TELEMOBILITY, HYBRID WORK AND THE NEXT NORMAL

Hani S. Mahmassani
Northwestern University Transportation Center

MIT Mobility Forum February 24, 2023
Motivation

• Broadest, deepest and longest natural experiment in the use of ICT for tele-activities and e-processes in modern history. Impacts on how we work, play, shop, seek medical assistance are still unfolding.

• What can we learn from that experiment, and where do we go from here?

• What is sticking, how is it morphing, are we there yet?

• What about telework, hybrid work, and simply work -- What is happening to downtown offices, commuting patterns, public transport...?

• What kind of “next normal” might lie ahead?

• Are we sticking to the same useless models for mobility planning?
Telemobility UTC

Acknowledgments

At NU

Amanda Stathopoulos

PhD Candidates

Divyakant Tahlyan (NU)
Maher Said (NU)
Nadim Hamad (NU)
Alexandra Pan (UC-Berkeley)

At UC Berkeley

Susan Shaheen
Joan Walker
1. **No demand without supply.** Predicting demand must necessarily entail understanding the supply side, and the forces governing the evolution of the business processes that determine the options available to customers; and

2. **Symbiotic interplay between virtual and physical worlds.** Adoption, engagement and use of tele-activity channels and e-processes cannot be analyzed and projected in a meaningful way independently of engagement with corresponding or complementary real, physical-world activities.

3. **The process is highly dynamic!** Must characterize the dynamics of the evolving adoption process as interaction between supply forces and demand responses, and the related roles of information, experience, shocks and policy interventions in that process.
High-level Framework for Examining Transportation and Travel Demand Impacts of E-activities
QUESTIONS ADDRESSED TODAY

For whom did telework not work during the pandemic?

Future of work: The employers’ perspective

Trajectories of teleworkers through the pandemic and beyond

What about teleworkers spatio-temporal activity patterns?
Wave 1: Dec 21, 2020  
Wave 2: Jan 11, 2021  
Wave 3: Jan 25, 2021  
Wave 4: Feb 08, 2021  
Wave 5: Feb 22, 2021  
Wave 6: Mar 08, 2021  
Wave 7: Mar 28, 2022
Employer Tracking Survey: 5 WAVES

- **5 waves** – Oct 2021, Nov 2021, Jan 2022, Apr 2022, Aug 2022
- Employee work location over time – overall and by department
- Attitudinal question – potential impact of remote work policies
- Business travel and in-person client interaction
- Perceived employee remote work preferences
- Issues with retaining and recruiting employees
- Peer companies’ remote work policies
- Vaccination and masking policies
- Data from 129 unique employers between wave 1-5.
- Data courtesy of NUTC BAC.
- About 50% transportation/warehousing/manufacturing companies and 50% others
Employee Satisfaction with Telework

- To understanding systematic heterogeneity and factors associated with telework satisfaction
- Data: U.S. representative sample of 318 adults asked to report their satisfaction with telework. Data collected in Wave 5
- Methods:
  - An ordered probit model connecting satisfaction with socio-demographic information
  - A MIMIC model connecting satisfaction with experienced benefits of and barrier to telework
- Individuals who have not been working from an office in the past week (240/318):
  “How satisfied are you with your experience of working from home?”

- Individuals who have been working exclusively from an office (78/318)
  “Imagine you were to asked to work from home. How satisfied do you think you would have been working from home?”

(Tahlyan, Said, Mahmassani, Stathopoulos, Walker, Shaheen, 2021)
Ordered Probit Model

\[ y^* = z' \gamma + u \]

\[ y = \begin{cases} 
1 & \text{if } y^* \leq \psi_1 \\
 j & \text{if } \psi_{j-1} < y^* \leq \psi_j \text{ } \forall \ j \in \{2, \ldots, J-1\} \\
 J & \text{if } \psi_{J-1} \leq y^* 
\end{cases} \]

\[ P(y) = \begin{cases} 
\Phi(\psi_1 - z' \gamma) \\
\Phi(\psi_{j-1} - z' \gamma) - \Phi(\psi_j - z' \gamma) & \forall \ j \in \{2, \ldots, J-1\} \\
1 - \Phi(\psi_{J-1} - z' \gamma) 
\end{cases} \]
Multiple Indicator Multiple Cause (MIMIC) Model

