Microsoft

Microsoft New Future of Work Report 2022

A summary of recent research from Microsoft and around the world that can help us create a new and better future of work.

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Welcome to the Microsoft New Future of Work Report 2022

Due to the "Great Remote Work Experiment" that began in March 2020 when workplaces around the world rapidly shut down, work is changing faster than it has in a generation. As many people now return to the workplace and begin to experiment with hybrid work, a range of different outcomes is possible. Thankfully, researchers at Microsoft and from around the world have been investigating evolving hybrid work practices and developing technologies that will address the biggest new challenges while taking advantage of the biggest new opportunities.

This Microsoft New Future of Work Report 2022 summarizes important recent research developments related to hybrid work. It highlights themes that have emerged in the findings of the past year and brings to the fore older research that has become newly relevant. Our hope is that the report will facilitate knowledge sharing across the research community and among those who track research related to work and productivity. This research area is unfolding as rapidly as work is changing, and the purpose of this report is to help the community build on what has been learned this past year.

Never before has there been such an opportunity to actively shape the future of work. With research and careful study, we can create a new future of work that is meaningful, productive, and equitable.

Jaime Teevan, Chief Scientist and Technical Fellow

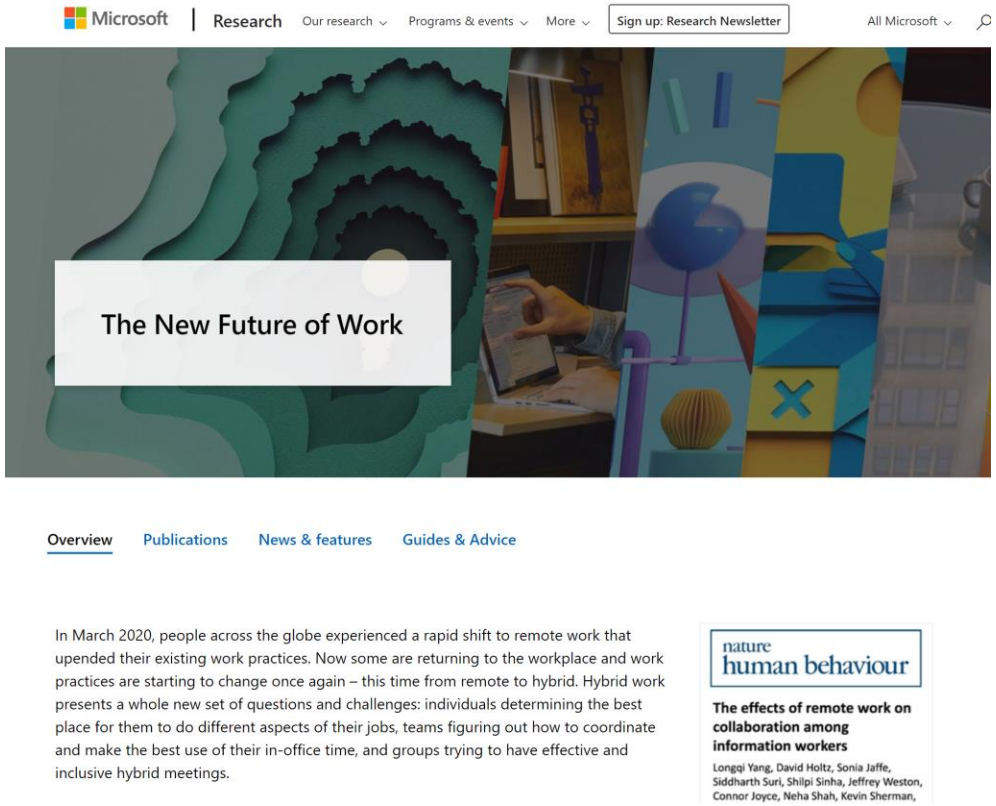
This report emerges from Microsoft's New Future of Work Initiative

Microsoft has helped shape information work since its founding. The current moment, however, presents a unique opportunity for the company to reimagine how digital technology can make work better for the people who return to the office, those who stay remote, and those who find the mix of the two that works for them, the people in their lives, and their organization.

In response to this opportunity, hundreds of researchers from across Microsoft, LinkedIn, and GitHub have come together to form the largest research initiative in the company's history, called the *New Future of Work Initiative*. This report is one of the many public resources the initiative has produced.

The New Future of Work Initiative has also published numerous research papers, a variety of practical guides, and several whitepapers that can inform the development of remote and hybrid work technologies. These resources are available at https://aka.ms/nfw.

https://aka.ms/nfw



This report is organized by changes in work practices at four different "scales"

Scale is one framework we use to organize our research efforts into remote and hybrid work. We look at work at the scales of the individual, team, organization, and society, as well as at their intersections.

- The **individuals** scale considers topics like the effects of remote and hybrid work on productivity and wellbeing, as well as the evolving relationship between work and 'life'.
- The **teams** scale considers topics like patterns of collaboration, the role of different tools, meetings and asynchronous collaboration, and virtual and mixed reality.
- The **organizations** scale considers topics like social capital, cross-team communication, systemic loneliness, office space, employee expectations, and the Great Reshuffle.
- The **society** scale considers topics like the changing geography of work and remote work, disparate impacts, and sustainability.

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Throughout, we highlight research – from Microsoft and elsewhere – using methods like the latest advances in AI, causal inference, experimentation, field work, surveys, interviews, and prototype-building to uncover challenges and opportunities facing workers.

A selection of key themes in this report

- **The Hybrid Work Era has begun**: Employees strongly prefer hybrid work (Slide 8) and employers are increasingly planning for a hybrid future (Slide 9). The emerging Hybrid Work Era represents a sea change in the geography of work (Slide 76), and the computing industry will play a large role in whether its benefits are maximized and equitably distributed (Slide 81).
- **New technologies are rapidly improving work:** When and where work happens is in flux and co-evolving with the technology. We are seeing new hybrid meeting environments (Slide 39), transformative improvements in asynchronous collaboration (Slide 51), novel applications of recommender systems in the workplace (Slide 65), and, of course, the use of VR and AR productivity environments (Slides 42-48). The share of patents in this space is growing over time (Slide 97).
- **Improved practices can make work better now**: Technology improvements may take time, but some changes don't have to wait. Meetings can immediately become more effective by carefully selecting locations and configurations to complement their purposes (Slide 32). Managers can expand their set of strategies (Slides 24, 102), leaders can avoid common misconceptions about hybrid work (Slide 64), and organizations can experiment with meeting-free days (Slide 26).
- **The definition of productivity is expanding**: Organizations and employees are increasingly recognizing that wellbeing (Slide 14), the balance between work and life (Slide 17), inclusivity (Slides 105), and other aspects of the employee experience are important (Slide 14), and taking steps to address these in a work context (Slide 18).
- **There is much to learn about The Hybrid Work Era:** This report provides some answers, but also raises new and exciting research questions. Will the prevalence of home offices change the way people use office space (Slide 75)? What new AI scenarios are enabled by the recent acceleration of the digital transformation (Slides 50, 51, 65, 91)? Can we end video fatigue (Slide 35)? How will remote innovations like meeting chat translate to a hybrid setting (Slides 29, 37)? What will hybrid work look like in developing markets (Slide 79)? How can we ensure hybrid work makes work more inclusive (Slides 50, 103)?

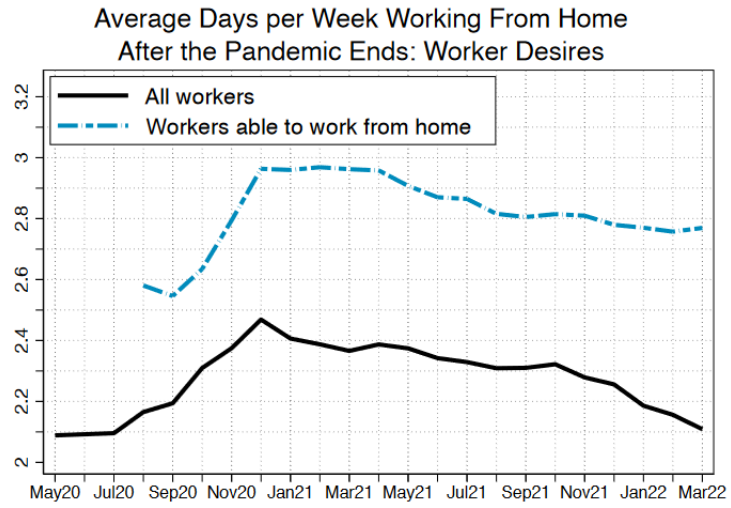
Individual Productivity and Wellbeing

Key Contributors: Mary Czerwinski, Brian Houck, Shamsi Iqbal, Eric Knudsen, Rick Pollak

Information workers prefer hybrid over other modes, at least for now

In survey after survey, a plurality or majority of respondents (from a variety of populations) report wanting to work partly at home and partly in-office. That said, there are signs of shifting preferences.

- For individuals, hybrid work refers to working part of the time in the office and part time from somewhere else. For organizations, hybrid can also refer to having a mix of fully on-site and fully off-site employees.
- Bloom (2021) reports that 47% of American workers prefer to work in a hybrid model, 21% want to return to the office full time, and 32% want to stay fully remote.
    - The average number of days Americans workers want to work from home (among those who can work from home) is around 2.8 as of March 2022 (Barrero et al. 2022).
- A survey in the United Kingdom found an even stronger preference for hybrid – 59% hybrid, 18% full-time office, 23% fully remote (Bloom et al. 2021).
- In a global survey, 21% of respondents who had quit their jobs in 2021 reported doing so because of lack of flexible working hours or location (Microsoft WTI 2022).
- Employees value flexibility in work location at non-trivial percentages of their salary, e.g., approx. 9% in one recent survey of U.S. workers who have worked from home during COVID (Barrero et al. 2021) and 8% in a pre-pandemic controlled experiment (Mas & Pallais 2017).
- Preferences may shift over time: approximately half of surveyed remote workers reported thinking of switching to hybrid and vice versa (Microsoft WTI 2022).
    - In a Glint (2021) survey of LinkedIn members, top concerns flagged by employees about working even partly outside of the office include lower socialization (61%) and lower visibility to leadership (42%).



Barrero et al. (2022) survey of U.S. workers

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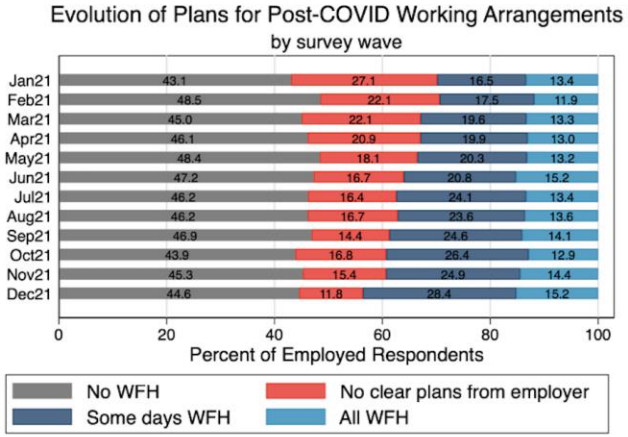
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*

More employers are embracing hybrid work, but not to the extent that employees want

There has been a major increase in employer acceptance of hybrid work, but employees still want more flexibility than employers are planning. We don't yet know how this will play out.

- From uncertainty to hybrid: Employers who were on the fence with their post-COVID plans have overwhelmingly chosen to go with a hybrid work model, where employees work from home some, but not all of the time. This was a large driver behind the near-doubling just in 2021 of U.S. employees who said their employer was planning a hybrid work model, from 16.5% to 28.4% (Barrero 2022).
- Employees appear to be embracing hybrid with their behavior when they have the chance: Health conditions in China made hybrid work more possible in China in 2021 than elsewhere, and although experiments with hybrid work were rare there, there was good uptake when the opportunity arose, e.g., around 50% (depending on definition) in recent study by Bloom et al. (2022) and a survey of Microsoft China employees in mid-2021 found that 35% of employees were working from home 1-2 days/week (Wang et al 2021).
- However, employers are still embracing hybrid less than employees want: As of March 2022, U.S. employees still want to work from home more than employers are planning to allow (around 0.5 days/week, depending on type of worker) (Barrero et al. 2022). Globally, we see the same dynamic: In AIPAC, 40% of employers are planning flexible work in 2022, but 60% of employees want it (Microsoft WTI 2022).
- And fulltime in-person work is more persistent than many believe: Barrero (2022) found ~45% of workers expect to be working full-time in-person after COVID and in one large global survey, 50% of business leaders in information worker roles reported that they will require full-time in-person work in 2022 (Microsoft WTI 2022). In Microsoft China in mid-2021, 31% of survey respondents were working full-time in-person despite the ability to work from home, with connectivity, collaboration, and equipment as the primary drivers for in-office work (Wang et al. 2021).
- Big questions remain: Will employers become more flexible, or will workers come back to the office? Will they quit instead? What are the implications of a strong vs. weak labor market? In a weaker labor market, would they behave the same?



Barrero (2022)
Sample: U.S. workers

Barrero, J. M. (2022). "*Economic Review*" The Work From Home Outlook in 2022 and Beyond." *Presented at the 2022 ASSA Meetings*.
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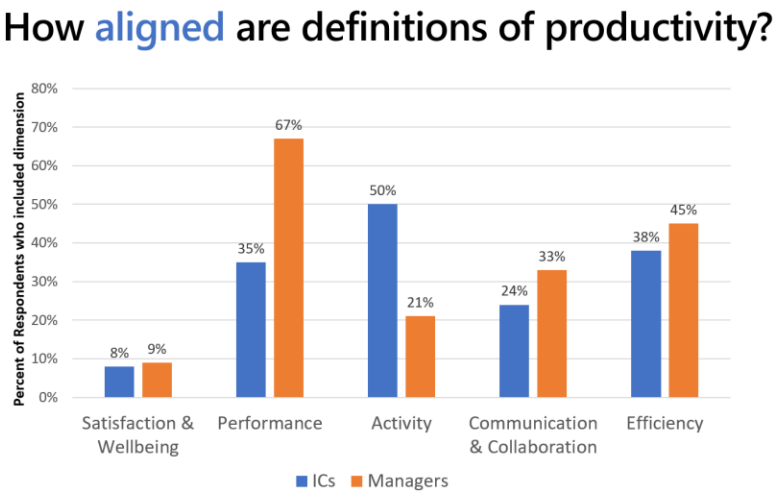
The word *productivity* has different meanings to different people

Moreover, individual definitions of personal productivity are often multi-faceted.

- Productivity cannot be reduced to a single dimension (or metric), so frameworks include multiple dimensions. Performance/Outcomes, Collaboration, and Efficiency are examples of potential dimensions to consider (Forsgren et al. 2021).
  - Often causal relationships can only be established with intermediate or proxy variables.
- Managers are more likely to define productivity as outcomes, and individual contributors are more likely to define productivity as output (Storey et al. 2021)
- Productivity is something that happens over time, and choosing a specific time interval is yet another dimension (Smith et al. 2021).
- This diversity of definitions is in addition to many other dimensions introduced by looking at productivity at different scales: e.g., organizational, national.
- One broader definition of productivity that has been proposed emphasizes several new dimensions in addition to what is typically considered by managers: well-being, collaboration, and innovation (Teevan 2021).



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Microsoft Study: Forsgren, N., et al. (2021). The SPACE of Developer Productivity. *ACM Queue 19(1): 1-29.*
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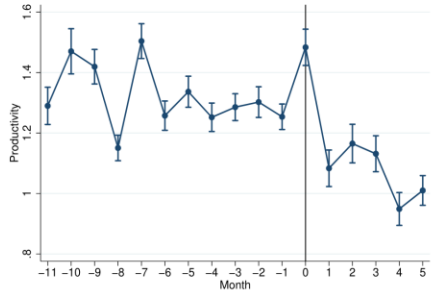
Smith S., & Carette, J. (2021). Long-Term Productivity Based on Science, not Preference. arXiv:2112.12580v1.
Microsoft Study: Teevan, J. 2021. Let's Redefine "Productivity" for the Hybrid Era. *Harvard Business Review*.

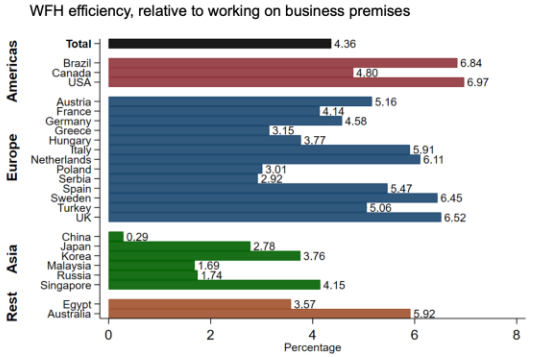
The evidence is mixed about short-term productivity during the pandemic

The evidence from attempts to measure short-term productivity following the onset of widespread remote work paints a mixed picture, with output per unit time potentially differing from self-reported productivity.

- Prior to the pandemic, two studies found positive average productivity effects when flexible work policies were introduced (Bloom et al. 2015; Choudhary et al. 2019).
- A study of GitHub developers in 2020 found signs of increased output, with pull request volume and push volume up by 17% and 16% respectively (Forsgren et al. 202)
- A recent international survey found that self-reported 'efficiency' was slightly higher when working from home in every country surveyed. U.S. workers reported the highest gain at 7.0%, China had the lowest at 0.2%. The average across all countries was 4% (Aksoy et al. 2022).
- Self-report data in other surveys is mixed, with typically a large subset of the sample reporting increases and another subset reporting decreases (e.g., Ford et al. 2021).
- In a study of a large Asian IT services firm, productivity as measured by output/time dropped by 8-19%. Output declined only slightly, but time spent working increased from ~5 to ~7 hours per day (Gibbs et al. 2021).
- In a large global survey, 80% of employees reported being as or more productive since going remote, but 54% of business leaders reported fearing that productivity was negatively affected since the shift (Microsoft WTI 2022).



Gibbs et al. (2021)



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Hybrid work may be able to maximize individual productivity through flexibility

The flexibility that hybrid affords may be able to maximize productivity by allowing people to work in the way that works best for them (via a hybrid workforce) or by allowing different tasks to be done at the office and at home (for hybrid employees) – or both.

- In a survey at the start of the shift to remote work, similar numbers of engineers felt more productive as felt less productive (37% and 32%, respectively) (Ford et al. 2020).
  - Even within job type (program managers or developers) and family situation (having children at home or not) there were substantial numbers of people in both the more productive and less productive groups.
- "Focused work" was cited as a reason by both 58% of Microsoft employees who plan to spend more time in the office *and* a 58% of those who plan to spend more time at home (Microsoft 2021).
- Hybrid represents a trade-off between the benefits of being in-person versus the benefits of not having to go into the office. Blending both may increase overall productivity by 5% (Bloom 2021).
- A proviso is that some of the benefits of hybrid hinge on having a critical mass in the office, so this needs to be managed.

Table 1. Changes in self-reported productivity based on the responses to the question *"Compared to working in office, how has your productivity changed?"* (Q13, Q13*) The responses to Survey 2 are further broken down by week: April 22–25 (W1), April 26–May 2 (W2), and May 3–9 (W3).

