingness to use an autonomous vehicle with a safety operator on board (2023, n=1054).
- This increase in the proportion of respondents reporting a willingness to use autonomous vehicles with a safety operator on board comparing the before and after surveys is statistically significant (chi-square=22.1, df=2, p=0.000016) i.e. it is very unlikely that this level of difference in willingness to use autonomous vehicles would have been observed between the two samples if there had been no change in perspectives amongst the wider population of Milton Park employees.

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