Structural Model: \( \eta = \alpha + B\eta + \Gamma X + \epsilon \)

Ordered Probit Component

Measurement Model: \( y^* = \nu + \Lambda \eta + K X + \mu \)
Results: Ordered Model

- Parabolic relationship
- Lower for younger and older individuals
- For young: loss of networking and career
Lower satisfaction for individuals with children attending online school

- Higher satisfaction for individuals with Hispanic ethnicity
- Potentially because they are historically under-represented in telework friendly jobs

- Lower satisfaction for individuals with children attending online school
- Lower for those with at least an UG degree
- But not higher for individuals with a Grad degree

- Higher satisfaction for individuals worried about contracting COVID-19 virus
- Potentially due to not needing to commute to work or relocation effect

SEM $R^2 = 0.219$

- Suburban household indicator
- Presence of children attending online school
- Age (in years)
- Age $^2$ (in years squared)
- Hispanic ethnicity indicator
- At least an undergraduate degree indicator
- Graduate degree indicator
- COVID-19 infection worry

$-0.653 \pm 0.334$

$-0.214$ (insig)

$-0.324 \pm 0.594$

$0.291$
Results: MIMIC Model

Higher experienced benefits leads to higher satisfaction
Higher experienced barriers leads to lower satisfaction

Lower benefits for those:
- Living alone
- With presence of children attending online school
- Living in suburban areas

Parabolic relationship between age and benefits/barriers

Higher barriers for those:
- With presence of children attending online school
- Who identify as essential workers

Lower barriers for those:
- Who work in remote work friendly industry

\[ \text{SEM } R^2 = 0.648 \]
• Benefits to and barriers to telework *disproportionately distributed* across age groups
  • **Younger and older individuals** experienced lower benefits and higher barriers, leading to lower satisfaction
• **Presence of children attending online school from home** a major factor driving satisfaction
• Potential presence of *inequity* along the lines of *racial/ethnic identity*
  • Individuals with black ethnicity experienced *lower benefits* to telework
  • Individuals with Hispanic/Latino ethnicity experienced *higher satisfaction*, potentially related to being disproportionately employed in telework unfriendly sector
QUESTIONS ADDRESSED TODAY

For whom did telework not work during the pandemic?

Trajectories of teleworkers through the pandemic and beyond

Future of work: The employers’ perspective

What about teleworkers spatio-temporal activity patterns?
Remote work trajectory through the pandemic:
The employer perspective

- 90% confidence interval obtained using bootstrapping with 5000 resamples
- For combined data, old response used for past time points and newest response used for future time points
- For future time points, “wait and see” responses excluded from analysis, totaling to about 5-10% respondents
Remote work trajectory differs by sector
Employer opinion of 2-days a week remote work policy’s impact

Employers are divided on remote work – conditional model shows those with negative outlook are more likely to be from transportation / warehousing / manufacturing industries.
### Predicting April 2024 remote work landscape

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Estimate</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation, Warehousing and Manufacturing sector indicator</td>
<td>0.406</td>
<td>1.652</td>
</tr>
<tr>
<td>Fully in-person approach pre-covid indicator</td>
<td>0.722</td>
<td>2.374</td>
</tr>
<tr>
<td>Shift from fully in-person pre-covid to fully remote in April 2020 indicator</td>
<td>-0.894</td>
<td>-1.820</td>
</tr>
<tr>
<td>Transportation, Warehousing and Manufacturing sector indicator interacted with Shift from fully in-person pre-covid to fully remote in April 2020 indicator</td>
<td>0.796</td>
<td>1.483</td>
</tr>
<tr>
<td><strong>Thresholds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-0.749</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.221</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1.669</td>
</tr>
<tr>
<td>Fit measure</td>
<td>0.177</td>
<td></td>
</tr>
<tr>
<td>No. of observations</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>

Even in transportation / warehousing sector, those able to make a full shift to virtual work in April 2020 less likely to be in-person

Sector of operations plays a critical role

Those who made a complete shift from fully in-person to fully virtual in April 2020 less likely to be in-person
Employer view of what employees want