	Survey 1	Survey 2	W1	W2	W3
Significantly more productive	8%	11%	13%	10%	10%
More productive	22%	26%	23%	28%	26%
About the same	32%	32%	31%	30%	34%
Less productive	32%	26%	26%	26%	24%
Significantly less productive	6%	6%	7%	6%	6%

Ford et al. (2021)

Bloom, N. (2021). Hybrid Work is Here to Stay. Now What? (Back to Work, Better) *HBR IdeaCast*.
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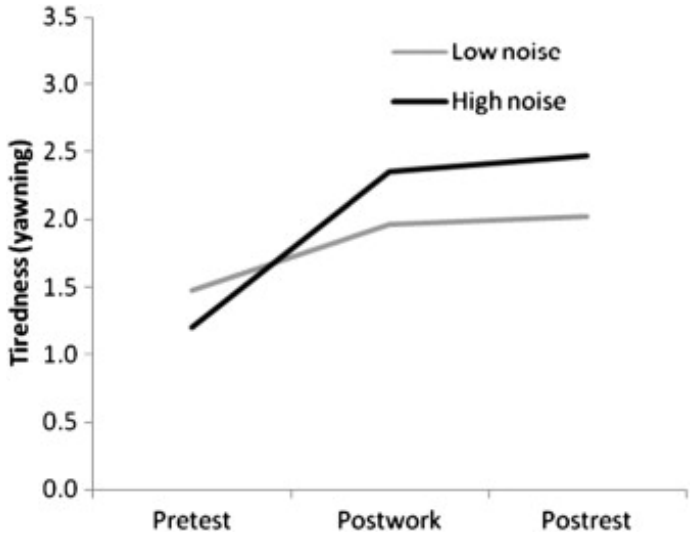
Microsoft Study: Microsoft (2021). To Thrive in Hybrid Work, Build a Culture of Trust and Flexibility. *Microsoft Worklab: Work Trend Index Pulse Report.*

Environmental factors at home and at work might be affecting productivity

Air quality, lighting, temperature, and other environmental factors are often overlooked elements of work environments. Research has found that these factors are linked to meaningful changes in productivity, which raises concerns about some work environments, at home and in the office.

- Increased PM2.5 indoor air pollution caused errors by players in chess tournaments to go up (Künn et al. 2019).
- Warmer temperatures have been linked to lower PSAT performance in the United States (Park et al. 2020)
- High-noise environments negatively affected memory and motivation and increased feelings of tiredness in a lab experiment (Jahncke et al. 2011).
    - One major open research question is how to prevent the noise pollution from increased remote calls from exacerbating these effects in open floorplan offices. Improvements in background noise suppression can help on the remote side of the call, but challenges remain on the local side (see e.g., Reddy et al. 2021).



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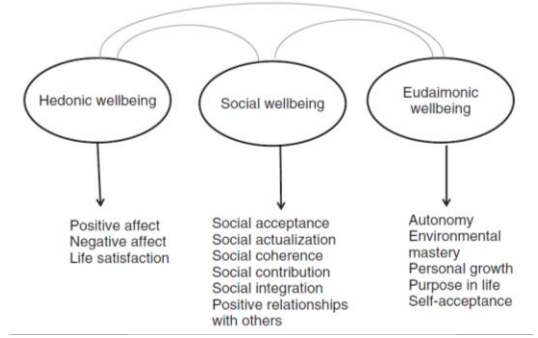
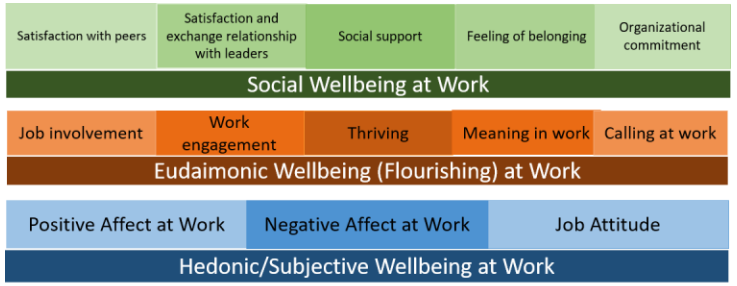
Wellbeing has multiple facets, each of which manifest in work settings

Wellbeing is a term that is often used without a clear understanding of its concrete meaning. However, it is well-studied in the literature and is often considered to have three components: subjective, eudaimonic, and social.

- *Subjective* (or *hedonic*) wellbeing focuses on the aspect of experiencing a pleasant life – which is a combination of positive emotions, and the lack of negative affects to the extent possible (Diener et al. 1991; Schimmack 2007).
  - At work it refers to experiencing a satisfactory work life, comprising a combination of positive affect (e.g., enthusiasm, inspiration), lack of negative affect (e.g., stress and frustration) and people's attitude around their job (Fisher 2014).
- *Eudaimonic* wellbeing focuses on flourishing, self-realization, or positive psychological functioning (Keyes 2002; Keyes 2005) and is related to the satisfaction of basic human needs for competence, autonomy, relatedness and self-acceptance (Ryff 2014; Fisher 2014; Ryan & Deci 2001).
  - At work it involves identifying closely with one's work (job involvement), finding vigor, dedication and absorption in work (work engagement), learning, developing oneself (thriving), feeling of doing something important (meaning in work) and contributing to a greater good (calling at work)
- *Social* wellbeing focuses on the quality connections which are seen as sources of energy (Dutton 2003) as well as constructs such as social acceptance, social coherence, social contribution and integration, and organizational belongingness (Fisher 2014).
  - At work, it includes satisfaction with peers and satisfaction and exchange relationship with leaders; social support (a potential buffer against workplace stress) which includes giving and receiving (Shakespeare-Finch & Obst 2011); feeling of belonging; being embedded in work communities; and group cohesion.



Fisher (2014)



Constructs associated with wellbeing at work

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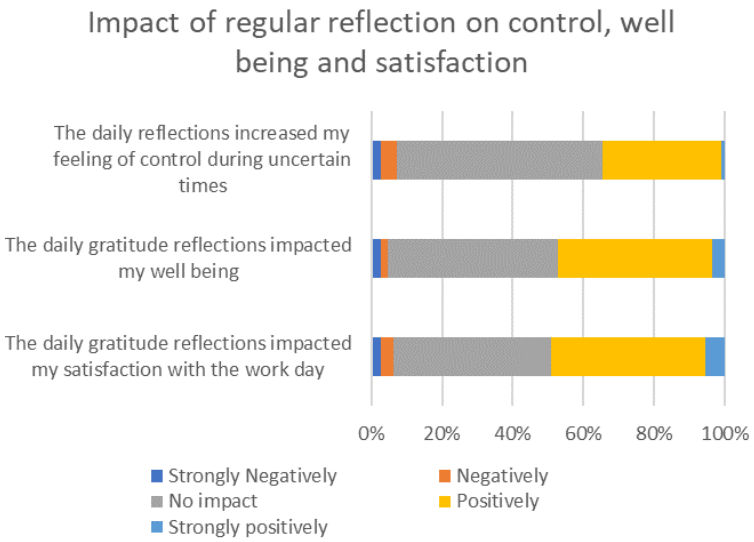
Individuals are recognizing wellbeing as an important component of workplace experiences

Post-pandemic, individuals are increasingly recognizing the relationship between their workplace experiences and their wellbeing, and the challenges span across subjective, eudaimonic, and social wellbeing needs.

- In a study of 31,000 people from 31 countries published by Microsoft in 2022, 53% of survey respondents are more likely to prioritize their health and wellbeing over work than before the pandemic (Microsoft WTI 2022).
- Since the onset of the COVID-19 pandemic, a number of pre-cursors of subjective and eudaimonic wellbeing (e.g., feeling cared for, fair/equitable treatment) have become stronger statistical correlates of employee happiness compared with prior to the pandemic (Glint 2021).
- One diary study showed that common self-reported "top challenges" shifted from meeting frequency (i.e., too many meetings) early in the pandemic to physical and mental wellbeing issues as the pandemic has continued (Butler & Jaffe 2021).
- Over time following the onset of COVID-19, negative impacts on physical wellbeing (e.g., fatigue) were most likely to persist among on-site employees. (Michel et al. 2021).



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Microsoft Study: Butler, J., & Jaffe, S. (2021). Challenges and gratitude: A diary study of software engineers working from home during covid-19 pandemic. *2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP)*, 362-363.

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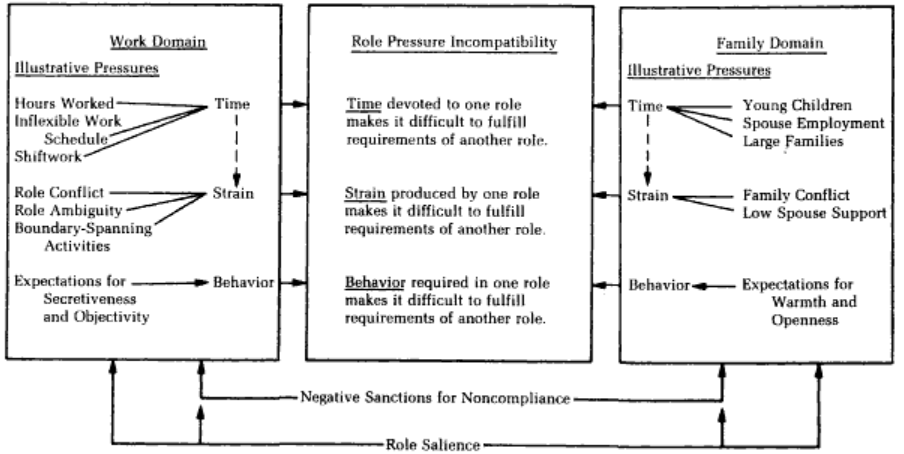
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*

Work-life relationships have evolved over time

The interplay between work and personal life has undergone a series of transformations. Early work showed work and life as two competing domains, followed by a focus on equal balance and more recently they are considered complementary where attention can shift fluidly based on priority.

- Work-life conflict: A few decades ago work-life relationships were viewed as two competing sides of a vertical axis, termed as work-life conflict (Greenhaus & Beutell 1985). The conflict arises from cases where the time devoted to the needs of one role makes it difficult to fulfil needs of the other, strain from participation in one role makes it difficult to fulfill needs of the other, and specific behaviors needed by one role impacts the requirements of the other.
- Work-life balance: Later in the early 2000s the focus shifted towards acknowledging equal importance of both work and life in work-life relationships (Kaliath & Brough 2008). Conceptualizations of work-life balance include equity across, satisfaction with and perceived control between multiple roles, relationship between the conflict and facilitation and compatibility with one's life priorities.
- Work-life integration: More recently, the concept of work-life integration is gaining popularity. Work and life demands are dynamic and transactional, and is a function of the amount of segmentation and flexibility possible to maintain a balance that prioritizes one over the other fluidly (Feigon et al. 2018).



Work-Family Role Pressure Incompatibility
(Greenhaus & Beutell 1985)

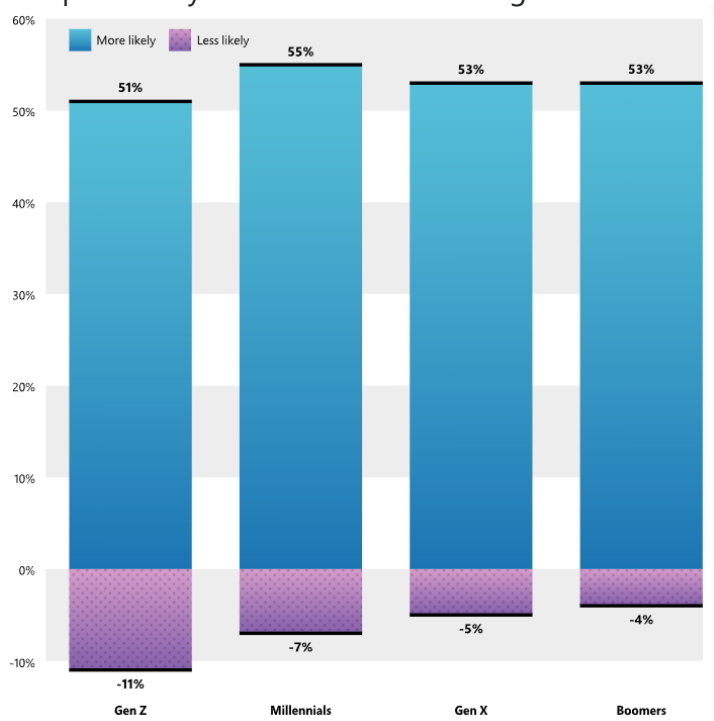
Feigon, M., et al. (2018). Work-life integration in neuropsychology: a review of the existing literature and preliminary recommendations. *The Clinical Neuropsychologist*, 2018, 32(2), 300-317.
Greenhaus, J. H., & Beutell, N. J. (1985). Sources of conflict between work and family roles. *Academy of Management Review*, 31(1), 72-92.
Kalliath, T., & Brough, P. (2008). A review of the meaning of the balance construct. *Journal of Management and Organization*, 14, 323-327.

Priorities have shifted towards tighter integration of work and personal needs

People report a greater need for prioritizing health, wellbeing, and family over work compared to pre-pandemic times and they wish to better integrate those needs through how and where they work. This requires renewed focus on spillover effects of performance, skills and affect across work and personal life.

- In Microsoft's Work Trend Index study, 47% of the survey respondents reported that they are more likely to put family and personal life over work than they were before the pandemic (Microsoft WTI 2022).
  - 53% reported they were more likely to prioritize their health and wellbeing over work than before (see chart).
  - Flexibility in where and how people work is a key priority moving forward: 51% of the hybrid employees reported that they will consider a switch to remote, and 57% remote employees said that they will consider a switch to hybrid.
- As people embrace hybrid and remote work, renewed focus is needed to best manage work-life integration challenges. Pre-pandemic research on work-life integration has highlighted areas of importance (Edwards & Rothbard 2000); these topics must be revisited with the current shift in working preferences.
  - Performance: risk of pursuing the domain (between work and life) that offers greater rewards and fulfilment at the expense of the other.
  - Health and wellbeing: risk of increase in stress, fatigue and burnout due to resource drain in one domain leaving insufficient resources for the other.
  - Enrichment: benefits of skills, abilities, values and moods in one domain positively enhancing the quality of life in another domain.

Compared to pre-pandemic, how likely are you to prioritize your health and wellbeing over work?"



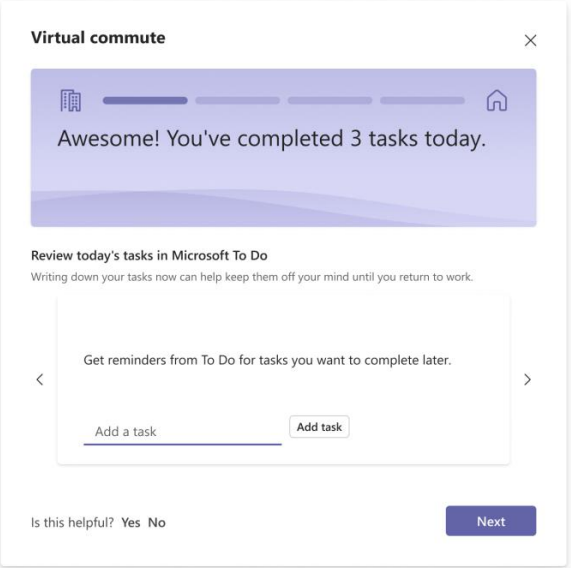
Microsoft WTI (2022)

Edwards, J. R., & Rothbard, N. P. (2000). Mechanisms linking work and family: Clarifying the relationship between work and family constructs. *Academy of Management Review*, 25, 178-199.
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*

Successful work-life integration requires goal prioritization and adjustments to work patterns

Work-life integration is highly personalized and depends on one's goals and circumstances. People have been adapting their existing ways of getting things done according to their priorities and there is a great opportunity for technology to help.

- A review of work-life integration challenges in neurophysiology suggests that it is a highly personalized path based on one's goals, pursuits, roles and circumstances. Recommendations include developing plans of career growth, establishing expectations and boundaries early, delegation and prioritizing self-care (Feigon et al. 2018).
- Anthropological studies of the way people separate work and life suggest that some people compartmentalize work and life in a way that one doesn't interfere with the other (Nippert-Eng 1996), but it becomes challenging when work and life coexist in the same place (e.g., when people work from home).
- With a shift to remote work and elimination of physical boundaries knowledge workers felt a sense of being 'always-on'. Tools that help individuals disconnect after work can reduce stress and promote employee wellbeing and reduce employee liability stemming from after-hour work (Williams 2018).
  - Microsoft released Virtual Commute to help Teams users transition out of work at the end of the day.
- Remote work has also changed how people track their productivity and plan their work and life. Because of the greater work-life integration, people find it effective to break down their tasks more and manually track their time (Ahmetoglu et al. 2021).
- Meeting free days can help individuals find time to do individual work and reduce the stress of meeting overload. Studies have shown on average 78% reduction in meeting volume and 22% increase in focused work on meeting free days (Houck 2021).



Screenshot from Microsoft Viva's Virtual Commute

Ahmetoglu, Y., et al. (2021). Disengaged From Planning During the Lockdown? An Interview Study in an Academic Setting. *IEEE Pervasive Computing*, 20(4): 18-25.
Feigon, M., et al. (2018). Work-life integration in neuropsychology: a review of the existing literature and preliminary recommendations. *The Clinical Neuropsychologist*, 32(2): 300-317.
Microsoft Study: Houck, B. (2021). "Happy and productive hybrid developers: How to have it all" [video].
Nippert-Eng, C. E. (1996). Home and work: Negotiating boundaries through everyday life. Chicago: University of Chicago Press.
Microsoft Study: Williams, A. C., et al. (2018). Supporting Workplace Detachment and Reattachment with Conversational Intelligence. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems.*, Paper 88, 1–13.

Remote work can have mixed effects on wellbeing

Pre-pandemic research on the relationship between remote work practices and wellbeing has shown mixed results. Remote work and subsequent work-life balance and job autonomy can improve job satisfaction, but employees may feel socially isolated, guilty and try to overcompensate.

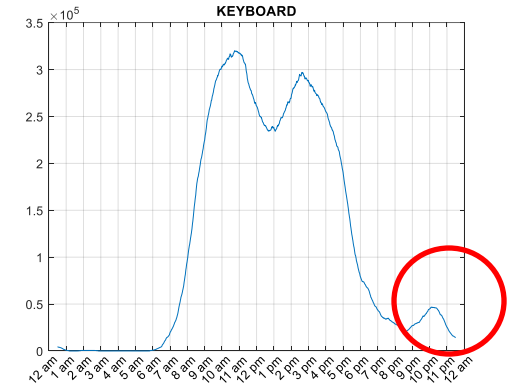
- An extensive pre-pandemic meta review of 63 studies emphasizes the complex relationship between remote work and work-related wellbeing – listing both positive and negative outcomes (Charalampous et al. 2019).
- Anderson et al. (2015) and others showed that remote workers reported higher degrees of positive emotions and lower degrees of negative emotions. However, working from home can cause increase in other negative emotions such as guilt and irritability (Mann & Holdsworth 2003), often leading to overcompensating at work.
- Feelings of autonomy through remote work positively affects job satisfaction and decreased emotional exhaustion (Sadesmukh 2012) but remote work is also associated with lower perceived career prospects (Gajendran & Harrison 2009).
- Social support is most depleted when employees work from home which also increases emotional exhaustion (Sardeshmukh 2012) but with organizational support employees feel less isolated, subsequently improving their job satisfaction levels (Bentley 2016).

Anderson, A. J., et al. (2015). The impact of telework on emotional experience: When, and for whom, does telework improve daily affective well-being? *European Journal of Work and Organizational Psychology*, 24, 882–897.
Bentley, T. A., et al. (2016). The role of organisational support in teleworker wellbeing: A socio-technical systems approach. *Applied Ergonomics*, 52, 207–215.
Charalampous, M., et al. (2018). Systematically reviewing remote e-workers' well-being at work: a multidimensional approach. *European Journal of Work and Organizational Psychology* 28: 51 - 73.
Gajendran, R. S., & Harrison, D. A. (2007). The good, the bad, and the unknown about telecommuting: Meta-analysis of psychological mediators and individual consequences. *Journal of Applied Psychology*, 92, 1524–1541.
Mann, S., & Holdsworth, L. (2003). The psychological impact of teleworking: Stress, emotions and health. *New Technology, Work and Employment*, 18, 196–211.
Sardeshmukh, S. R., et al. (2012). Impact of telework on exhaustion and job engagement: A job demands and job resources model. *New Technology, Work and Employment*, 27, 193–207.