Mostly in-person

Mostly remote

Hybrid

Indifferent

Mean percentage of employees

Employees too largely prefer some form of hybrid work
Office space reorganization (N = 38)

(Multiple answers allowed)

- Relocated (or plan to relocate) offices to new larger space (in the same area) 4
- Relocated (or plan to relocate) offices to new larger space (in different area) 4
- Expanded size of leased/rented space (e.g. added floors) in the same building 4
- Relocated (or plan to relocate) offices to new smaller space (in different area) 5
  - Reduced office space (in a different area) 5
  - Added office space (in a different area) 5
- Reduced size of leased/rented office space (e.g. fewer floors) in the same building 7
- Relocated (or plan to relocate) offices to new smaller space (in same area) 8
- Added office space (in the same area) 8
- Reduced office space (in the same area) 10
- Reconfigured office space to cater to the changing nature of the work environment 21

Open ended responses

"Aviation is busier. We have expanded staff."

"Growing company. Added workspaces in the same leased office even after accounting for work from home practices."

"We have mostly frozen office space needs because we were growing rapidly and did not have to add space in order to add people. But we did have a business need to open a new office. It is modest-sized because of remote-work expectations."

"We had two office buildings near to each other which have been reconfigured and consolidated into a single space."

Question only asked in Wave 5 (Aug 2022)
QUESTIONS ADDRESSED TODAY

For whom did telework not work during the pandemic?

Future of work: The employers’ perspective

Trajectories of teleworkers through the pandemic and beyond

What about teleworkers spatio-temporal activity patterns?
DATA

Part of 7-wave longitudinal tracking panel with over 1800 unique respondents

Work location trajectory
- During 2019
  - April 2020
  - April 2021
  - July 2021
  - December 2021
  - March 2022
  - Oct 2022
  - April 2024

Options include:
- Exclusively at office
- Mostly at office
- About 50/50
- Mostly at home
- Exclusively at home
- Don’t know (for future time points)

Occupational sector
Ethnicity
Age
Household location
Education level
Income
Gender
Student Status

Opinion on impact of 2-days a week remote work
- Productivity
- Creativity
- Effectiveness
- Innovation
- Employers’ ability to complete goals
- Public Image
- Profit
- Feedback
- Collaboration
- Mentoring
- Career Advancement
- Social Interaction

Socio-demographic information

Collected in March / April 2022
- 1291 respondents
- 905 working adults

Positive, negative or neutral

905 working adults

1291 respondents

Collected in March / April 2022
TELEWORK TRAJECTORIES

Working exclusively at office throughout the pandemic

In person pre-pandemic, at home at peak pandemic and slowly going back to in person

Working exclusively at home throughout the pandemic
ANALYSIS FRAMEWORK

Work Location Trajectory Clusters

Data Time Points
- During 2019
- April 2020
- August 2020
- April 2021
- July 2021
- December 2021
- March 2022

Agglomerative Trajectory Clustering

Employee outlook to remote work

Impact of 2 days/week remote work on following:
- Productivity
- Creativity
- Effectiveness
- Innovation
- Employers' ability to complete goals
- Public Image
- Profit
- Feedback
- Collaboration
- Mentoring
- Career Advancement
- Social Interaction

Socio-demographic information:
- Occupational sector
- Ethnicity
- Age
- Household location
- Education level
- Income
- Gender
- Student Status

Multinominal logit

Cluster Membership Model

Two-part model:
- Binary probit: To understand uncertainty in future work location
- Ordered probit: To understand work location decision for those who know it

Unconditional latent class model i.e., no covariates

3 versions of this model:
- With socio-demographic only
- With socio-demographic + trajectory cluster indicators
- With socio-demographic + trajectory cluster indicators + opinion latent class indicators
TRAJECTORY CLUSTERS

In-person workers

Level 1 hybrid workers

Level 2 hybrid workers

Remote workers

25.2%
19.7%
20.1%
35%

Cluster 1 (25.2%)
Cluster 2 (19.7%)
Cluster 3 (20.1%)
Cluster 4 (35%)

Exclusively at office
Mostly at office
About 50/50
Mostly at home
Exclusively at home
Not Applicable (not working)
Don't Know
Cluster 1: In person cluster

Cluster 2/3: Hybrid workers

Cluster 4: Remote work clusters

TRAJECTORY CLUSTERS
Employee Opinion – Impact of 2-days a week remote work

[Diagram showing the proportion of negative, neutral, positive, and not applicable responses for various aspects such as productivity, creativity, effectiveness, innovation, public image, profit, feedback, collaboration, mentoring, career advancement, and social interaction.]
Latent Class Analysis of Employee Opinion – Impact of 2-days a week remote work

### Class Labels

<table>
<thead>
<tr>
<th>Proportion</th>
<th>Negative</th>
<th>Neutral</th>
<th>Positive to Neutral</th>
<th>Mixed</th>
<th>Positive</th>
<th>NA</th>
<th>Proportion</th>
<th>Negative</th>
<th>Neutral</th>
<th>Positive to Neutral</th>
<th>Mixed</th>
<th>Positive</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>20.29%</td>
<td>10.17%</td>
<td>6.15%</td>
<td>24.53%</td>
<td>21.12%</td>
<td>10.82%</td>
<td></td>
<td>20.29%</td>
<td>10.17%</td>
<td>6.15%</td>
<td>24.53%</td>
<td>21.12%</td>
<td>10.82%</td>
</tr>
<tr>
<td>Creativity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Career Advancement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to innovate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social interaction with colleagues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness to get the job done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employer’s ability to accomplish goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving / delivering mentoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employer’s profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving / delivering feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employer’s public image</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Item Response Probabilities

- **Negative**
- **Neutral**
- **Positive to Neutral**
- **Mixed**
- **Positive**
- **NA**

### Six latent classes with varying degree of positivity regarding impact of telework on various work aspects

- **Negative**
- **Neutral**
- **Positive**
- **Not Applicable**

---

**Note:** The table presents item response probabilities for different latent classes across various work aspects. The probabilities indicate the likelihood of员工's responses falling into each category (Negative, Neutral, Positive, Not Applicable) for each work aspect.
April 2024 work location model

Similar trends as earlier on occupational sector

Consistent age effect: 65+ are remote; 44- are more in-person

Zero vehicle household expected to be more remote

From latent class analysis

From trajectory clustering analysis

+: more in-person
-: more remote
Future telework trends will vary by **occupational sectors**
- More **in-person work** in transportation / warehousing, health care, education
- More **remote work** in information, professional / technical services, finance and insurance

**Age** effect
- More remote work by older individuals (65+)
- More in-person work by younger individuals (44-)

**Zero vehicle households** (who potentially also are **transit users**) are likely going to be more remote

**Employer decisions** will play a critical role – uncertainty for a significant share of individuals. Policies that employers adopt will define future trends
QUESTIONS ADDRESSED TODAY

For whom did telework not work during the pandemic?

Future of work: The employers’ perspective

Trajectories of teleworkers through the pandemic and beyond

What about teleworkers spatio-temporal activity patterns?
Activity Diary Data Collected in March 2022: 747 working adults

Question 1
What is the effect of telework on the duration spent on out-of-home non-work activities?

Question 2
Does telework increase or decrease the average distance traveled from home to reach out-of-home non-work activities?

Question 3
Is there a telework effect on the time of day chosen to engage in out-of-home non-work activities?

Tobit Regression

Tobit Regression

Multinomial Logit

How does out-of-home non-work activity patterns differ across teleworkers and non-teleworkers?
- Data from 747 working adults collected in March 2022
- On the day of the survey, asked to report activities participated yesterday
- Day of the survey distributed across all 7 days by design.
Teleworkers are spending less time out of home for non work activities.

Teleworkers are traveling shorter distance for out-of-home non-work activities (i.e. more closer to home activities).
Teleworking individuals choose to perform activities in the early afternoon (12PM-3PM) and evening (6PM-9PM), compared to other times of the day, and compared to non-teleworking individuals.

Multinomial logit model for time of day to engage in non-work out-of-home activities.
What about the NEXT normal?

Where do we go from here?