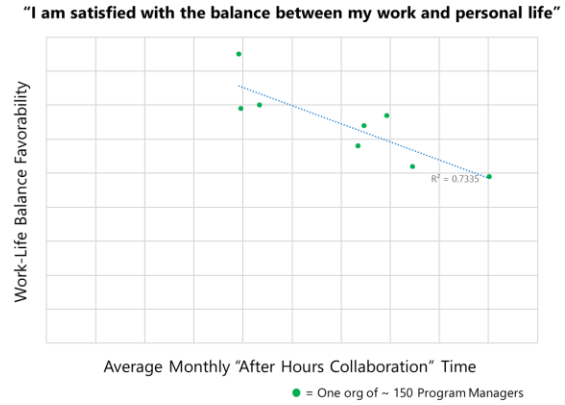
Working from home offers flexibility but also impacts permeability across domains

One's level of work-life integration or segmentation depends on both the flexibility – one's ability to shift one's boundary spatially or temporally to meet the demands of the other domain – and the permeability – how much intrusion occurs from one domain to the other

- According to a national survey that followed Canadian workers between September 2019 and April-June 2020, during the pandemic, work-life conflict *decreased* for people with no children at home, or with older children compared to pre-pandemic. In contrast people with children < 12 years old did not see any change in the contention between work and life demands (Schieman et al. 2021).
- A study with Redditors showed that choosing when and how to work gave them more freedom and flexibility to choose how to spend their remaining time – including more leisure time with family, more time to work on personal projects and hobbies and more freedom to exercise (Cho et al. 2022).
- On the other hand, flexible work patterns impact permeability- intrusion of work into personal time. Research has shown emergence of a 'third productivity peak', where work hours are extending beyond the regular pre-pandemic 9-5, and emails are shown to be the most frequent activity during the after-hour work (Morshed et al. 2021).
- Telemetry also showed an increase in the span of work time – a 46 minute increase in the span of workdays, 28% increase in after-hours work, and a 14% increase in weekend work (Microsoft WTI 2022).
- After-hour communications may impact colleagues' work-life balance. In a survey, 78% of engineers reported that it had been challenging establishing a work-life boundary during COVID. Engineers who reported such challenges were 22% more likely to report decreased productivity (Ford et al. 2021).



Additional productivity peak after hours as indicated by keyboard activity on productivity app (Morshed et al. 2021)



After hour collaboration is inversely related to work-life balance favorability scores (Storey et al. 2021)

Cho, J., et al. (2022). Topophilia, Placemaking, and Boundary Work: Exploring the Psycho-Social Impact of the COVID-19 Work-From-Home Experience. *Proceedings of the ACM Human.-Computer Interact*. 6, GROUP, Article 24.
Microsoft Study: Ford, D., et al. (2022). A Tale of Two Cities: Software Developers Working from Home During the COVID-19 Pandemic. *ACM Transactions on Software Engineering and Methodology* 31(2).
Microsoft Study: Morshed, B. M., et al. (2022). Advancing the Understanding and Measurement of Workplace Stress in Remote Information Workers from Passive Sensors and Behavioral Data. (Under Review)
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022*.
Schieman, S., et al. (2021). Work-life conflict during the COVID-19 pandemic. *Socius: Sociological Research for a Dynamic World* 7 (2021), 1–19.

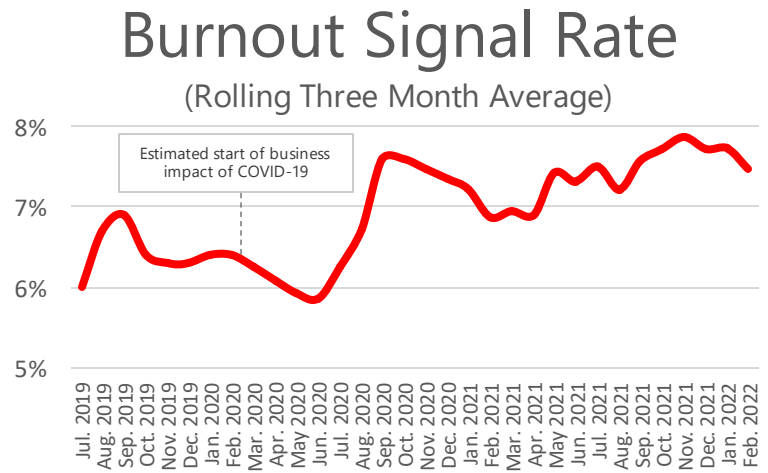
Burnout has been on the rise during the pandemic

Burnout, characterized by emotional exhaustion, depersonalization, and a reduced sense of accomplishment (Maslach & Jackson 1981) jumped in summer 2020 and currently remains high.

- Glint's February 2021 *Employee Well-Being Report* (Glint 2021) identified three top contributors to employees' sense of burnout. Among the survey respondents who reported feeling burned out, these the most common stated reasons were:
  - Feeling disconnected from colleagues (selected by 41% of survey respondents who also reported feeling burned out).
  - Overwhelming workload (selected by 38% of burned out respondents).
  - Conflict between demands from home and work (selected by 35% of burned out respondents).
- An analysis of employee engagement survey comments also demonstrated increases in mentions of staffing and workload issues (Glint 2020).
- Microsoft's longitudinal interviews with organizational decision makers over four time periods in 2020 also highlighted rising burnout (Coleman 2020).
  - June 2020: moving to remote work had driven higher employee output, but many leaders saw these productivity gains happening via longer working hours, not increased efficiency.
  - September 2020: these same leaders struggled with burnout given the breadth of new challenges they faced: e.g., employees relocating to new states or countries, client revenues falling, and the need to connect with employees on a more regular, personalized basis.

> *"I am a naturally caffeinated person - I am ready to go into meetings and bring energy - but doing this remotely is simply exhausting as I have to look at the camera for 9 hours, it is a lot. I over energize"*
> – Head of Global Ops & Strategy (Entertainment & Media) US

- A survey of 2067 attorneys demonstrated that one cause of burnout is the work of feigning appropriate emotional displays, an expectation in many other careers as well (Powers & Myers 2020).



Glint (2022)

Note: Glint's Burnout Signal Rate (BSR) represents the percent of comments from a global sample accompanying the key Engagement question and assigned the tag 'Burnout' by Narrative Intelligence.

Microsoft Study: Coleman, A (2020): 2020's indelible impact on the way we will work in the future. *Microsoft Research*.
Microsoft Study: Glint (2020). Employee Well-Being Report. *LinkedIn*.
Microsoft Study: Glint (2021). Employee Well-Being Report. *LinkedIn*.
Microsoft Study: Glint (2022). Employee Well-Being Report. *LinkedIn*.
Maslach, C., & Jackson, S. (1981). The measurement of experienced burnout. *Journal of Organizational Behavior*, 2(2), 99-113.
Powers, S. R., & Myers (2020). Work-Related Emotional Communication Model of Burnout: An Analysis of Emotions for Hire. *Communication Management Quarterly*, 34(2), 155-187.

Stress is costly and can lead to burnout at work, but interventions can help

Work-related stress increases the risk of mental and physical health disorders, decreases productivity due to absenteeism and burnout, impairs decision making, decreases overall job satisfaction & increases rates of stress-related accidents and employee medical, legal, and insurance costs.

- Workplace is the #1 stressor for American adults, costing the U.S. economy $300 billion annually (APA 2017). COVID-19 has exacerbated these issues.
- Workplace stress can also spillover into life outside of work, disrupting the overall wellbeing of workers (Grzywacz et al. 2002).
- Workplace stress intervention strategies such as organizational changes, individual stress management skills training, & therapeutic counseling are recommended for long-term stress reduction (Cooper et al. 1997).
- Individual-based stress management interventions (e.g., cognitive-behavioral skills , meditation, exercise, etc.) have been shown effective on psychological, physiological, and organizational outcome measures (Richardson et al. 2008; Howe et al. 2022).
- We have an opportunity to tightly integrate digital micro-interventions into productivity tools to significantly reduce stress (Howe et al. 2022).
- In a survey of tech employees, frequent and intense stressors are commonly associated with work overload and its impact on work-life balance (Morshed et al. 2022, see figure).

Morshed et al. (2022)

APA Working Group on Stress and Health Disparities (2017). Stress and health disparities: Contexts, mechanisms, and interventions among racial/ethnic minority and low-socioeconomic status populations.
Cooper, C. L., & Cartwright, S. (1997). An intervention strategy for workplace stress. *Journal of psychosomatic research* 43(1), 7–16.
Grzywacz, J. G., et al. (2002). Work– family spillover and daily reports of work and family stress in the adult labor force. *Family relations* 51(1).
Microsoft Study: Howe, E., et al. (2022). Design of Digital Workplace Stress-Reduction Intervention Systems: Effects of Intervention Type and Timing. *CHI Conference on Human Factors in Computing Systems (CHI '22).*
Microsoft Study: Morshed, M. B., et al. (2022). "Advancing the Understanding and Measurement of Workplace Stress in Remote Information Workers from Passive Sensors and Behavioral Data." (Under Review)
Richardson, K. M. & Rothstein, H. R. (2008). Effects of occupational stress management intervention programs: a meta-analysis. *Journal of Occupational Health Psychology* 13(1).

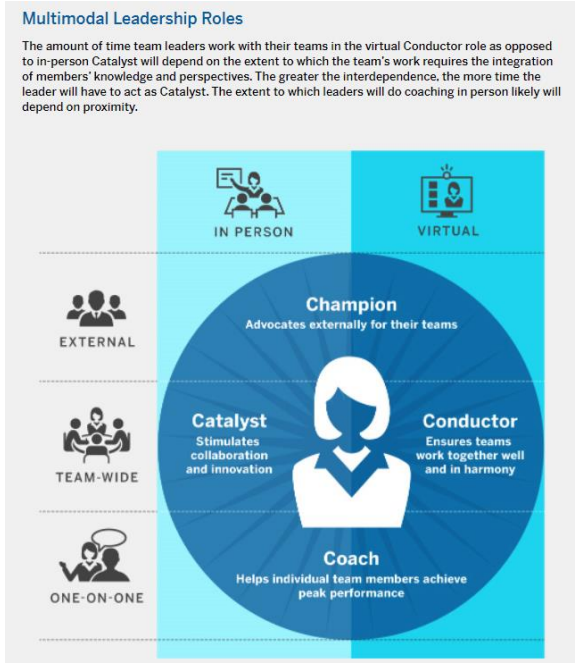
Team Collaboration

Key Contributors: Sean Rintel, Abigail Sellen, Mar Gonzalez Franco, Aaron Halfaker, Victor Poznanski, Kori Inkpen, Marcus Ash, Piali Choudhury, Shiraz Cupala, Kunal Gupta

Remote and hybrid team leadership requires a focus on relationships

Relationship-focused leadership can motivate and support virtual team members to help address unfulfilled team needs, especially as virtual team size increases.

- Effective leadership in hybrid conditions requires new skills. Leaders need to play four roles - conductor, catalyst, coach, and champion - across two modes: virtual coordination mode and in-person collaboration mode (Hooijberg & Watkins 2021) .
- Research on virtual leadership has generally assumed that physical dispersion and technology dependence represent obstacles to be overcome. However, there may also be virtues to separation depending on task complexity, collocation of the worker with experienced peers, and manager supervisory experience (Bell et al. 2019).
- Brown et al.'s (2021) meta-analysis of 116 empirical studies of leadership in virtual teams explores the relative effectiveness of relationship-focused leadership (focused on mission, collegiality, and interpersonal engagements) and task-focused leadership (focused on processes and procedures). Both relationship and task-focused leadership have positive effects on team performance, but relationship-focused team leadership shows stronger effects on virtual team performance in teams with larger team size. Relationship-focused leadership had equal effects on virtual team performance in long term and ad-hoc teams, but task-oriented leadership had weaker effects for ad-hoc teams compared to long-term teams.



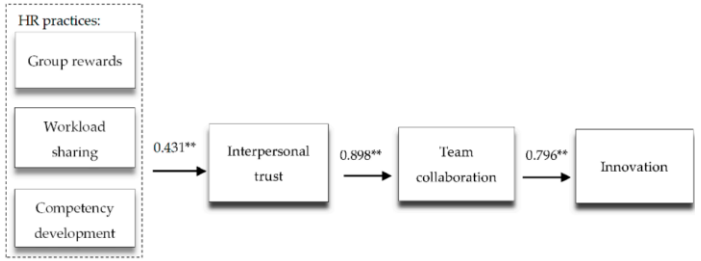
Hooijberg & Watkins (2021) argue that hybrid work requires multimodal leadership

Bell, B. S., et al. (2019). Leading from a distance: Advancements in virtual leadership research. In R. N. Landers (Ed.), *The Cambridge Handbook of Technology and Employee Behavior* (pp. 387–418). Cambridge.
Brown, S. G., et al. (2021). Leadership and virtual team performance: A meta-analytic investigation. *European Journal of Work and Organizational Psychology*, 30(5): 672-685.
Hooijberg, R., & Watkins, M. (2021). The Future of Team Leadership Is Multimodal. *MIT Sloan Management Review*.

Interpersonal trust is key to successful virtual and hybrid teams

Remote and hybrid teams need to develop methods for establishing and maintaining trust. Swift trust in short-term teams depends heavily on team composition and an open conversational environment.

- Interpersonal trust is about confidence in people and a willingness to be vulnerable to one another (Ma et al. 2019). Team trust has a cognitive aspect (reciprocal knowledge of competences and credibility) and an affective dimension (reciprocal perception of emotional investment, care, and concern about others) (Alves et al. 2022).
- Morrison-Smith & Ruiz (2020) find that geographical, temporal, and perceived distance all reduce awareness of activities and schedules. As these decrease, so too does confidence in others and willingness to seek help. As a result, there may be increased interpersonal and task conflicts. There are other contributing factors, such as the nature of work, management and leadership, and group composition, but interpersonal trust is often key. Virtuality also has its opportunities. Alves et al. (2022) find that virtuality may have a buffering effect that reduces conflict, but this still requires cognitive trust to be high.
- Organizations should explicitly assist creation of team common ground (shared vocabulary, mental models, practices, experiences etc.) and work standards, facilitate team communication, provide mechanisms for teamwork transparency (Morrison-Smith et al. 2020; Lechner & Mortlock, 2021). HR also has an important role to play in improving practices for workload sharing, group rewards, and team competency development, which are antecedent to building the interpersonal trust needed for team collaboration, and ultimately feed into team innovation Bulińska-Stangrecka & Bagieńska, 2019).
- Not all teams are permanent. Fast-response virtual teams (FRVTs) form to deal with periodic needs or emergent challenges. Team composition is crucial (Kroeger, et al. 2021), but to avoid the risk of intuitive decisions, establishing a safe conversational space for exploring diverse perspective is important (Yu, et al. 2021).
- Technology can assist in building interpersonal trust, making it easy to see who is working where and what they have contributed (e.g., Microsoft Loop), while also improving spontaneous engagement through the day (see also: "Spatial environments are conducive to spontaneous engagement").



Interpersonal trust has a crucial place in team innovation, and HR has an important role to play (Bulińska-Stangrecka & Bagieńska 2019)

Alves, M. P., et al. (2022). Can virtuality be protective of team trust? Conflict and effectiveness in hybrid teams. *Behaviour & Information Technology,* Article 2046163.
Bulińska-Stangrecka, H., & Bagieńska, A. (2019). HR Practices for Supporting Interpersonal Trust and Its Consequences for Team Collaboration and Innovation. *Sustainability,* 11(16) , Article 4423 .
Kroeger, F., Racko, G., & Burchell, B. (2021). How to create trust quickly: A comparative empirical investigation of the bases of swift trust. *Cambridge Journal of Economics,* 45(1): 129–150.
Lechner, A., & Mortlock, J. T. (2021). How to create psychological safety in virtual teams. *Organizational Dynamics*, 6, Article 00849.
Ma, J., et al. (2019). Interpersonal Trust in Organizations. *Oxford Research Encyclopedia of Business and Management.*
Morrison-Smith, S., & Ruiz, J. (2020). Challenges and barriers in virtual teams: a literature review. *SN Applied Science*, 2, Article 1096.
Microsoft Study: Microsoft (2021). To Thrive in Hybrid Work, Build a Culture of Trust and Flexibility. *Microsoft Worklab: WTI Pulse Report.*
Yu, X., Shen, Y., & Khazanchi, D. (2021). Swift Trust and Sensemaking in Fast Response Virtual Teams. *Journal of Computer Information Systems*, Article 1978114.

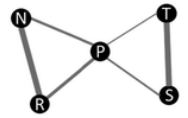
Global teamwork must be intentional

Temporal brokerage is the unofficial enabler of global teams. Global teams may succeed fast but fail slowly. Cultural Intelligence training increases global team performance.

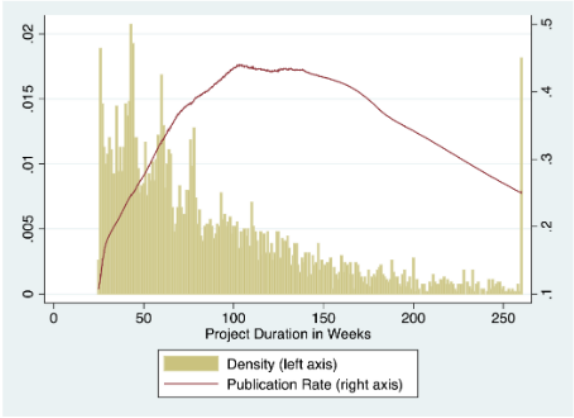
- *Temporal brokerage* (Mell at al. 2021) is an informal coordination role that an employee takes on within a dispersed team's set of time zones bridging subgroups that have little or no temporal overlap with each other. Two large studies (N=4553 and N=123,586) find that temporal brokering increases the ability of teams to do complex projects. This comes at a cost of increased workload and reduced number of projects for the temporal broker, but the projects completed were, on average, of higher quality. Other factors in the experience or skills of a temporal broker may shape team-level performance, such as the broker's level of multicultural experience and their facility with virtual communication. Leaving the temporal broker unofficial risks uncertainty. Temporal brokerage may be considered as an aspect of the *conductor role* in relationship-first leadership. (See previous slide on leadership and relationships.)
- Mors & Waguespack (2021) compared times and outcomes of 5,250 teams working together on collaborative documents for the Internet Engineering Task Force (IETF). Dispersed research teams reached success faster than non-dispersed teams, which may result from choosing low risk projects or, when choosing high risk projects, investing more early effort to minimize coordination challenges. However, dispersed teams fail more slowly than non-dispersed teams, possibly unwilling to let go of their idea or forgo upfront investments. This slow failure may delay reinvestment of resources in other projects.
- Technology to coordination and handover would benefit global teams. This might enable temporal brokers to concentrate on relational aspects of teamwork, while removing some burdens of the unofficial role. Planning for global team success should also involve up-front clarity around early milestones.
- Cultural Intelligence training also increases global team performance, both in the team and of individuals (Yari, et al. 2018; Prebitero & Toledano 2018).

Pairwise overlapping hours

	N	R	P	S	T
New York	-	8	4	0	0
Rio de Janeiro	8	-	6	0	0
Paris	4	6	-	3	2
Singapore	0	0	3	-	9
Tokyo	0	0	2	9	-



The temporal broker is the 'middle of the bow tie' playing an unofficial role coordinating global teamwork (Mell et al. 2021)



Global teams succeed fast and fail slow (Mors & Waguespack 2021)

Mell, J. N., et al. (2021). Bridging Temporal Divides: Temporal Brokerage in Global Teams and Its Impact on Individual Performance. *Organization Science,* 32(3): 731–751.