What should cities/agencies/MPO’s be planning for?

Scenario planning exercise – led by Susan Shaheen (UC-Berkeley), with Alexandra Pan (PhD student, UC-B)
Scenario World Vectors - Example

Rigid Work Policies

"Old Normal"

Centralized Work Location

Decentralized Work Location

Flexible Work Policies

Credit: Alex Pan and Susan Shaheen, Telemobility UTC
Scenario World Vectors - Example

Rigid Work Policies

“Old Normal”

Disrupted Transition

Centralized Work Location

Flexible Work Policies

Decentralized Work Location
Scenario World Vectors - Example

“Old Normal”

Disrupted Transition

“New Normal” (now)
Scenario World Vectors - Example

"Old Normal"

Disrupted Transition

NEXT NORMAL?

“New Normal” (now)

Rigid Work Policies

Decentralized Work Location

Centralized Work Location

Flexible Work Policies
Scenario World Vectors - Example

“Old Normal”

Disrupted Transition

NEXT NORMAL?

“New Normal” (now)

Centralized Work Location

Flexible Work Policies

Decentralized Work Location

Rigid Work Policies
Scenario World Vectors - Example

"Old Normal"

Rigid Work Policies

"New Normal" (now)

Disrupted Transition

Centralized Work Location

Flexible Work Policies

Decentralized Work Location

NEXT NORMAL?
Where does all this leave us

1. Still much uncertainty in the future of work.
2. Push and pull between employers and employees likely to continue.
3. Most likely scenario on the horizon is hybrid-2, though pressures for in-person + flex are strong.
4. Flexibility will stick – technology now widely available.
5. Key impacted areas (from transportation planning perspective):
   1. Urban cores – downtown office space is in flux; uneven recovery
   2. Conventional public transit – still below 60% of pre-pandemic levels
6. Winners (so far): TNC’s, (some) neighborhoods, freight, leisure travel (“experiences”).
7. Transportation planners’ toolkit-- even less relevant today than pre-pandemic, though badly needed to step up.
Thank you!

Connect with NUTC
Twitter @InfoNUTC

We Love Feedback

Questions/Comments
Email: masmah@northwestern.edu

Follow Me
Twitter @b_rational
Part I: Related Research


Part II: News Articles


Part III: Expert Commentary and Q&A

Frank Levy, Professor Emeritus of Urban Economics, MIT: Frank believed that there is a big difference between workers who had been with the same company for some time before the pandemic and maintained the same job throughout, compared to new hires integrated into firms, which could account for some degree of variability in telework satisfaction amongst workers in addition to age and industry of employment. This is something that he wishes could be captured in future work.

Mike Schiffer, Senior Vice President of Regional Planning, New York MTA: Mike commented that the MTA’s ridership recovery is slowly climbing from 60% to 70% compared to pre-pandemic levels. He notes that interestingly, while off-peak and weekend trips were the first to recover, the latest ridership recovery has actually been at the ‘peak of the peak’ periods. Mondays and Fridays are not as strong as the middle of the week, but they are not as weak as many suspect. There is also a large geographical difference which also reflects the industries where people are employed. Mike mentioned that the MTA is very interested in the evolution of various office markets and CBDs as they rethink various aspects of their service offerings, noting that even within CBDs, different industries have different telework behaviors because the benefits of agglomeration are different from industry to industry. He is interested in academic research that continues to draw out the differences in industry and geographical areas, and demand for travel to such areas.

Chandra Bhat, Chair Professor of Civil, Architectural, and Environmental Engineering, UT Austin: Chandra appreciated the use of the term the ‘next normal’ instead of the ‘new normal’ in this research, signifying that even this emerging ‘normal’ is not permanent and stable. He also made several connections to ongoing research at UT Austin and the transportation planning profession:

- Similar results have been seen documented remote work rates and satisfaction with age, which has been able to be justified with human development literature.
- The concept of the ‘average workday’ in transportation planning is evolving from a single day to a longer multi-day period such as a week, and we may have to consummate travel models with evolving hybrid work patterns, such as by creating multi-day models.
- The proportion of in-person to remote work has ramifications far beyond commuting to daily activities such as dining patterns and non-work patterns over time
- The tension between employers and employees is very interesting, because some have suggested the continued prevalence of remote work has been because employees have more power over employers, but recently companies have noticed a ‘boomerang effect’ of workers who previously resigned due to ending of remote work policies and returned back.
- Bhat also wonders whether telework is encouraging more people to move further away, or whether employees who live further away are more inclined to telework. This may be another interesting thing to track from the panel.

Jinhua Zhao, Associate Professor of Transportation and City Planning and Director of the MIT Mobility Initiative, MIT: Jinhua mentions that people who studied organizational behavior and transportation behavior rarely talked to each other, but now it is imperative that they work together to
solve these co-dependent problems involving the evolution of work, transportation, and cities. He notes that all mayors have been encouraging more workers to return back downtown. Secondly, the impacts to public transportation operators is especially significant since they have endured the biggest hit from remote work travel patterns. Zhao recalls a conversation with the Vice-Chairman of JR East, who lost US$5 billion in 2020 (without government subsidies, since they operate privately), but has taken reduced demand in a positive light to try new ideas and operation models. He hopes to bring some of this thinking as an opportunity to reform our transportation system, instead of complain about it.

Hani Mahmassani agrees to all these points, and made the following responses:

- There is no set direction hybrid work is seen to be going even though it is tending towards they ‘Hybrid 2’ scenario outlined in his research. One aspect that is not yet settled is that any job that can be done 100% remotely could technically be performed in a lower-paying environment (unless specific skills are needed), so remote workers in the US might lose their value proposition to workers elsewhere.

- In transportation, the prospect of universally taking 2 days off is ‘scary’ because if people coordinate their days off (e.g. on Monday and Friday, like how many remote schedules are playing out), then we haven’t accomplished anything from a congestion standpoint.

- While his talk focused on transportation and travel activity patterns, other projects at the Telemobility UTC have tracked expenditures of remote vs. in-person workers, and have a lot of relevance to Chandra Bhat’s topics of interest. They have also tracked office space and real estate, and asked employers what they are doing with their office space, and found that while some were shedding office space, many were expanding their footprint because they are looking forward to future growth and maintaining that prime office space (to Mike Shiffer’s points). In that case, he does not believe that a long-term evolution equilibrium is known yet.

### Part IV: Audience Q&A

1. In the survey, how do we ensure that everyone’s experience is equally representative?

   **Answer:** The survey is meant to be a nationally representative sample in terms of urban/rural, age, income, etc, but one thing we do not know is the quality of the internet connection in someone’s home, which could greatly affect their teleworking experience. Although there is likely a lot of details missing, we try to control for as many variables as we can.

2. Would the satisfaction of employees be more if they were in control of their proportion of telework, compared to being ‘forced’ on them by employers?

   **Answer:** The dynamic between employees and employers for choice of days has been evolving as we have emerged out of the pandemic and fear of catching COVID-19 became less of an issue. In early responses, employees preferred to choose their own days, however employers and employees themselves have realized that it is preferential to coordinate teams to go into the office instead of
having employees choose their own days, since many days they could end up in the office on zoom calls. So in this case the employer ‘chooses’, but teams realize it is to their own benefit as well, since coordinating office days maximizes in-person interaction which is missing on zoom.

3. Has there been any measurement of the outcome of telework policies on productivity, learning experience, career development, etc., and is there a ‘sweet spot’ between remote work and achieving these outcomes (more associated with in-person work)?

Answer: We have not yet looked at those outcomes, the survey asked for perceptions of these objectives. Employers themselves have not actually had the opportunity to fully evaluate these impacts except for profits, which do not provide the full picture. Even this measure is still fluctuating widely because at the initial phase of remote work, companies were still doing well and thought remote work worked out well, but lately there have been a lot of layoffs because things have not been going as well. So this is still evolving.

Commentary from Joanne Pratt: There seems to be tensions between individuals and governments on this as well, which ties back to employers and employees mentioned earlier. In New Mexico for example, employees have tried to pass a resolution maintaining their rights to work remotely, while the government and managers have authored an opposing bill which mandates that everyone comes back to work.