Mors, M. L., & Waguespack, D. M. (2021). Fast success and slow failure: The process speed of dispersed research teams. *Research Policy,* 50(5), Article 104222.

Presbitero, A., & Toledano, L. S. (2018). Global team members' performance and the roles of cross-cultural training, cultural intelligence, and contact intensity: The case of global teams in IT offshoring sector. *The International Journal of Human Resource Management*, 29(14): 2188–2208.

Yari, N., Lankut, E., Alon, I., & Richter, N. F. (2020). Cultural intelligence, global mindset, and cross-cultural competencies: A systematic review using bibliometric methods. *European Journal of International Management*, 14(2): 210–250.

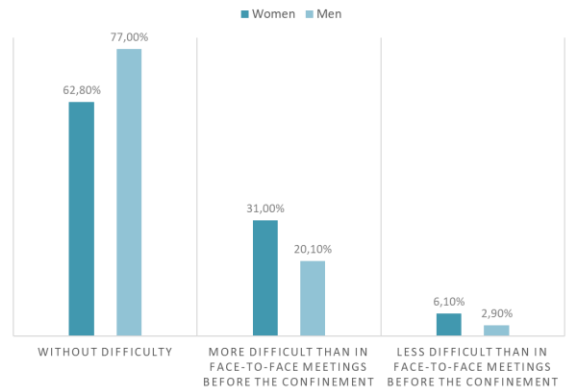
Mixed gender groups have a higher collective intelligence

Women's communication in teams often provides significant leadership and coordination, even if they are not in official roles. On the other hand, gender inequalities may be exacerbated in video meetings.

- Collective intelligence (Wooley et al. 2015) improves when more women are part of a mixed group (Riedl et al, 2021). Having more women in a team has a significant positive impact on how strategy and effort contribute to collective intelligence, and "other things being equal, a group with one standard deviation higher CI would increase task performance by 18%, plus or minus about 12%". Further, overall, group collaboration process is more important in predicting collective intelligence than the skill of individual members (Riedl et al. 2021).
- Thinnyun et al. (2021) found that women in a collaborative learning community posted more questions than men (but answer proportions are balanced), spent more time on the site, and achieve higher reputation scores on average. In Garcia et al.'s (2021) study of student teams using Slack to complete an eight-week project, women sent far more messages than men, and provided significant unofficial leadership, coordination, and project-monitoring.
- The coordinative work of women's communication is a form of leadership which should be rewarded, instead of being unrecognized *glue work* often undertaken by women (Reilly 2018). Organizations should select promising combinations of people for teams instead of over-indexing on individual skill, evaluate groups as well as individuals, and scaffold coordination with technological aids such as intelligent project overviews and task tracking (Reidl et al. 2021).
- However, video meetings may exacerbate inequalities faced by women in meetings, such as being held to higher or stereotypical appearance standards than men, and negative treatment of how they talk (Dhawan et al. 2021). Standaert & Thunus (2022) found that men participated in more meetings than women pre-pandemic and participate in even more virtual meetings since the pandemic. Women also report more difficulty speaking up in virtual meetings than men.

Mediation	ACME [95% CI]	*p*-value
Female → RME → CI	**0.35 [0.15 - 0.63]**	< 0.001
Female → Skill Congruence → CI	0.03 [-0.08 - 0.18]	0.544
Female → Strategy → CI	**0.63 [0.23 - 1.07]**	< 0.001
Female → Effort → CI	**0.27 [0.03 - 0.52]**	0.022
RME → Skill Congruence → CI	0.00 [-0.01 - 0.02]	0.890
RME → Strategy → CI	**0.06 [0.02 - 0.12]**	0.014
RME → Effort → CI	**0.03 [0.01 - 0.07]**	0.022

Women have a significant impact on collective intelligence (Riedl et al. 2021)



Difficulty reported by men and women related to speaking up in virtual meetings (Standaert & Thunus 2022)

Dhawan, N., et al. (2021.) Videoconferencing Etiquette: Promoting Gender Equity During Virtual Meetings. *Journal of Women's Health*, 30(4): 460–465.
Garcia, R., et al. (2022). Gender Influence on Communication Initiated within Student Teams. *ACM SIGCSE'22, 1: 432–438.*
Reilly, T. (2018) Being Glue. *No Idea Blog.*
Riedl, C., et al. (2021). Quantifying collective intelligence in human groups. *Proceedings of the National Academy of Sciences,* 118(21), Article e2005737118.
Standaert, W. & Thunus, S. (2022). Virtual Meetings during the Pandemic: Boon or Bane for Gender Inequality. *30th European Conference on Information Systems.*
Thinnyun, A., et al. (2021). Gender and Engagement in CS Courses on Piazza. *ACM SIGCSE'21:* 432–438.
Woolley, A.W., et al. (2015) Collective Intelligence and Group Performance. *Current Directions in Psychological Science*, 24(6): 420-424.

Meeting-free days improve both cooperation and self-reliance

Having some meetings is essential for coordination and social ties, but meeting-free days improve overall work and satisfaction. The change to fewer meetings requires better meeting management.

- Laker et al. (2022) surveyed 76 companies employing more than 1,000 people across 50 countries about meeting-free days (that is, prohibiting synchronous 1:1 to large meetings, but not asynchronous communication such as email or messaging).
  - Participants reported perceptions of cooperation, autonomy, communication, cooperation, engagement, productivity, satisfaction, stress, and micromanaging.
  - More meeting-free days were associated with better *autonomy,* (lower) *stress,* and (perhaps surprisingly) better *communication*.
  - Four meeting-free days per week was associated with better *cooperation*, *engagement*, *productivity,* and (lower) *micromanaging*.
  - Four meeting-free days per week was associated with the highest *satisfaction*.
  - As such, allocating some days for meetings is essential for the maintenance of social ties and management of schedules that, in turn, impact cooperation etc.
- In a study of 435 Microsoft employees from one product group during COVID-19, No Meeting Fridays had a very positive response. 75% of people liked them and 93% said it was respected by their manager. In addition, 73% of people said it was good for their wellbeing and 77% said it gave them more focus time. However, some verbatims said that this made their Thursdays or Mondays too meeting heavy, and thus the practice was instituted every second week (Butler & Jaffe, 2020).
- Limiting meeting days requires planning. Pushing all meetings to a different day can lead to scheduling overload and stress and limit employees' flexibility. Managers should solicit feedback before and during a period of change (see also Perlow, et al. 2017), encourage asynchronous communication, and ensure that the meetings they do have are run more intentionally (Rintel et al. 2021).

Percentage Change in Employee Ratings After Introduction of Meeting-Free Days

Regardless of the number of meeting-free days instituted, employees subsequently reported improvements in factors like autonomy and cooperation and decreases in stress and micromanagement. But arguably, the best results were achieved at companies that had three meeting-free days per week.

VARIABLE	MEETING-FREE DAYS PER WEEK				
	1	2	3	4	5
Autonomy	62%	78%	83%	86%	88%
Communication	45%	57%	61%	65%	68%
Cooperation	15%	43%	55%	58%	52%
Engagement	28%	32%	41%	44%	27%
Micromanaging	-33%	-52%	-68%	-74%	-63%
Productivity	35%	71%	73%	74%	64%
Satisfaction	48%	52%	65%	62%	42%
Stress	-26%	-43%	-57%	-63%	-75%

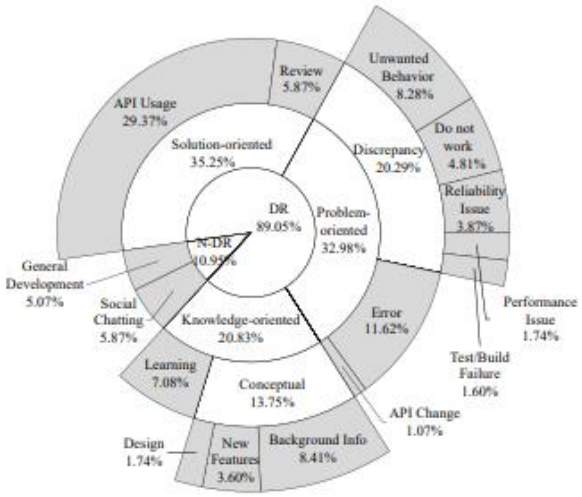
Meeting-free days improve overall work and satisfaction (Laker et al. 2022)

Microsoft Study: Butler, J., & Jaffe, S. (2021). Challenges and gratitude: A diary study of software engineers working from home during covid-19 pandemic. *ICSE-SEIP'21,* 362-363.
Laker, B., et al. (2022). The Surprising Impact of Meeting-Free Days. *MIT Sloan Management Review*.
Perlow, L. A., et al. (2017). Stop the Meeting Madness. *Harvard Business Review*.
Microsoft Study: Rintel, S., et al. (2021). A guide to having better remote meetings by being more intentional. *The New Future of Work*.

Chat workspaces can replace some meetings, when used thoughtfully

Routine meetings can be replaced with text-based chat, but there is a need to manage chat overload. Successful teams align work routines to communicate in bursts, interspersed with individual work periods.

- Stray et al. (2021) report on two groups in a software company using Slack. Chat reduced the number of some routine meetings, but also often sparked ad hoc meetings. Chat could also be overwhelming in volume, requiring context switching and interrupting focused work.
- Shi et al. (2021) used natural language processing to analyze over 173K dialogs of developer chat in Glitter. To reduce chat overload (volume, frequency and timing of notifications etc.), they suggest that individuals provide examples when seeking help, avoid asking new questions in ongoing discussions, and be aware of others' quiet/focus time. Communities should also improve information repositories such as FAQs and onboarding documentation, so that chat is used for problem solving.
- Riedl & Woolley (2017; 2020) found that successful remote teams work and communicate in bursts, interspersed with periods of individual work or non-work. In an experiment using 260 people working in geo- and time zone-distributed teams of 5, they found that high performing teams had high levels of responsiveness and coordination, but this coordination was not associated with predictable points such as beginning, middle, or end of work, or external temporal rhythms. As such, Reidl and Williams Wooley propose changing team assumptions about asynchronous communication as meaning 'everyone sending messages whenever they feel like it' and instead align work routines to communicate in short periods when everybody can respond rapidly and attentively. This can be extrapolated to also choosing communication modalities (meetings or chat/email) suited to task responsiveness. Tools that help people communicate and create in the same space (e.g., Microsoft Loop) will reduce context switching and allow better integration of content creation and co-working.



Shi et al. (2021) analyze OSS developer chat in Glitter

Riedl, C., & Woolley, A. W. (2017). Teams vs. Crowds: A Field Test of the Relative Contribution of Incentives, Member Ability, and Emergent Collaboration to Crowd-Based Problem Solving Performance. *AMD* 3(4), 382–403.
Riedl, C., & Woolley, A. W. (2020). Successful Remote Teams Communicate in Bursts. *Harvard Business Review*.
Shi, L., et al. (2021). A first look at developers' live chat on Gitter. AMC *ESEC/FSE'21*: 391–403.
Stray, V., et al. (2021). Using Objectives and Key Results (OKRs) and Slack: A Case Study of Coordination in Large-Scale Distributed Agile. *TechRxiv. Preprint,* Article 16892161.

Team creativity may benefit from low-fidelity asynchronous methods

Group creativity is not necessarily always at its best when people are together. Technological constraints may suit asynchronous ideation methods such as *brainwriting*, and may improve decision quality.

- The lack of shared collaboration tools has been a reported pain point for team creativity in remote and hybrid work, but reviews show that individual ideation can be richer than group ideation, because the processes of sharing ideas live can block ideation (Paulus & Kenworthy 2022; Thompson 2020). Further, while in-person two-person ideation may lead to the generation of more ideas than video meetings, the decision quality of ideas in video meetings can be higher than in-person (Brucks & Levav 2022).
- Toumi et al. (2021) review a range of technologies for group design ideation and found that even low fidelity systems for brainwriting (where participants write independently then pass their contribution to the next participants) or digital sticky notes can work well for the actual process, but social loafing remains a problem (some members may do less work in a group). Social loafing may be less noticeable when remote/hybrid than in-person – but may also be difficult to disambiguate from difficulty of remote participation in general.
- Brainwriting (Rituzzi & De Napoli 2020) and related asynchronous concepts such as the idea tree (Stokols, et al. 2019) are especially well suited to asynchronous creativity, as there are general findings that task alternation seems to reduce fixation effects on early ideas (Sio et al. 2017; Diehl & Stroebe 1987).
- Creativity does not 'just happen': training in effective group processes is crucial and the process needs to be managed. Task-appropriate diversity of participants (e.g., people from the set of roles for whom a solution is being determined) is also helpful for creativity, and may be enabled more in remote and hybrid situations (Paulus & Kenworthy 2022; Michinov & Jeanson 2021).

Asynchronous ideation methods such as brainwriting suit distributed groups

Brucks, M.S., Levav, J. (2022). Virtual communication curbs creative idea generation. *Nature*, Article s41586-022-04643-y.
Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology*, 53(3): 497–509.
Michinov, N., & Jeanson, S. (2021). Creativity in Scientific Research: Multidisciplinarity Fosters Depth of Ideas Among Scientists in Electronic "Brainwriting" Groups. *Human Factors*.
Paulus, P. B., & Kenworthy, J.B. (2022). Research Findings on Ideational Creativity in Groups. In Doboli, S., et al. (eds) *Creativity and Innovation. Understanding Complex Systems*. Springer.
Rizzuti, S., & De Napoli, L. (2020). Proposal of a Framework Based on Continuous Brainwriting to Expand Mindfulness in Concept Generation. In *Design Tools and Methods in Industrial Engineering*, Springer: 352–360.
Sio, U. N., Kotovsky, K., & Cagan, J. (2017). The Facilitating Role of Task Alternation on Group Idea Generation. *Journal of Applied Research in Memory and Cognition*, 6(4): 485-295.
Stokols, D. et al. (2019) Idea tree: A tool for brainstorming ideas in cross-disciplinary teams. *Integration and Implementation Insights*.
Thompson, L. (2020). Virtual Collaboration Won't Be the Death of Creativity. *MIT Sloan Management Review*, 62(2): 42-46.
Toumi, K., et al. (2021). Technologies for Supporting Creativity in Design: A View of Physical and Virtual Environments with Regard to Cognitive and Social Processes. *Creativity. Theories – Research – Applications*, 8(1): 189–212.

Spontaneous and serendipitous talk is still hard for distributed teams

Opportunistic informal talk is harder for remote and hybrid teams, but is crucial for knowledge sharing, trust, and morale. In the short term, informal talk can be organized around social rituals.

- The loss of spontaneous and serendipitous informal talk by the watercooler, in the hallway or breakroom, coming in/out of meetings etc. was keenly felt during COVID-19 (Bleakley et al. 2021; Miller et al. 2021; Lal et al. 2021; Methot et al. 2021).
- Such opportunistic talk enables knowledge sharing, trust, and morale building but it may also be distracting or exclusionary for some employees, so teams should ensure that work does not rely too heavily on it (Methot et al. 2021).
- Teams should organize social rituals, which provide both moments to socialize and a sense of ongoing team culture (Methot et al. 2021); Bleakley et al. 2021). These may be either traditional rituals such as eating together, or new ones such as playing video games together. This can also include joining meetings early to engage in small talk (Allen et al. 2014; Reed & Allen, 2021).
- Spatial environments may enable more persistent opportunities for informal talk not just throughout the day, but also the pre- and post-meeting talk (Gonzalez Diaz 2022) (see also: "Spatial environments are conducive to ad hoc engagement").

Spontaneous talk outside of formal engagements is crucial to work, both in rituals such as coffee (top) and hallway or pre/post meeting talk (bottom).

Allen, J. A., et al. (2014). Linking pre-meeting communication to meeting effectiveness. *Journal of Managerial Psychology*, 29(8), 1064–1081.
Bleakley, A., et al. (2021). Bridging social distance during social distancing: exploring social talk and remote collegiality in video conferencing. *Human–Computer Interaction*.
Microsoft Study: Gonzalez Diaz, et al. (2022). "Making Space for Social Time: Supporting Conversational Transitions Before, During, and After Video Meetings." *ACM CHIWORK'22*.
Lal, B., et al. (2021). Working from Home During Covid-19: Doing and Managing Technology-enabled Social Interaction With Colleagues at a Distance. *Information Systems Frontiers*.
Methot, J. R., et al. (2021). Office Chitchat as a Social Ritual: The Uplifting Yet Distracting Effects of Daily Small Talk at Work. *Academy of Management Journal* 64(5), 1445–1471.
Microsoft Study: Miller, C., et al. (2021). "How Was Your Weekend?" Software Development Teams Working From Home During COVID-19. *ACM ICSE'21*, 624–636.
Reed, K. M., & Allen, J. A. (2021). *Suddenly Virtual: Making Remote Meetings Work*. John Wiley & Sons.

Meetings improve when business objectives drive technology choices

All meetings need good voice and task sharing capabilities but building trust and resolving conflict benefit from showing people's video streams.

- Standaert et al. (2021) used data from the organizers of 612 business meetings at a large global technology company to develop a decision matrix for how to match meeting goals/needs to communication modes.
- The ability to hear voice and share screens – but not video of participants – was identified by Standaert et al. (2021) as critical to all business meeting objectives. However, resolving conflicts and building trust were reported to benefit from views of gestures, facial expressions, and what people are looking at.
- Considerations may change when participants have disabilities (Das et al. 2021) (see also: "Collaboration systems need to be more accessible").

	Business Meeting Objective	Important Capabilities						Proposed Meeting Mode
		Hear attendees' voices (speech and vocal tone)	Use shared computer screens and/or work spaces	Experience co-location (the sense of being in the same physical location) (1, 3, 4, 11)	See attendees' body language and gestures (1, 3)	Discern attendees' facial expressions (1, 3)	Observe what attendees are looking at (3)	
1	Routine exchange of information							Audio-conferencing (or video-conferencing for longer meetings)
2	Non-routine exchange of information							
3	Clarify a concept, issue, or idea							
4	Exchange/share different opinions or views of a topic or issue							
5	Find a solution to a problem that has arisen							
6	Generate ideas on products, projects, or initiatives							Video-conferencing or telepresence
7	Show personal concern or interest							
8	Make a decision							
9	Give or receive feedback							
10	Generate buy-in or consensus on an idea							
11	Assemble a team and/or motivate teamwork on a project							
12	Exchange confidential, private, or sensitive information							
13	Maintain relationships and stay in touch							
14	Resolve conflicts and disagreements within a group							Telepresence or face-to-face
15	Build trust and relationships with one or more individuals							

Fig. 3. Business Meeting Objectives, Important Capabilities, and Proposed Meeting Modes.
Note: the numbers in parentheses in the columns with the important capabilities indicate the objectives (numbered in the left-hand column) for which a significant, positive relationship was found with meeting duration.

Standaert et al. (2021)

Microsoft Study: Das, M., et al. (2021). Towards Accessible Remote Work: Understanding Work-from-Home Practices of Neurodivergent Professionals. *Proc. ACM-HCI 5 (CSCW1)*, Article 183.
Standaert, W., et al. (2021). How shall we meet? Understanding the importance of meeting mode capabilities for different meeting objectives. *Information & Management*, 58(1), Article 103393.

Hybrid meetings can work when participation is encouraged

Early post-pandemic adopters are finding that hybrid meetings have value, with the strong requirement that participation is encouraged and moderated

- The technological struggles of hybrid meetings are well known, such as the difficulty of hearing/seeing remote attendees and the ability for in-person attendees to use devices for parallel chat and other collaboration (Saatçi et al. 2019, 2020). While current technology can be carefully set up (Frisch & Greene 2021), and the technology will improve, there are practices to ensure equitable engagement and meeting success. (See slide 39 on new hybrid meeting technologies.)
- Early post-pandemic adopters of hybrid meetings are findings some benefits, according to a June 2021 survey of 1000 knowledge workers (Reed & Allen 2022). While hybrid meeting satisfaction lags video and in-person, hybrid meetings scored better than in-person, video, and telephone meetings in having: the most participation (although it is unclear if this includes equal remote and in-person participation), less counterproductive behaviours (such as complaining, monologues, multitasking); less 'surface acting' (faking expected emotions – a practice that related to meeting fatigue); and in requiring the least meeting recovery time (the time required to reset intellectually, emotionally, and physically after a meeting).
- Individual participation is even more important to meeting satisfaction and effectiveness in hybrid meetings in comparison to in-person, video, and telephone meetings. Further, as leader-initiated participation increases, individual participation increases. (For detailed guides, see Hybrid Work Solutions for a Hybrid Workplace, 2022; Reed & Allen 2022, Mroz et al. 2018).

Participation and Meeting Satisfaction Across Format

Format Style	Correlation of MP with MS	Correlation of IP with MS
Video	.47	.61
Face-to-Face	.47	.50
Hybrid	.22	.56
Telephone	.37	.32

Participation and Meeting Effectiveness Across Format

Format Style	Correlation of MP with ME	Correlation of IP with ME
Video	.38	.64
Face-to-Face	.70	.58
Hybrid	.38	.73
Telephone	.68	.63

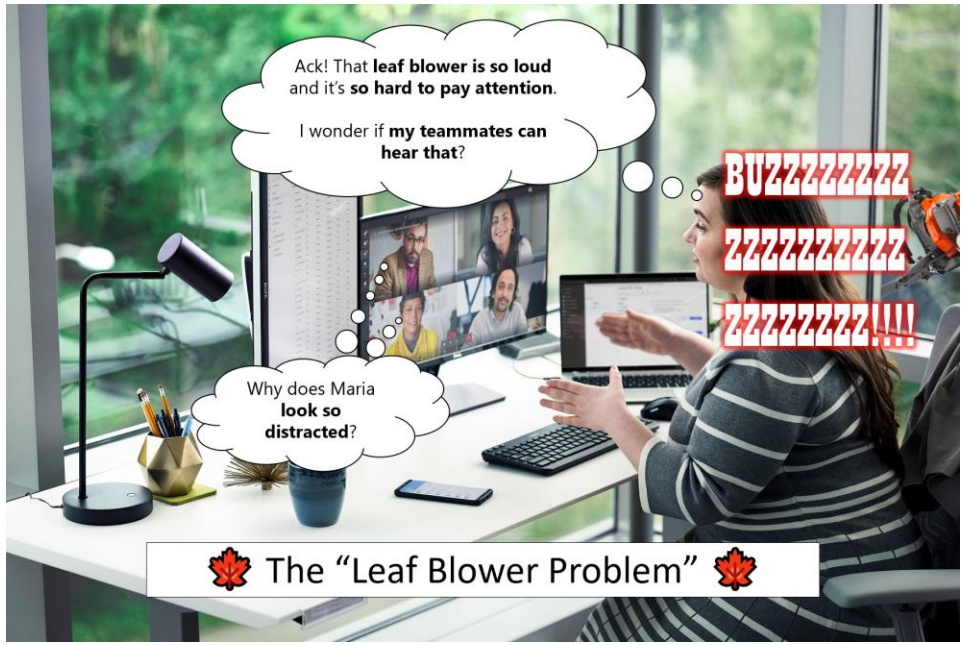
Participation is key to hybrid meeting satisfaction and effectiveness (Reed & Allen 2022)

Frisch, B., & Greene, C. (2021, June 3). What It Takes to Run a Great Hybrid Meeting. *Harvard Business Review*.
Microsoft Study: Microsoft (2022). Hybrid Work Solutions for a Hybrid Workplace.
Mroz, J. E., et al. (2018). Do We Really Need Another Meeting? The Science of Workplace Meetings. *Current Directions in Psychological Science*, 27(6), 484–491.
Reed, K. M., & Allen, J. A. (2022). *Suddenly Hybrid: Managing the Modern Meeting*. John Wiley & Sons.
Microsoft Study: Saatçi, B., et al. (2019). Hybrid Meetings in the Modern Workplace: Stories of Success and Failure. In H. Nakanishi, H., et al. (Eds.), *Collaboration Technologies and Social Computing* (pp. 45–61). Springer.
Saatçi, B., et al. (2020). (Re)Configuring Hybrid Meetings: Moving from User-Centered Design to Meeting-Centered Design. *Computer Supported Cooperative Work*, 29, 769-294.

The *Leaf Blower Problem* is an open challenge for remote meetings

When we share the same room, we implicitly understand how we are perceived. When joining a meeting remotely, a lack of common ground may lead to misunderstandings about what others perceive.

- The *Leaf Blower Problem* occurs when only one side of a conversation experiences a major disruption (like a leaf blower or children) and that disruption is only perceptible to those on that side of the conversation, leading to significant confusion in the conversation (Hecht et al. 2021). The Leaf Blower Problem is a new manifestation of an old problem in human-centered AI and UX design: the grounding error. Grounding errors happen when we lack shared understanding. Shared understanding is what makes effective conversation possible (Clark 1996).
- A related problem is the lack of *reciprocity of perception* or not knowing how we are perceived by others which is a particular problem in technology-mediated conversations, which in turn underpins and contributes to the difficulty of turn-taking in video calls. Early research into communicating through video (Heath & Luff 1991, 1992) showed how always having think about how you are heard and how you are seen means that the flow of a conversation is disrupted and interaction becomes an effortful performance.
- This is made worse in hybrid meetings where the asymmetries in perception are amplified. In an all-remote situation, we may have a better understanding of how others perceive us because we are in similar situations. Not so in hybrid meetings, where knowing how you are seen and heard in a meeting room is more difficult. This can be made even worse if the camera through which remote people are viewing a meeting and the place in the room where they are displayed are not lined up resulting in head turning and gaze cues being distorted (Gaver 1993).



Clark, H. H. (1996). *Using Language*. Cambridge University Press.
Gaver, W. W., et al. (1993). One is not enough: Multiple views in a media space. *ACM INTERACT'93 and CHI'93:* 335-341.
Heath, C., & Luff, P. (1992). Media space and communicative asymmetries: Preliminary observations of video-mediated interaction. *Human–Computer Interaction*, 7(3), 315-346.
Heath, C., & Luff, P. (1991). Disembodied conduct: Communication through video in a multi-media office environment. *CHI' 91:* 99-103.
Microsoft Study: Hecht et al. (2021) The "Leaf Blower Problem" and the importance of common ground. *Microsoft Research*.

Video meeting fatigue is a multidimensional problem

Video meeting fatigue stems from a combination of unnaturally low or high cognitive load imposed by the user interface combined with intense/inappropriate use.

- Reidl (2021) developed a synthetic definition from a review of 45 articles: "[Video meeting fatigue] is defined as somatic and cognitive exhaustion that is caused by the intensive and/or inappropriate use of videoconferencing tools, frequently accompanied by related symptoms such as tiredness, worry, anxiety, burnout, discomfort, and stress, as well as other bodily symptoms such as headaches."
- Video meeting tools introduce two poles of unnaturalness compared to being in person: lack of information (e.g., lack of body language, eye contact) and too much information (e.g., self mirror, artificial grouping of faces) (Bailenson 2021). However, unnaturalness alone is not enough, the key to fatigue is "intensive and/or inappropriate use" – that is, too many meetings, held too close together, for goals that are not always suited to its use (Reidl 2021; Döring 2022).
- In a study of approximately 10k participants during COVID-19, Fauville et al. (2021) found that daily video meeting usage predicts amount of fatigue and that women reported greater fatigue than men. They found that mirror anxiety mediated the difference in fatigue across gender, with race, age, and personality possibly also relating to fatigue.
- On personality, Kuhn (2022) reports two studies in which people with the personality trait of higher public self-consciousness had a more negative attitude toward their virtual meetings the more often their own face was visible, whereas for people with low public self-consciousness had more favourable attitudes toward using video in meetings.
- For people who are deaf or hard of hearing, however, the artificial frontal view of all participants in a video meeting may make meetings less fatiguing, because it aids identification and lip reading (Tang 2021).

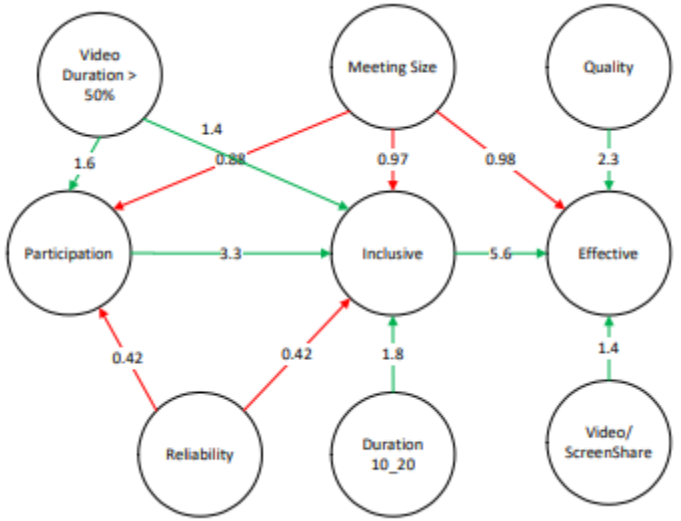
Video conference fatigue has multi-dimensional inputs (Raake et al. 2022)

Bailenson, J. N., (2021). Nonverbal Overload: A Theoretical Argument for the Causes of Zoom Fatigue. *Technology, Mind, and Behavior.* 2(1), Article tmb0000030 .
Döring, N. (2022). Videoconference Fatigue: A Conceptual Analysis. *International Journal of Environmental Research and Public Health*, 19(4), Article 2061.
Fauville, G., et al. (2021). Nonverbal Mechanisms Predict Zoom Fatigue and Explain Why Women Experience Higher Levels than Men. *Social Science Research Network, 3820035.*
Kuhn, K. M. (2022). The constant mirror: Self-view and attitudes to virtual meetings. *Computers in Human Behavior*, 128, Article 107110.
Raake, A., et al. (2022). Technological Factors Influencing Videoconferencing and Zoom Fatigue, *arXiv preprint*, arXiv.2202.01740.
Riedl, R. (2021). On the stress potential of videoconferencing: definition and root causes of Zoom fatigue. *Electronic Markets*, December 6.
Microsoft Study: Tang, J. (2021). Understanding the Telework Experience of People with Disabilities. *Proc. ACM-HCI 5(CSCW1)*, Article 30.

Video often benefits remote meetings, but should be used intentionally

Research suggests that video is a valuable tool for remote (and hybrid) meetings, but in specific circumstances there might be reasons to stick with audio.

- During and after the primary COVID-19 pandemic, many groups had to negotiate when video should be on or off in remote meetings (Castelli et al. 2021).
- Cutler et al. (2021), using a very large data set from a global technology company, found that video usage is often correlated with more inclusive meetings.
  - This is particularly the case for participants who are deaf or hard of hearing (Tang 2021)
- There are reasons teams may sometimes want to be intentional about the use of video in meetings.
  - Video may be less inclusive for people who are low-vision or neurodivergent (Tang 2021).
  - Pressure to use video can make interactions feel forced, or lead to anxiety and privacy helplessness, all of which may lead to worse subjective productivity (Okabe-Miyamoto et al. 2021) and video conference fatigue. (See previous slide on video meeting fatigue.)
  - People frequently turn off video when they are only monitoring meetings and want to multitask (Cao et al. 2021).
- Video is useful in hybrid meetings, but can be challenging when remote participants are sized unequally compared to those in the room. Screen and microphone placement can also cause confusion about who is speaking or being referenced (Saatçi et al. 2020).
  - These issues are starting to be addressed by new practices – such as collocated participants turning their laptop video on – and new technologies – like Front Row (Microsoft 2021), MSR Perspectives (Microsoft Research 2021), and MSR Virtual Cube (Zhang et al. 2021).



Correlations from in-client end-of-meeting survey (Cutler et al. 2021)

Microsoft Study: Cutler, R., et al. (2021). Meeting Effectiveness and Inclusiveness in Remote Collaboration. *Proc. ACM-HCI, 5(CSCW1)*, Article 173.
Okabe-Miyamoto, K., et al. (2021). Did zoom bomb? Negative video conferencing meetings during COVID-19 undermined worker subjective productivity. *Human Behavior and Emerging Technologies,* 3(5), 1067–1083.
Castelli, F. R., & Sarvary, M. A. (2021). Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so. *Ecology and Evolution,* 11(8), 3565–3576.
Microsoft (2022). The Future of Hybrid Work – See What's next for the Future of Hybrid Work.
Microsoft Study: Panel: Perspectives on the new future of hybrid meetings. (2021). *Microsoft Research Summit 2021*.
Microsoft Study: Tang, J. (2021). Understanding the Telework Experience of People with Disabilities. *Proc. ACM-HCI, 5(CSCW1)*, Article 30.
Microsoft Study: Cao, H., et al. (2021). Large Scale Analysis of Multitasking Behavior During Remote Meetings. *ACM CHI'21,* Article 448.
Saatçi, B., et al. (2020). (Re)Configuring Hybrid Meetings: Moving from User-Centered Design to Meeting-Centered Design. *Computer Supported Cooperative Work*, 29, 769-294.
Microsoft Study: Zhang, Y., et al. (2022). VirtualCube: An Immersive 3D Video Communication System. *IEEE Transactions on Visualization and Computer Graphics*. 28(5), 2146–2156.

Meeting chat has promise and peril

Parallel chat allows groups to communicate flexibly but may be distracting.

- Sarkar et al. (2021) report that parallel chat has become essential in many video meetings. Parallel chat in meetings is seen as a net positive. It can help organize the meeting, work around problems, and manage turn taking. During the pandemic, the usage of parallel chat increased greatly by women aged 25-34, this, along with qualitive reports of parallel chat as an inclusive space, may indicate that it is especially important in overcoming some problems of turn-taking that are inherent to video meetings.
- However, many people report being distracted by parallel chat, and there are different expectations around how on-topic or formal chat needs to be. Distraction may be a particular challenge for people who are neurodivergent.
- Chat may also be inaccessible to people with reading difficulties, those struggling with written sentiment, or blind and low vision people.
- Future AI may help people manage different information flows of AV and parallel chat in meetings. For example, annotating distinct categories of chat messages could reveal patterns of activity and enable effective scanning.

Prompt	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree	Sparkline
My use of text chat in meetings has increased compared to before mandatory working from home.	2%	7%	5%	14%	21%	24%	26%	
Other people's use of text chat in meetings has increased compared to before mandatory working from home.	1%	5%	2%	17%	19%	28%	29%	
I find text chat in meetings distracting from the presentation or discussion.	7%	24%	13%	11%	28%	10%	13%	
Text chat in meetings helps overcome conversational issues like interruption.	1%	5%	3%	7%	23%	36%	25%	
Text chat in meetings helps add more resources like links.	0%	0%	1%	1%	8%	32%	57%	
Text chat is a net positive for meetings.	0%	1%	3%	9%	14%	42%	30%	

Age	Men	Women
25-34	20%	59%
35-44	8%	29%
45-64	24%	26%

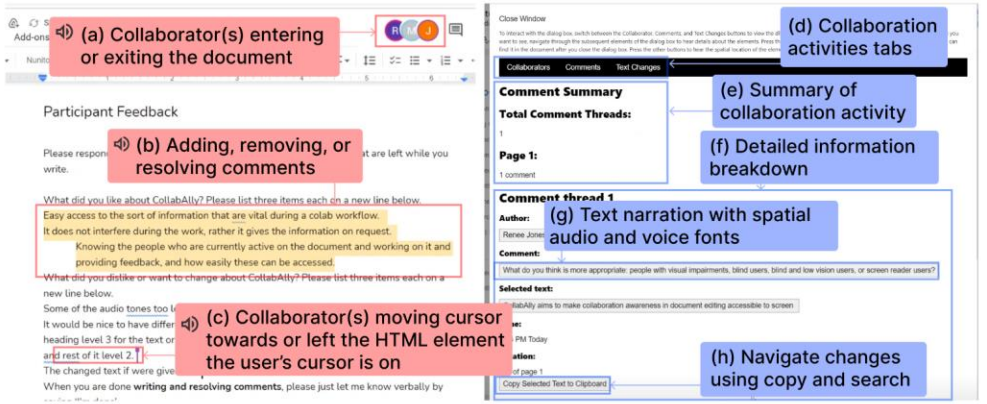
Parallel chat in meetings is seen as a net positive, albeit with some issues around distraction (top table). Its usage increased greatly by women aged 25-34, which may be indicative of providing a space for inclusion (Sarkar et al. 2021)

Microsoft Study: Sarkar, A., et al. (2021). The promise and peril of parallel chat in video meetings for work. *ACM CHI EA'21*, Article 260.

Collaboration systems need to be more accessible

From meetings to document collaboration, there are more opportunities to broaden inclusion.

- Workspaces have improved the base level of accessibility over the last few years. The pandemic has accelerated some improvements. However, tools could go further to support personalized needs and more diverse methods of representation.
- Both Leprorini et al. (2021) and Tang (2021) report challenges and opportunities with video collaboration platforms for blind, deaf blind and deaf. These include screen reader navigation of platforms, video-based screen sharing, and visibility of interpreters.
- Tang (2021) reports that deaf and hard of hearing (DHH) people are unable to lip-read when others do not turn their camera on, and there are ongoing issues ensuring that deaf people and sign language interpreters are seen and identified correctly. Closed captioning can help DHH people (when available); its accuracy rates can be high enough for university education (Millet 2021), but sometimes manual captioning is still desired. (See slide 46 on avatar acceptance.)
- The social-emotional-sensory needs of neurodiverse people require attention (Zolyomi & Snyder 2021). Das et al. (2021) report that for neurodiverse people, seeing people's backgrounds may be a distraction, and being seen by others or seeing themselves in self view may make them uncomfortable with the way they demonstrate attention or their need to focus using support objects.
- Beyond meetings, document collaboration (Lee et al. 2021) and collaboration that requires an ecosystem of tools, such as programming (Pandey et al. 2021), also need improvement for individuals who use assistive technology.



CollabAlly uses spatial audio, earcons, and voice fonts to help blind and low vision users collaborate on documents (Lee, et al., 2022).