Qing Shen, Professor of Urban Design & Planning, University of Washington related this work to earlier efforts in 2007 to form a TRB special session under Telecommunications & Travel: “Major Disruptions to Personal Travel, Behavior Response and the Role of Telecommunication”, where Hani Mahmassani was the main speaker. He mentions that before this became an extraordinarily important topic during the pandemic, Mahmassani and others have been very interested in this field, yet in 2007 and even five years ago, nobody could predict this would happen. He asked Mahmassani, looking back, is there anything you could have done differently? Shen is surprised at the relatively small impact of teleworking on the functioning of society as a whole.

Answer: That’s a tough question, there’s a lot of things that can be discussed. Survey-wise, perhaps access to technology is a very important one. (This answer was truncated due to lack of time in the forum).

Part V: Summary of Memos

Shoichi Ishida was interested in how cultural differences shaped perceptions and satisfaction with remote and hybrid work, pointing out that hispanics in the survey panel seemed to be more satisfied with remote work, while in his own culture in Japan, in-person work interactions are highly valued which leads to less satisfaction with remote work. Shoichi also anticipates that the lines between in-person and remote work may blur in the future with the advancement of technologies such as virtual reality to simulate in-person environments.

McKenzie Humann was interested in Mahmassani’s suggestion that transportation planning tools are now becoming ‘irrelevant’ in the face of advancements in telemobility, and postulates that they could
still be relevant for the large percentage of US workers who still work in-person. While telemobility indeed exposed gaps in existing planning metrics, she wonders if the focus on the needs of telecommuters is overly skewed towards middle and higher-income workers as compared to lower income workers, and sees e-commerce and delivery services as a more immediate phenomenon which is largely affecting transportation. Like many chat participants, she also wonders about understanding of family structure, pre-pandemic travel modes, and distance between work and home as factors affecting remote work satisfaction.

Michael Leong drew comparisons between Mahmassani’s panel-based survey and Nicholas Blooms’ WFH research national survey presented at last semester’s edition of the MIT Mobility Forum. He notes that compared to Bloom’s survey, Mahmassani’s survey panel size is smaller, but is consistent, and the main benefit of this consistency of panelists is the ability to track the evolving decisions of employees and employers throughout the survey period of 2021-2022. He was most interested in how companies’ predictions of remote and in-person work percentages changed over time, noting that many seemed to over-predict their return to work rates for 2022, and had varied medium-term prediction rates for 2024. He also appreciated Mahmassani’s questions about leisure travel distances and on-demand delivery effects, which help articulate the behavior of teleworkers beyond their changed commutes.

Spencer McDonald was skeptical about how well we are able to predict hybrid work preferences for the future, given that nobody could realistically predict the onset of the COVID-19 pandemic, which makes us question our ability to stably predict travel patterns and world events at any time in the future. He also mentions that several other factors other than personal preferences could come into play for the long-run, such as environmental factors or technological factors (for example, autonomous vehicles making it easier to commute).

Yen-Chu Wu was interested in the specific influences of spatio-temporal activity patterns, which this survey did not capture, that could have large implications for the transportation system. However, she was interested in results that both younger and older individuals were equally dissatisfied with teleworking, and appreciated the examination of factors affecting attitudes to teleworking from both the supply-side and the demand-side.

Yunhan Zheng was intrigued by the out-of-home non-work activity results of the research, especially in the context of carbon emissions and the climate. She notes that previous literature before COVID-19 has documented the ‘rebound effect’ of teleworking on urban mobility, which refers to the fact that teleworking can increase carbon emissions by inducing more non-work trips. In contrast, Mahmassani’s survey-based research shows that teleworkers spent less time outside their homes for non-work activities and also traveled shorter distances for out-of-home non-work activities, which could lead to a net decrease in travel, reducing both congestion and emissions, and increasing urban livability.

James Shaw appreciated the study design incorporating both employers’ and employees’ perception of remote vs in-person work. He notes that from the city perspective, cities need to understand these trends to strategize post-pandemic economic development and downtown revitalization. He wondered about the political and legal ramifications of continued remote work practices, bringing up a New Hampshire vs. Massachusetts case where NH used MA for making lost commuters to Boston
from NH pay MA income tax. To Mahmassani’s point about remote work being able to be performed from almost anywhere, he wonders what can governments do to retain employers and businesses in cities, or perhaps mitigate the export of jobs elsewhere.