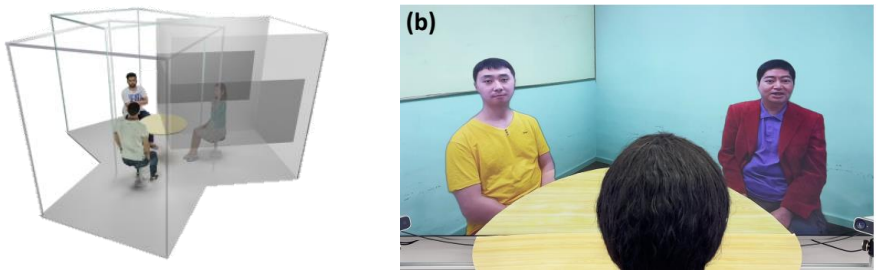
Microsoft Study: Das, M., et al. (2021). Towards Accessible Remote Work: Understanding Work-from-Home Practices of Neurodivergent Professionals. *Proc. ACM-HCI 5(CSCW1)*, Article 183.
Lee, C. Y. P., et al. (2021). CollabAlly: Accessible Collaboration Awareness in Document Editing. *ACM CHI'22, Article 596*.
Leporini, B., et al. (2021). Distance meetings during the covid-19 pandemic: are video conferencing tools accessible for blind people? *ACM W4A '21, Article 7* .
Millett, P. (2021). Accuracy of Speech-to-Text Captioning for Students Who are Deaf or Hard of Hearing. *Journal of Educational, Pediatric & (Re) Habilitative Audiology*, 25, Article 21.
Pandey, M. (2021). Understanding Accessibility and Collaboration in Programming for People with Visual Impairments. *Proc. ACM-HCI 5(CSCW1)*, Article 129.
Microsoft Study: Tang, J. (2021). Understanding the Telework Experience of People with Disabilities. *Proc. ACM-HCI 5(CSCW1)*, Article 30.
Wolfe, R., et al. (2021). State of the Art and Future Challenges of the Portrayal of Facial Nonmanual Signals by Signing Avatar. In *Universal Access in Human-Computer Interaction. Design Methods and User Experience*, Springer,
Zolyomi, A., & Snyder, J. (2021). Social-Emotional-Sensory Design Map for Affective Computing Informed by Neurodivergent Experiences. *Proc. ACM-HCI 5(CSCW1)*, Article 77.

New hybrid meeting technologies are showing significant promise

Hybrid meetings are difficult to run effectively and combining the best of remote and in-person meetings is a major open challenge. Fortunately, new prototypes show significant short- and long-term potential.

- The primary challenge of hybrid meetings is that endpoints have asymmetrical perspectives. Remote and local people see and hear one another differently, are grouped in artificial ways, and have different access to shared resources. This tends to advantage groups in rooms and disadvantage individual remote users (Saatçi, et al. 2020).
- Both the MSR Perspectives Prototype (Panel 2021) and the VirtualCube prototype (2022) strive to provide equitable and immersive views of meeting participants without the need for head-mounted displays.
- The MSR Perspectives Prototype (Panel 2021), is designed for small hybrid meetings. All participants, including people who are co-located, join the meeting as individual video streams with background removed. Each endpoint has a unique perspective, and consistent 'around the table' spatial positioning is preserved. Remote users experience the meeting as sitting at a shared virtual table, while people in the room experience it as an extension of the physical room. Spatial audio streams are provided for each attendee. This approach takes advantage of natural spatial cues for taking turns, enabling a stronger sense of co-presence, and more dynamic engagement, resulting in the feeling of sharing a common space in an equitable way.
- VirtualCube (2022) takes the view of each person one step further by using multiple Azure Kinects at each endpoint to create photo-realistic life size 3D views of each person, with correct eye-contact and natural user interactions between remote participants including side conversions in a group meeting and seamlessly sharing of work items remotely.
- As we develop new ways to enable hybrid meetings, we should make sure to include people who are participating using any approach: in-person in the room, over audio using a phone, remotely using a computer desktop, or virtually using VR or AR headsets.

The MSR Perspectives Prototype local room view (left) and a remote user's view (right) (Panel 2021)



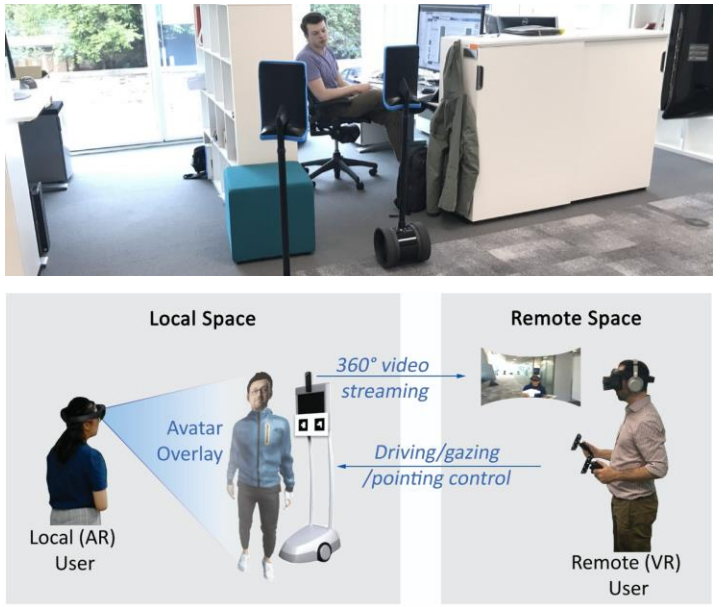
VirtualCube from Zhang et al. (2022)

Saatçi, B., et al. (2020). (Re)Configuring Hybrid Meetings: Moving from User-Centered Design to Meeting-Centered Design. *Computer Supported Cooperative Work*, 29, 769-294.
Microsoft Study: Panel: Perspectives on the new future of hybrid meetings. (2021). *Microsoft Research Summit 2021*.
Microsoft Study: Zhang, Y., et al. (2022). VirtualCube: An Immersive 3D Video Communication System. *IEEE Transactions on Visualization and Computer Graphics*. 28(5), 2146–2156.

Telepresence robots provide autonomy at a distance

While they may be expensive, telepresence robots have had positive results for team building and remote user presence in retail, education, healthcare and more.

- Mobile Robotic telePresence (MRP) systems provide a combination of videoconferencing and locomotion. A remote pilot may log in to and move an MRP autonomously around a local activity space, engaging in both structured and informal talk with others in that environment. They are already used, albeit sometimes experimentally, in a range of contexts including conferences (Neustaedter et al. 2018), retail (Singh 2021), education (Lei et al. 2022), healthcare (Isabet et al. 2021), and even domestic contexts (Boudouraki, 2022).
- The autonomy of connecting to an organizational space without the need for a call to a specific individual or meeting, and being able to move around that space, has significant positive benefits for hybrid organizations. They have been found to enable virtual team building (Keller et al. 2021), although like other hybrid videoconferencing applications the ability of remote pilots to hear and be heard among a group of real people may be challenging.
- One specific challenge of MRP usage is that remote pilots do not see or hear in the local environment as well as local people, and may have trouble navigating around physical obstacles. In such cases, local people may treat the MRP pilot in a manner that affects their influence, role, and power (Boudouraki et al. 2021).
- To increase the sense of belonging for both ends, telepresence robots may be enhanced with overlayed life-size avatars viewed through augmented reality HMDs, and immersive VR piloting (Jones et al. 2021).



Telepresence robots at work (top) and the VROOM system with overlayed avatars (bottom) (Jones, et al. 2022)

Boudouraki, A., (2022). Mediated Visits: Longitudinal Domestic Dwelling with Mobile Robotic Telepresence. *ACM CHI '22*, Article 251.

Microsoft Study: Boudouraki, A., et al. (2021). "I can't get round": Recruiting Assistance in Mobile Robotic Telepresence. *Proc. ACM-HCI 4(CSCW3)*, Article 248.

Isabet, B., et al. (2021). Social Telepresence Robots: A Narrative Review of Experiments Involving Older Adults before and during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, 18(7), 3597.

Microsoft Study: Jones, B., et al. (2021). Belonging There: VROOM-ing into the Uncanny Valley of XR Telepresence. *Proc. ACM-HCI 5(CSCW1)*, Article 59.

Keller, L., et al. (2021). Driving Success: Virtual Team Building Through Telepresence Robots. In P. Zaphiris & A. Ioannou (Eds.), *Learning and Collaboration Technologies: Games and Virtual Environments for Learning* (pp. 278–291). Springer.

Lei, M., et al. (2022). The Acceptance of Telepresence Robots in Higher Education. *International Journal of Social Robotics*, 2022 Jan 27:1-18 .

Neustaedter, C., et al. (2018). From Being There to Watching: Shared and Dedicated Telepresence Robot Usage at Academic Conferences. *ACM TOCHI*, 25(6), Article 33.

Singh, S., et al. (2021). Combating COVID-19: Study of robotic solutions for COVID-19. *AIP Conference Proceedings*, 2341(1), 020042.

Devices need to be better together rather than adding friction

Device ecosystems need to support natural work transitions, home/work connections, and security.

- Information workers move between activities, places, and devices, interacting with different people and kinds of information – but using devices together often comes with high friction. (Brudy et al. 2018; Nguyen 2021).
- Remote and hybrid workers face difficulties in using devices (individually or in combinations) from home or in meeting rooms where they must bring their own device. Difficulties include friction using devices together, difficulty connecting to work device, different devices at home and work, tensions over device management, and home personal device and IoT security threats (Ford et al. 2022; Edelmann et al. 2021; Barlette et al. 2020)

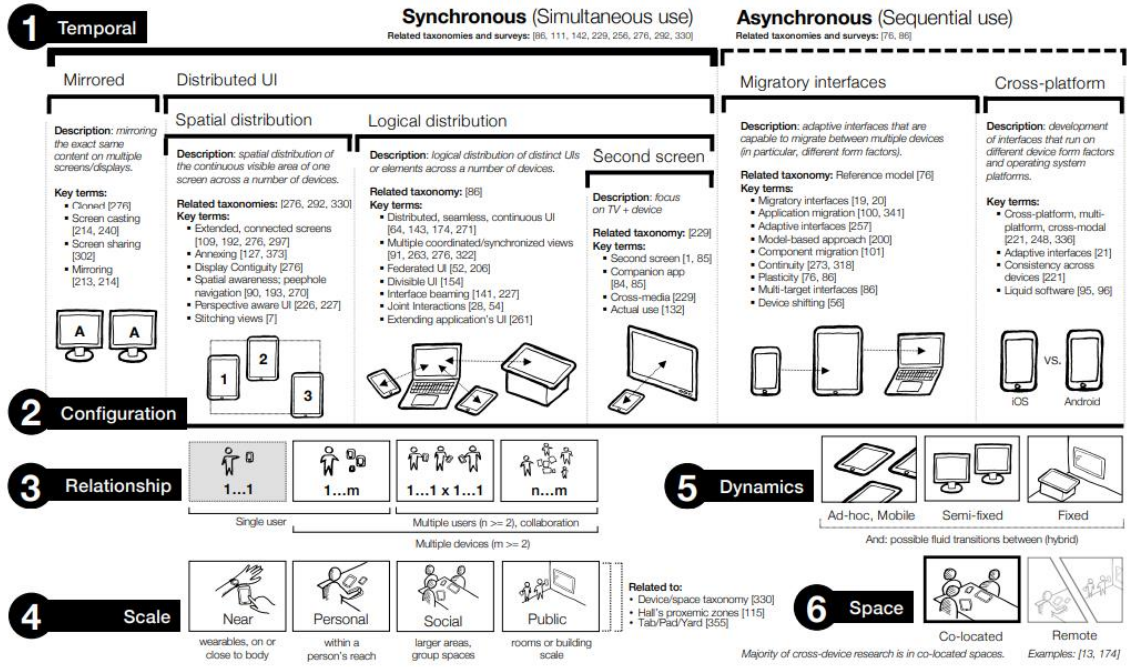


Figure 2: Taxonomy of cross-device design space dimensions: temporal, configuration, relationship, scale, dynamics and space.

Overview of the cross-device design space (Brudy et al. 2018)

Barlette, Y., et al. (2021). Bring Your Own Device (BYOD) as reversed IT adoption: Insights into managers' coping strategies. *International Journal of Information Management* 56, Article 102212.
Brudy, F., et al. (2019). Cross-Device Taxonomy: Survey, Opportunities and Challenges of Interactions Spanning Across Multiple Devices. *CHI'19*, Article 562.
Edelmann, N., et al. (2021). Remote Work in Public Sector Organisations: Employees' Experiences in a Pandemic Context. *DG.O2021*, 408–415.
Microsoft Study: Ford, D., et al. (2022) A Tale of Two Cities: Software Developers Working from Home During the COVID-19 Pandemic. *ACM TOSEM*, 31(2), Article 27.
Nguyen, N. T., et al. (2021). Intelligent Shifting Cues: Increasing the Awareness of Multi-Device Interaction Opportunities. *ACM UMAP '21*, 213–223 .

The *metaverse* is a phase shift in the era of immersive technologies

The metaverse was first coined in 1992 in Neil Stephenson's novel *Snowcrash*. Interest in the metaverse grew during remote work. However, definitions vary, presenting challenges and opportunities.

- A common definition for the metaverse is an online world that fulfills real-world desires and activities. It offers the possibility to step outside of the normal bounds of reality and realize goals in a new way (Slater & Sanchez-Vives 2016). It is also about data persistency and represents a shift from devices to content (Gonzales-Franco 2021).
- The metaverse requires a rethinking of how applications and a society of devices work in new digital spaces. A better understanding of the role it plays in respect to our devices is needed. Results from a Microsoft study in progress show people estimate they will use the metaverse for 5-10% of their meetings while keeping PC the preferred method to work.
- Another important component of the metaverse is the social component. It is not just about content, but about social content. The metaverse is a web of social, networked immersive environments in persistent multiuser platforms (Mystakidis 2022). The social component creates opportunities for the metaverse as a transaction platform, since wherever there are people there are transactions. While methods like Blockchain (Jeon et al. 2021) can ensure trust in transactions, transactions do not need to made be in cryptocurrencies or NFTs. Thus the success of the metaverse is not tied to cryptocurrencies or vice versa (Fenwick & Jurcys 2022; Yang et al. 2022).
- The metaverse is based on the convergence of technologies that enable multisensory interactions (Mystakidis 2022; Gonzales-Franco & Lanier 2017). It can be considered an aggregator of technologies like other interaction breakthroughs with content, e.g., smartphones (Huynh-The et al. 2022). Metaverse skepticism often stems from this facet since a single platform does not exist and agreement from many players is required for progress.
- Despite skepticism, the metaverse represents a new form of interaction with digital content that has potential to be very disruptive. There are many large industry players in the space and devices have improved over the years. Multiple adoption channels currently exist, including gaming and entertainment, front line workers, and information workers. Widespread adoption comes with security and privacy issues that must be carefully addressed (Buck & McDonnell 2022).

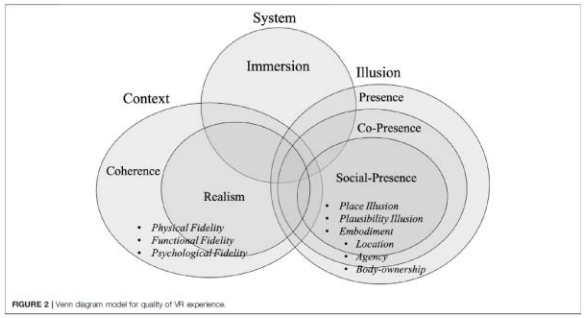
Microsoft Mesh

Buck, L., & McDonnell, R. (2022). Security and Privacy in the Metaverse: The Threat of the Digital Human. *ACM CHI EA '22*.
Fenwick, M., & Jurcys, P. (2022). The Contested Meaning of Web3 and Why it Matters for (IP) Lawyers. *Social Science Research Network, 4017790,*
Gonzalez-Franco, M. (2021). Keynote Speaker: Metaverse from Fiction to Reality and the Research Behind It, *ISMAR'21*: 17-17.
Microsoft Study: Gonzalez-Franco, M., & Lanier, J. (2017). Model of illusions and virtual reality. *Frontiers in Psychology*, 8, 1125.
Huynh-The, T., et al. (2022). Artificial Intelligence for the Metaverse: A Survey. *arXiv preprint*, arXiv:2202.10336.
Jeon, H., et al. (2021). Blockchain and AI Meet in the Metaverse. *IntechOpen*.
Mystakidis, S. (2022). Metaverse. *Encyclopedia* 2(1), 486–497.
Slater, M., & Sanchez-Vives, M. V. (2016) "Enhancing our lives with immersive virtual reality." *Frontiers in Robotics and AI*, 3 (2016), Article 74.
Yang, Q., et al. (2022). Fusing Blockchain and AI with Metaverse: A Survey. *arXiv preprint*, arXiv:2201.03201.

Social presence in AR/VR does not equate to realistic people or environments

Presence depends on the application context and the ability to share meaning.

- Social presence is the salience of people who are interacting and their interpersonal relationship(s) (Short et al. 1976).
- "Imitating reality to some degree when meeting remotely is beneficial, but it is not always necessary and perhaps even harmful, since they give way to both negative and positive aspects of physical interactions" (Zibrek et al. 2021).
- Whether social presence equates/requires total sensory realism (e.g., photorealistic avatars) is a central problem in developing AR/VR collaboration systems, especially because improving sensory realism incurs a high cost in hardware. Jung & Lindeman's (2021) overview shows better or more visual, auditory, or haptic cues may lead to increased realism, but not necessarily increased presence. In their model for quality of VR experience, realism intersects with, rather than equates to, presence.
- Wienrich et al. (2021) argue that *spatial presence*, not just *presence* in AR, requires specific attention in three areas:
  - Because AR blends rather than replaces the real world, how should decisions be made about real or digital frame of reference, e.g., when should the virtual environment occlude the physical environment?
  - Given that the user moves in a real physical world, what metaphors of transportation connect the user to other people/objects – is it instant or does it take time?
  - Given the obvious incongruence between the real and virtual world, perhaps this gives license for digital people and objects to not be realistic?
- The key design feature for enabling the sense of touch in AR/VR is shifting emphasis from focusing on realistic touches (e.g., the touch of a finger) to instead developing tools that allow people to establish common understanding about the meaning of haptic feedback that may not be realistic (Price et al. 2022). Particularly since study participants frequently interpret physical feedback as aligning with visual cues, even when it does not (Kim et al 2022).
- McVeigh-Shultz & Isbister (2021) argue for evolving AR and VR team collaboration beyond simulation to enabling *social superpowers* such as the tracking of signals to support emotional communication, social affiliation, and shared navigation, and new geometries of attention for large group interactions.



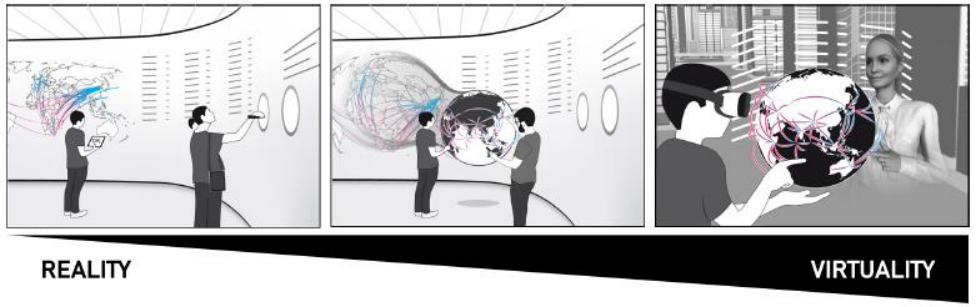
Jung & Lindeman (2021) propose a new model for quality of VR experience in which realism is a subset of coherence, and intersects with than equates to presence

Jung, S., & Lindeman, R. W. (2021). Perspective: Does Realism Improve Presence in VR? Suggesting a Model and Metric for VR Experience Evaluation. *Frontiers in Virtual Reality*, frvir.2021.693327.
Kim, M. J. et al. (2022). SpinOcchio: Understanding Haptic-Visual Congruency of Skin-Slip in VR with a Dynamic Grip Controller. *ACM CHI'22*, Article 433.
McVeigh-Schultz, J., & Isbister, K. (2021). A "beyond being there" for VR meetings: Envisioning the future of remote work. *Human–Computer Interaction*, 1994860.
Price, S., et al. (2022). The Making of Meaning through Dyadic Haptic Affective Touch. *ACM TOCHI,* 29(3), Article 21.
Short, J., et al. (1976). *The Social Psychology of Telecommunications*. John Wiley, New York, NY.
Wienrich, C., et al. (2021). Spatial Presence in Mixed Realities–Considerations About the Concept, Measures, Design, and Experiments. *Frontiers in Virtual Reality*, 25, Article frvir.2021.694315.
Zibrek, K., et al. (2021). Editorial: Meeting Remotely—The Challenges of Optimal Avatar Interaction in VR. *Frontiers in Virtual Reality*, 4, Article frvir.2021.773258.