Jason Luo, like McKenzie Humann, was interested in the impacts of familial obligations, commuting distance, and commute mode on relative satisfaction and rates of remote working. He appreciated the complexities of survey design, especially compared to other telemobility-related surveys such as Prof. Nick Bloom’s WFH research, and was interested in methods to confirm the validity of survey results compared to actual real-world observations.

Ao Qu was interested in the results that suburban households had a positive impact on telework satisfaction, relating this to personal experiences where the inclination to work in-person declined as the commuting distance to a job increased. He is interested in exploring the relationship between satisfaction and productivity, as on one hand, remote work could increase productivity if commute time is saved; on the other hand it could result in more distractions at home and decreased work focus. He is also interested in exploring the factors which contributed to differences in remote work satisfaction amongst age groups and race groups, such as access to technology, job types, and job environments.

Samuel Chin was interested in the dynamic between unknown supply and demand in the age of telemobility patterns, especially at a time when we are trying to envision the ‘future of transportation’ in the next normal. He notes these questions are complex but can inform where governments can intervene to create supply, or how latent demand due to newfound circumstances can be detected. On that end, he was interested to explore how the results of this survey could go beyond describing current trends to articulating actions which can be taken to address these trends behind telemobility.

Nineveh O’Connell was interested in the response of transit agencies in the age of telemobility, and questioned if, in times where remote work continues to be ‘sticky’, transit agencies should continue to focus on getting people to work in offices, or focus on adapting their frequency, pricing, and reach of networks to shift people to less energy-intensive travel modes.

Jay Maddox thought Mahmassani’s research added much needed evidence to the benefits and costs of remote work, especially the parts which seemed to go against “conventional wisdom” including the relative dissatisfaction of younger survey respondents with remote work. He was interested in where to benchmark the fact that only 74.21% of employers were satisfied with remote work, commenting that this number seems relatively high, but should probably be compared with overall employer satisfaction with work and/or their employees.
Part VI: Reflection

The work by Hani Mahmassani and the Telemobility UTC uncover many insights into the state of the teleworking practice and the behaviors of both employees and employers as a result of direct surveys from both categories of stakeholders. The recency of the surveys, as well as the presence of predictions about telework practices in May 2024, provide real-time insight into the extent which we feel our patterns reflect a ‘stable equilibrium’ as we emerge from the official end of the COVID-19 pandemic declaration in May 2023. Mahmassani was also the first to acknowledge that the factors which explain many patterns in the survey are still yet to be solidified, outlining a future research agenda into how to make telework ‘work’ for society, and how to thereby adjust the transportation supply to achieve the best outcomes for society. As a wealth of studies about the impact of remote work on travel in the next normal become more prevalent, we are able to appreciate the specific contributions of Mahmasani’s work in the form of surveying a wide range of stakeholders from employers to employees, uncovering both work-based and non-work-based behavioral patterns, as well as tracking the evolution of individual working patterns and future anticipated behaviors throughout the various waves of the survey.

Planners and engineers could benefit greatly from quantitative data from Mahmassani’s survey which could allow the articulation of trends by industry, age, and geography to inform local levels of economic and transportation planning. This is especially relevant at a time when the transportation system is pursuan
t of large-scale goals such as decarbonization, technological advancement, and equity. As we jointly create this future, knowledge of what succeeds for employees and employers in a telework environment is valuable to the design of future systems, since demand for transportation is fundamentally derived from the demand for conducting activities.

Participants overwhelmingly enjoyed Mahmassani’s talk and remained actively engaged in the chat throughout the presentation, relating the variable results to their own experiences and where it coincided with or went against their own intuition. They provided Mahmassani with a wealth of suggestions about other explanatory factors for remote work rates and satisfaction which piqued their curiosity, proving that future research in this area is extremely relevant to the transportation community as a whole. The MIT Mobility Forum greatly appreciated Hani Mahmassani’s presentation and looks forward to his continued research on the future of telemobility and the next normal.