AR/VR team collaboration requires more than just avatars in a space

Development of AR/VR spaces requires a blending of space, place, and embodiment in coordinating work, and accounting for the needs of a wide variety of users.

- Jetter et al. (2021) propose the concept of Transitional Interfaces (TIs) enabling seamless integration of systems along the Reality to Virtual Reality continuum, depending on users' tasks and needs.
- Radu et al. (2021) developed a set of 18 core needs for collocated AR. Active needs include awareness of others' attention and activities, and coordination of attention and instructions. However, privacy adds a key complexity, because the need for shared awareness is in tension with preventing the leakage of private information.
- Miller & Bailenson (2021) note that a current specific limitation for AR is that the digital field of view is a subset of the full human field of view. Virtual characters outside the digital field of view receive lower social presence scores, but task performance is not lower. Application designers may expect some users to look around to bring 'missing' things back into view, but a subset of people may never look back or around when focused on a task.
- VR/AR collaboration research has well-documented accessibility problems. As interest increases, accessibility must be a priority design issue from the outset (Mott et al. 2020).



The Transitional Interface continuum (Jetter et al. 2021)

Jetter, H. C., et al. (2021). Transitional Interfaces in Mixed and Cross-Reality: A new frontier? *ISS'21*: 46–49.
Miller, M. R., & Bailenson, J. N. (2021). Social Presence Outside the Augmented Reality Field of View. *Frontiers in Virtual Reality*, 7, Article frvir.2021.656473
Microsoft Study: Mott, M. et al. (2020). "I just went into it assuming that I wouldn't be able to have the full experience": Understanding the Accessibility of Virtual Reality for People with Limited Mobility. *ACM ASSETS'20*, Article 43.
Radu, I., et al. (2021). A Survey of Needs and Features for Augmented Reality Collaborations in Collocated Spaces. *ACM-HCI, 5(CSCW1)*, Article 160.

Acceptance for avatars in professional settings is increasing – with caveats

We have yet to understand the appropriateness and ethical implications of different kinds of avatars across diverse contexts and for users with disabilities.

- Nordin Forsberg & Kirchner (2021) report on largely positive experiences with avatars helping overcome professional networking shyness. However, they also report difficulty judging likelihood to talk based on age or demeanor cues.
- Increased avatar realism does not also equate to a simple linear increase in value. In AR meetings, participants rate the communicative functionality of realistic avatars higher than cartoon avatars, but participants accommodate to cartoon avatars over time (Dobre et al. 2022). Avatar acceptance for accessibility needs may be dependent on more than avatar realism. For deaf and hard of hearing (DHH) users, those with earlier age of sign language acquisition are more sensitive to movement quality problems than those with later sign language acquisition (Quandt, et al. 2021).
- Avatars may be a replacement for real-time video in traditional video meetings (Higgins & McDonnell, 2021; Panda, et al., 2022). Avatar facial expressions may be driven by live facial capture (Wen et al, 2021), neural rendering from still images (Rings & Steincke, 2022), or derived from speech (audio visemes) (Chai, 2021). Neural rendered and audio viseme avatars may reduce the need for costly facial capture, and enable a range of positive outcomes, such as increased privacy, overcome situational impairment (e.g., mobile, driving, no camera), personal needs or accessibility preferences, fixing eye gaze, or making current speakers more prominent by rendering them with a 3D effect (Rings & Steincke, 2022).
- As positive as the above scenarios are, the replacement of real-time video brings with it significant ethical dilemmas around authenticity. Unfortunately, there is limited research on the ethical dimensions of avatar use in team collaboration, especially with respect the issues around the deceptive replacement of real video. Early research points to risks ranging from inappropriate influence, through cultural appropriation, to deceptive impersonation (Hancock & Bailenson, 2021; Mullen, 2022). (See slide 72 on security threats in video meetings.)

Avatars networking at a professional event (Nordin Forsberg & Kirchner, 2022)

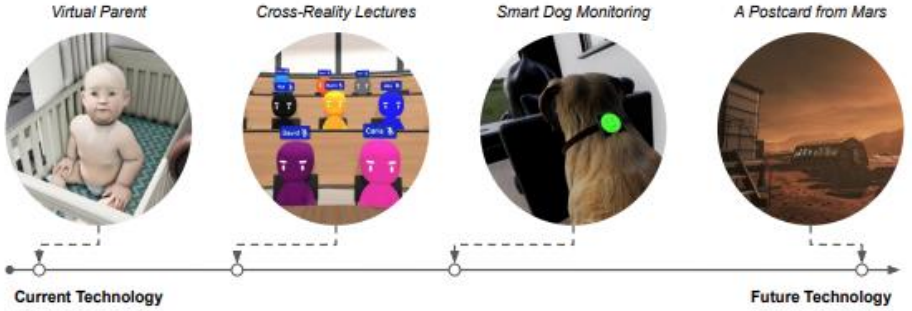
Cartoon vs realistic avatars (Dobre et al. 2022)

Chai, Y., et al. (2021). Speech-driven facial animation with spectral gathering and temporal attention. *Frontiers in Computer Science*, 16, Article 163703.
Microsoft Study: Dobre, G. C., et al. (2022). Nice is Different than Good: Longitudinal Communicative Effects of Realistic and Cartoon Avatars in Real Mixed Reality Work Meetings, *ACM CHI EA'22*, Article 437.
Hancock, J. T., & Bailenson, J. N. (2021). The Social Impact of Deepfakes. *Cyberpsychology, Behavior, and Social Networking*, 24(3), 149–152.
Higgins, D., & McDonnell, R. (2021). A Preliminary Investigation of Avatar Use in Video-Conferencing. *IEEE Computer Society*, 540–541.
Mullen, M. (2022). A New Reality: Deepfake Technology and the World Around Us. *Mitchell Hamline Law Review*, 48, 1, Article 5.
Nordin Forsberg, B., & Kirchner, K. (2021). The Perception of Avatars in Virtual Reality During Professional Meetings. In *HCII'21 – Posters*: 290–294.
Microsoft Study: Panda, P., et al. (2022 frth). All Together: Effect of Avatars in Mixed-Modality Conferencing Environment. *ACM CHIWORK'22*.
Quandt, L. C., et al. (2022). Attitudes Toward Signing Avatars Vary Depending on Hearing Status, Age of Signed Language Acquisition, and Avatar Type. *Frontiers in Psychology*, Article fpsyg.2022.730917
Rings, S., & Steinicke, F. (2022). Local Free-View Neural 3D Head Synthesis for Virtual Group Meetings. 2022 *IEEE VRW*: 333–337.
Wen, L., et al. (2022). A Survey of Facial Capture for Virtual Reality. *IEEE Access*, 10: 6042–6052.

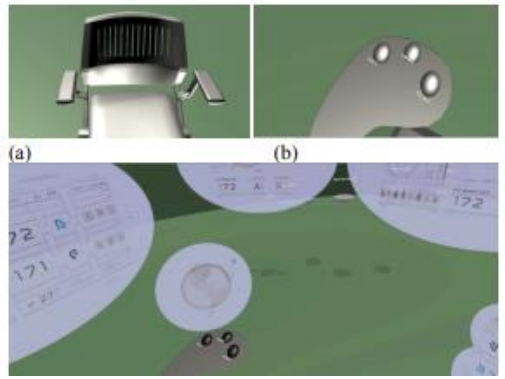
AR/VR design fiction enables experimentation with work practices

AR/VR environments enable rapid but rich experiments with radical changes to work environments.

- Design fictions are explorations of speculative scenarios that are expressed in design artifacts such as images and objects.
- Immersive Speculative Enactments (ISEs) (Simeone et al. 2022) use AR/VR applications for design fictions. They enable users to experiment with simulations of technologies in context that are too expensive, difficult, or infeasible to examine in the real world. The use of VR/AR overcomes the limitation of static and non-functional artifacts as well as the lack of context for their use. ISEs can immerse users in open-ended environments, within which they are free to interact with a tangible rendition of a possible future. For example, they imagine near term scenarios from cross-reality lectures to future scenarios such as a Mars mission.
- McVeigh-Shultz et al. (2018) present a case study of Steelcase reimagining their work practices. Steelcase designers used a range of novel tools in VR to both change their own ideation practices (e.g., a camera eyeball that helps coordinate joint attention) and to try furniture concepts such as chairs with AR controls for the workplace.



Immersive Speculative Environments enable exploration of issues in future-oriented scenarios



Steelcase's hybrid virtual/physical chair concept could be presented in an AR environment

McVeigh-Schultz, J., et al. (2018). Immersive Design Fiction: Using VR to Prototype Speculative Interfaces and Interaction Rituals within a Virtual Storyworld. *ACM DIS '18*: 817–829.
Simeone, A. L., et al. (2022). Immersive Speculative Enactments: Bringing Future Scenarios and Technology to Life Using Virtual Reality. *ACM CHI '22*, Article 17.

Blended realities enable new forms of real-time collaborative creativity

Avatars in brainstorming, flexible video windows, and AI-augmented tools may evolve remote and hybrid creativity to be better than in person.

- In comparison to brainstorming in video meetings, immersive brainstorming may enable greater use of clustering around shared resources in dynamic ways, such as how people move around physical whiteboards (Tuomi 2021). AI Agents can also be a more dynamic resource for brainstorming. "Avatar-mediated brainstorming" uses AI-agent avatars in place of static persona documents, to improve designer empathy in feature brainstorms (Bonnardel & Pichot 2020).
- One problem with remote brainstorming in traditional 2D video meetings is the limitations that traditional video grids place on referencing people and content in a dynamic manner. MirrorBlender (Grønbæk et al. 2021) takes advantage of the malleability of video streams by treating all streams as translucent 'mirrors' that can be repositioned in a What-You-See-Is-What-I-See videoconferencing system.
- Chung et al's (2021) review of AI-augmented creativity support tools (e.g., aids for creating images) notes the rise of tools that support production roles (e.g., novices or experts) or execution assistance (e.g., providing layout, colour, or form assistance in the form of ideas or actual changes to the human-produced material). Such aids can improve the sketching of novices or broaden the concepts from experts in brainstorming. However, there is still limited research on how AI-aided creativity interacts with who uses the tool, the biases of such tools, and how those who use (or even come to depend) on such tools will deal with biases in tools.

Dynamic virtual avatars (Bonnardel & Pichot 2020) are a tool for increasing designer empathy

Figure 1: MirrorBlender is a malleable video-conferencing system that creates a WYSIWIS blended space for co-located and remote users. Deploying MirrorBlender in three hybrid meeting sessions, we studied A: deictic gestures, B: embodiment of mirror images, and C: how remote users are included and grab attention via their malleable representation in the interface.

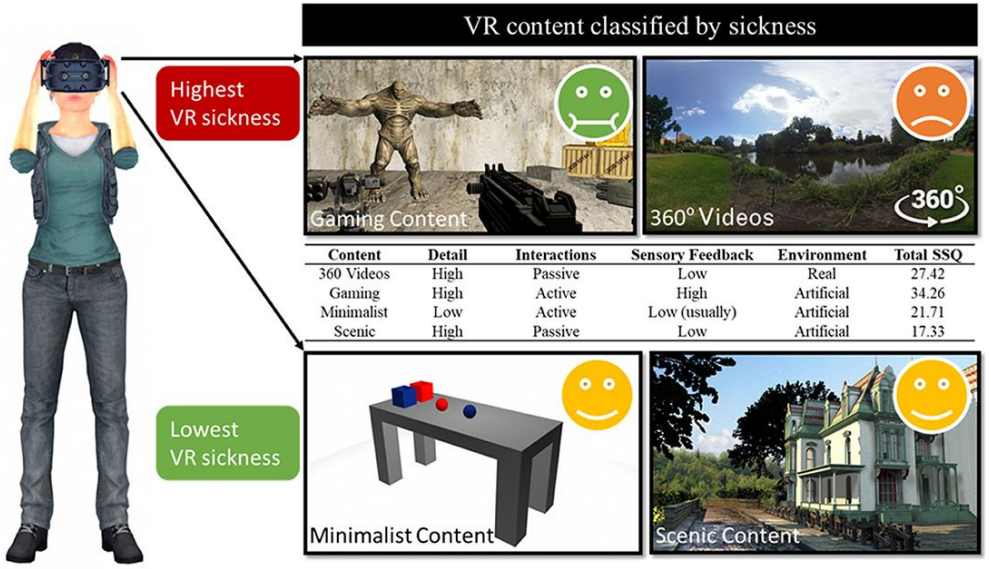
MirrorBlender (Grønbæk et al. 2021) uses video translusence to enable naturalistic cues

Bonnardel, N., & Pichot, N. (2020). Enhancing collaborative creativity with virtual dynamic personas. *Applied Ergonomics*, 82: Article 102949.
Chung, J. J. Y., et al. (2021). The Intersection of Users, Roles, Interactions, and Technologies in Creativity Support Tools, *ACM DIS '21*: 1817–1833.
Grønbæk, J. E., et al. (2021). MirrorBlender: Supporting Hybrid Meetings with a Malleable Video-Conferencing System' *ACM CHI'21*, Article 451.
Toumi, K. (2021). Technologies for Supporting Creativity in Design: A View of Physical and Virtual Environments with Regard to Cognitive and Social Processes. *Creativity. Theories – Research – Applications*, 8(1): 189–212.

Simulation sickness is a significant speedbump for AR/VR collaboration

Content, visual stimulation, locomotion, and exposure times have effects on reported sickness in AR/VR systems, but results are biased by studies conducted on very limited populations.

- Saredakis et al. (2020) reviews 55 studies of adverse symptoms from head-mounted displays (HMD) for virtual reality (VR) applications. Content significantly influences VR sickness symptoms. VR sickness profiles were also influenced by visual stimulation, locomotion and exposure times. (See also Lawson & Stanney 2021.)
- There are many anecdotal reports of HMD sickness affecting women more than men, but studies have conflicting or weak results. However, more research is needed because many studies do not directly address sickness, do not collect gender, or rely mainly on men as subjects (Saredakis et al. 2020; MacArthur et al. 2021; Grassini & Laumann 2020; Criado Perez, 2019).



Content	Detail	Interactions	Sensory Feedback	Environment	Total SSQ
360 Videos	High	Passive	Low	Real	27.42
Gaming	High	Active	High	Artificial	34.26
Minimalist	Low	Active	Low (usually)	Artificial	21.71
Scenic	High	Passive	Low	Artificial	17.33

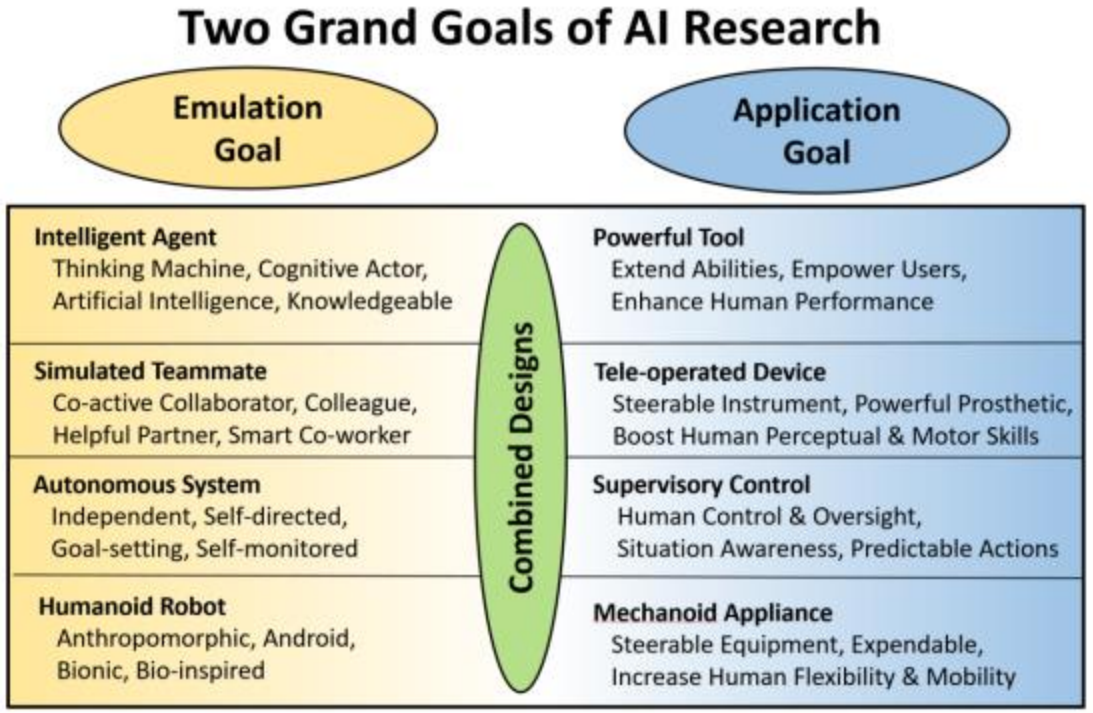
VR sickness levels and content (Saredakis et al. 2020)

Criado Perez, C. (2019). *Invisible Women: Exposing Data Bias in a World Designed for Men*. Random House.
Grassini, S., & Laumann, K. (2020). Are Modern Head-Mounted Displays Sexist? A Systematic Review on Gender Differences in HMD-Mediated Virtual Reality. *Frontiers in Psychology*, Article fpsyg.2020.01604
Lawson, B. D, & Stanney, K. M. (2021). Editorial: Cybersickness in Virtual Reality and Augmented Reality. *Frontiers in Virtual Reality*, frvir.2021.759682.
MacArthur, C., et al. (2021). You're Making Me Sick: A Systematic Review of How Virtual Reality Research Considers Gender & Cybersickness. *ACM CHI'21, Article 401.*
Saredakis, D., et al. (2020). Factors Associated With Virtual Reality Sickness in Head-Mounted Displays: A Systematic Review and Meta-Analysis. *Frontiers in Human Neuroscience,* fnhum.2020.00096

The power of AI in the future of work hinges on getting the role of AI right

Human–AI collaboration is likely to increasingly augment human abilities, but human-centric AI points to empowering rather than emulating humans.

- Managers need to be vigilant about the dualities/tensions that introducing highly capable AI might create in human–machine work environments (Seeber et al. 2020). For example, an AI might drive higher quality decision making on some dimensions, but this must not come at the cost of reducing the capability of team members to criticize decisions on dimensions that the AI does not consider.
- Getting the allocation of roles right between humans and machine is therefore critical in designing AI systems for the future of work. Shneiderman (2020) argues that human-centric AI should view AI systems as intelligent tools rather than human-like teammates. Users want to be in control of technologies that support self-efficacy, responsibility and creativity.
- Microsoft's Guidelines for Human-AI Interaction (Amershi et al. 2019) give practical guidance for getting the relationships right.



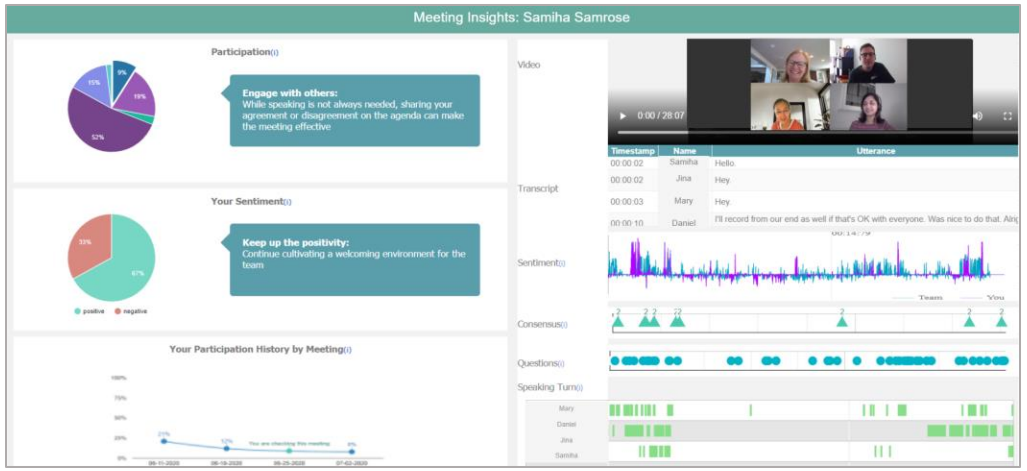
Four sets of issues raised by adopting either emulation or application goals in developing AI (Shneiderman 2020)

Microsoft Study: Amershi, S., et al. (2019). Guidelines for Human-AI Interaction. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, Article 3300233.
Seeber, I., et al. (2020). Machines as teammates: A research agenda on AI in team collaboration. *Information & Management*, 57(2), 103174.
Shneiderman, B. (2020). Human-Centered Artificial Intelligence: Three Fresh Ideas. *AIS Transactions on Human-Computer Interaction*, 12(3), 109-124.

AI may help with inclusive and effective meeting behaviors

From turn-taking patterns, to the vocal patterns of effective or productive meetings, AI can help uncover patterns that are hard for people to perceive.

- AI can be used to capture inclusive behaviours that are verbal and non-verbal (e.g., turn-taking, sentiment, consensus, questions). A study of longitudinal use in a large global technology company showed that post-meeting dashboards with explanations of inclusivity measures and suggestions may enable both personal reflection and organizational meeting training (Samrose et al. 2021).
- Neibuhr et al. (2021) report that meetings that are perceived to be more effective are characterized by affectively calmer, simpler, and shorter prosody (patterns of voice stress and intonation). However, more objectively productive meetings (generating a high output of feasible or good ideas) are characterized by lively, interactive, stimulating prosody. Such meeting productivity is correlated with the overall *sound* of the individual meetings, with pitch features being the most diverse and powerful predictors. Prosodic analysis of meetings could be implemented in AI dashboards such as those above, enabling methods for tracking meeting effectiveness that preserve privacy by not requiring transcript analysis.
- Margariti et al. (2022) note that when talk behaviours are tracked for inclusion reporting, it is important to look beyond simplistic assumptions. For example, overlapping talk is not necessarily negative – it may be either competitive or cooperative, and either may be indicative of positive or negative inclusion. They also argue for privacy preserving methods for finding and tracking such talk.



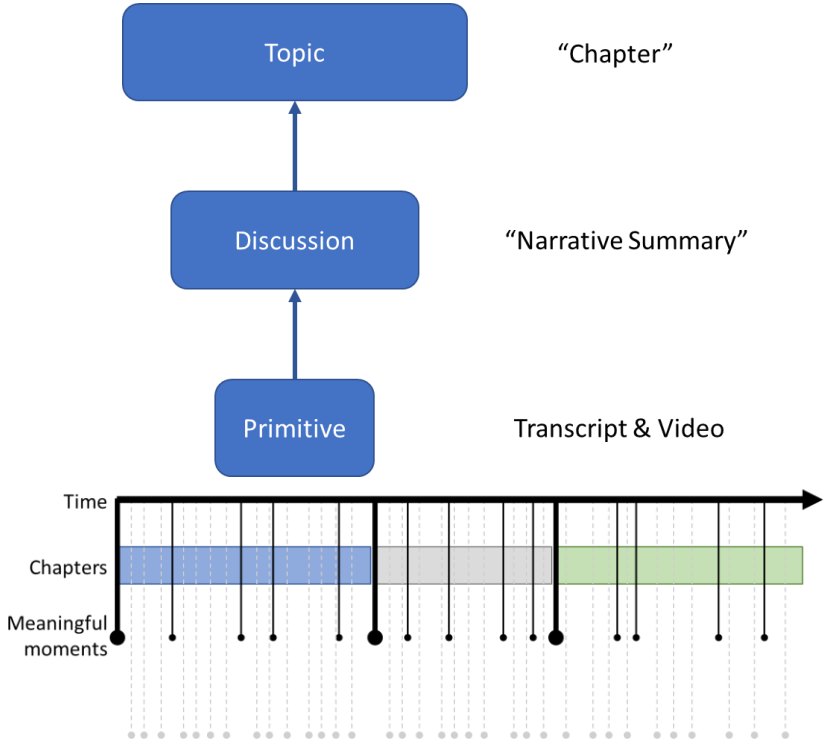
Post-meeting dashboards of collected inclusive behaviours can Improve meeting culture and training (Samrose et al. 2021)

Microsoft Study: Margariti, E., et al. (2022). Automated mapping of competitive and collaborative overlapping talk in video meetings. *ACM CHI EA'22*, Article 311.
Niebuhr, O., et al. (2021). On the Sound of Successful Meetings: How Speech Prosody Predicts Meeting Performance. *ICIMI'21*, 240-248.
Microsoft Study: Samrose, S., et al. (2021). MeetingCoach: An Intelligent Dashboard for Supporting Effective & Inclusive Meetings. *ACM CHI'21*, Article 252.

AI summarization may reduce meeting FOMO and improve asynchronous work

Summarization technology allows us to make better use of recorded meetings and take better notes making asynchronous participation possible and synchronous participation better.

- Past research has identified lightweight interaction patterns that enable users to work in collaboration with AI – noting important moments (Nathan 2012) and letting the AI do the hard work of capturing what was said (Zhu 2021).
- Perception science also gives us strong hypotheses about how to present automatic summaries to users so that they can understand and browse the structure of a meeting (Zacks 2001).
- Extracting action items, key decisions, and other *discourse acts* provides a focal point for asynchronous coordination and has shown the potential to improve synchronous meeting focus as well (Zhang 2018).



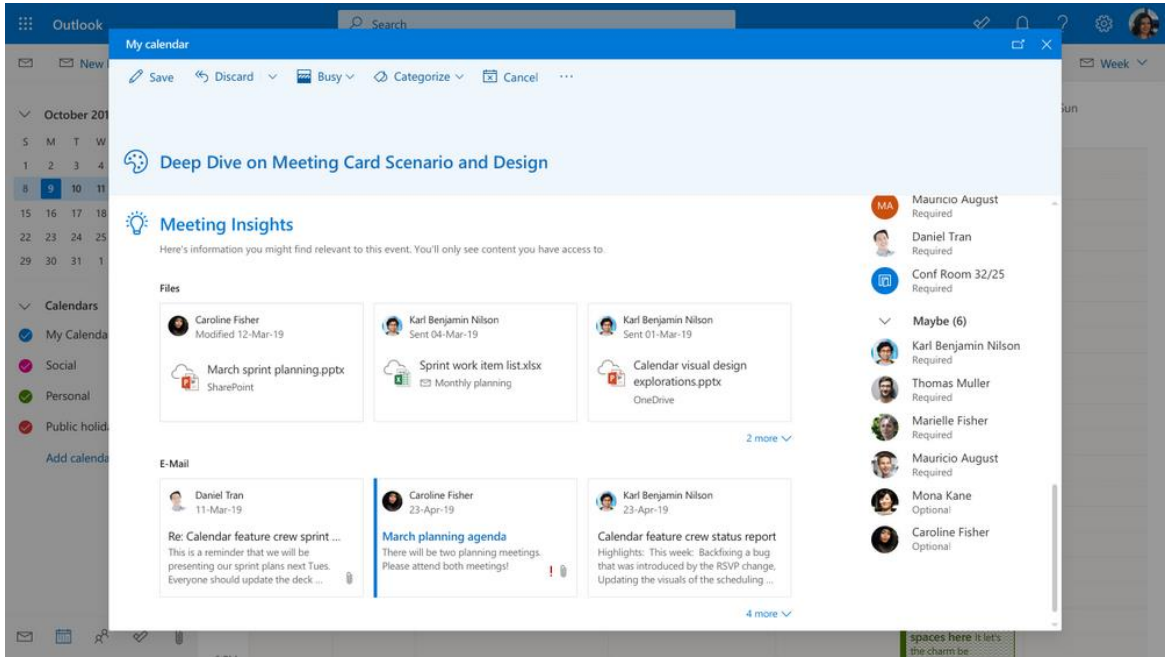
Hierarchical structure of event perception (Jeffery 2001) applied to meeting summarization

Nathan, M., et al. (2012). In case you missed it: benefits of attendee-shared annotations for non-attendees of remote meetings. *CSCW'12*, 339-348.
Zacks, J. M., et al. (2001). Perceiving, remembering, and communicating structure in events. *Journal of Experimental Psychology: General*, 130(1), 29–58.
Microsoft Study: Zhang, A. X., & Cranshaw, J. (2018). Making Sense of Group Chat through Collaborative Tagging and Summarization. *Proc. ACM-HCI 2018, 2(CSCW)*, Article 196.
Microsoft Study: Zhu, C., et al. (2021). MediaSum: A large-scale media interview dataset for dialogue summarization. *arXiv preprint:* arXiv.2103.06410.

Async meeting experiences are needed, and summarization tech can help

Advanced information filtering and summarization systems may help improve the information choice and overload challenges of pre-meeting materials, parallel chat, and post-meeting catch-up.

- There has been a 252% increase in weekly time spent in meetings for the average Teams user since February 2020 (Microsoft WTI 2022).
- Improving async collaborations has the promise of making meetings more effective and reduce this meeting load (Rogelberg 2018).
- Large language models / summarization methods can convert raw meeting content to structured async artifacts such as notes and action items for post-meeting catchup and engagement (Sachdeva et al. 2021).



Active pre-meeting document and related email recommendations in Microsoft Outlook (Qian 2018)

Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*
Rogelberg, S. G. (2018). *The Surprising Science of Meetings: How You Can Lead Your Team to Peak Performance*. Oxford.
Sachdeva, K., Maynez, J., & Siohan, O. (2021). Action Item Detection in Meetings Using Pretrained Transformers. *IEEE ASRU'21*, 2021, 861-868.
Microsoft Study: Zhao, Q., et al. (2018). Calendar-Aware Proactive Email Recommendation. *ACM SIGIR '18*, 655–664 .

Collaboration tools are not neutral

Technology shapes team activities and teams shape the way technology is used. Flexible collaborative environments, co-created with workers, are likely to be most successful.

- The relationship between team members in person is different than their relationship using a collaboration tool. Managers should consider how teams and tools are partners forming "technologized team relationships" (Soga et al. 2021). Technologized team relationships are those in which the technology is an intermediator, an active participant that influences, and is also influenced by, the human actors in the relationship. Very active examples include 'to do' apps that prompt action or recommendations of documents or people. A less active but just as important example would be a tool's file upload, storage, and sharing capabilities, which directly impact information access and transparency.
- Opportunities for valuable technologized team relationships lie in technologies doing what people find hard, such as prioritization of work and awareness of project history (El Mezouar et al. 2021). However, technologized team relationships may have unintended consequences, such as increased tendency towards trusting command-and-control over relational engagement, tensions between transparency and the perception of surveillance, and problems over- or under-estimating participation (Soga et al. 2021).
- Meluso et al.'s (2022) review of reviews from management journals on distributed work found that the heterogeneity of identities, incentives, and information in team collaboration means that no technology environment is likely to fit all teams. They argue that flexible collaborative environments, co-created with workers, are most likely to be successful. This needs to go beyond attempts to recreate yesterday's work systems and instead capitalize on novel patterns and capabilities, taking the technologized team relationship as a starting point.
- Technology designed for this new way of working should be flexible enough to be used by different people in different ways, while still allowing for focused work. It should also address known hybrid work issues, like working in different time zones and catching up on what others have done since a person was last engaged in the work. As we build new tools, it will be critical to get user feedback on if they are meeting the new needs of users. New frameworks for feedback, such as BLUE (2022), can be used to get the best possible user feedback.

The future of team collaboration requires deciding *who are we together in this system* and then experimenting with and co-creating flexible collaborative environments

El Mezouar, M., et al. (2021). Exploring the Use of Chatrooms by Developers: An Empirical Study on Slack and Gitter. *IEEE Transactions on Software Engineering*, Article 3109617.
Meluso, J., et al. (2022). Flexible Environments for Hybrid Collaboration: Redesigning Virtual Work Through the Four Orders of Design. *Design Issues*, 38(1), 55–69.
Soga, L. R., et al. (2021). Web 2.0-enabled team relationships: an actor-network perspective. *European Journal of Work and Organizational Psychology* 30(5), 639–652.
Microsoft Study: Hillman, S., et al. (2022) The BLUE Framework: Designing User-Centered In-Product Feedback for Large Scale Applications. *ACM CHI EA'22*, Article 21.

Organizational Change

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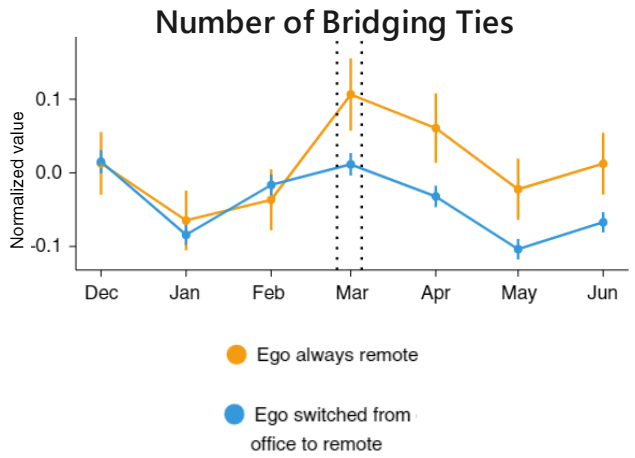
Communication in organizations became more siloed with more remote work

Remote work has influenced the way people collaborate in organizations, resulting in denser connections within groups and weaker connections across groups. These effects may make it harder for employees to acquire and share new information across the organizational network. Fortunately, hybrid work can likely help.

- In 2020, communication networks in organizations around the world became more modular or siloed compared to 2019 (Larson et al. 2021).
  - This pattern broadly holds across countries and seems to coincide with the imposition of national emergency orders.
  - Study based on anonymized metadata from over 4,000 organizations worldwide, including 1.4 billion accounts.
- Causal analysis shows that firm-wide remote work *caused* the collaboration network of workers to become more static and siloed (Yang et al. 2021).
  - People had 9% fewer bridging ties.
  - There was a 40% drop in the share of collaboration time spent with bridging ties.
  - Employees already working remotely were the "control" group to separate the effects of firm-wide remote work from other confounding factors.
  - Study based on anonymized metadata from Outlook and Teams for ~62k US MSFT employees.
- Pandemic remote work led to the loss of more than 480K weak ties among researchers at MIT (Carmody et al. 2022).
- There is strong reason to believe hybrid work will ameliorate some or most of these effects, and research is underway at Microsoft to more fully explore this hypothesis.
  - Spatial co-location during hybrid work helped bring back some lost ties at MIT (Carmody et al. 2022).



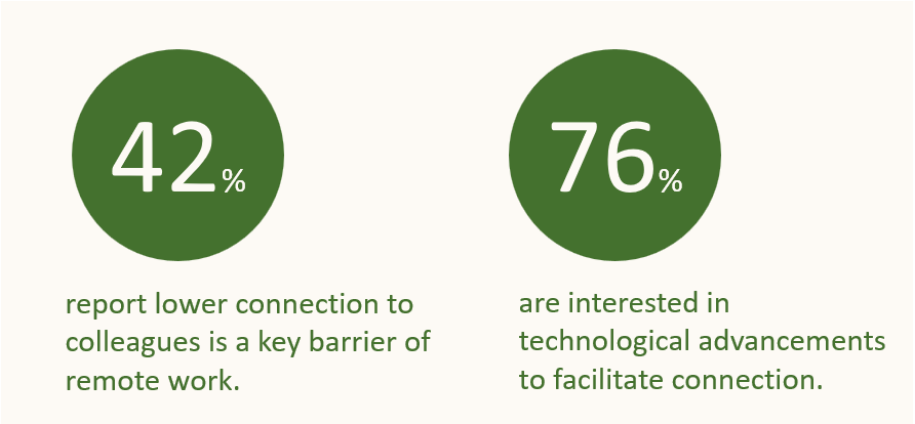
Yang et al. (2021)

Carmody, D., et al. (2022). "The effect of co-location of human communication networks." *arXiv preprint,* arXiv:2201.02230.
Microsoft Study: Larson, J., et al. (2021). "Dynamic Silos: Increased Modularity in Intra-organizational Communication Networks during the Covid-19 Pandemic." *arXiv preprint*, arXiv:2104.00641.
Microsoft Study: Yang, L., et al. (2021). The Effects of Remote Work on Collaboration among Information Workers. *Nature Human Behavior*, 6, 43-54.

Building and maintaining relationships is harder in remote work

The social side of workplace relationships, including exchanges of non-work-related information, social support and even small talk, is particularly influential role in building trust and fostering innovation.

- Social work relationships, and social support in particular, promote job satisfaction, organizational commitment, and the success of remote work (Charalampous et al. 2019).
- Small talk enhances positive social emotions at work, translating into heightened organizational citizenship behaviors (OCB) and wellbeing at the end of the workday (Methot et al. 2021).
- Emotional demands of work diminish job performance. Having colleagues with whom you can vent and relax can buffer these negative effects (Parker et al. 2022).
- The difficulty of social support and small talk may be one factor in the increased siloing of collaboration networks in remote work. (See previous slide on collaboration networks.)



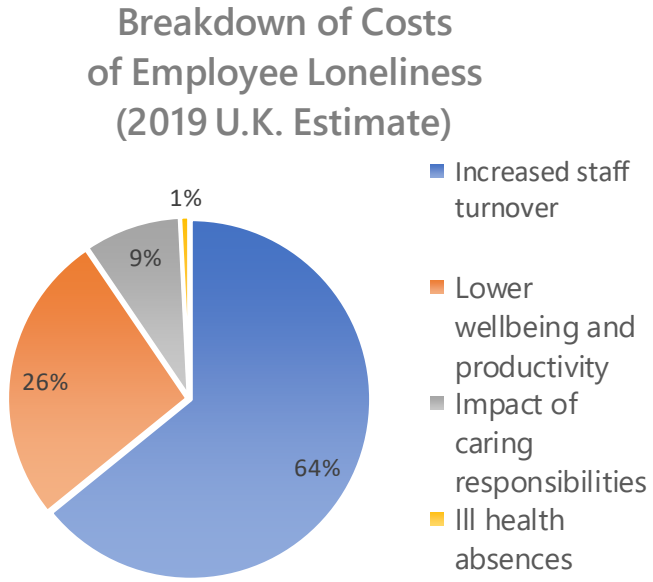
Glint (2021)

Charalampous, M., et al. (2019). Systematically reviewing remote e-workers' well-being at work: A multidimensional approach. *European Journal of Work and Organizational Psychology*, *28*(1), 51-73.
Microsoft Study: Glint (2021). People science culture consultation deck. *LinkedIn*. [Internal]
Methot, J. R., et al. (2021). Office chitchat as a social ritual: The uplifting yet distracting effects of daily small talk at work. *Academy of Management Journal*, *64*(5), 1445-1471.
Parker, A., et al. (2022). "The coevolution of emotional job demands and work-based social ties and their effect on performance." *Journal of Management* (2022).

The pandemic raised awareness about workplace loneliness

Workplace loneliness was a problem before the pandemic and continues to be one now, as remote and gig workers may experience even greater isolation.

- The pandemic has increased public awareness of loneliness in the workplace, but it is not a new issue. U.S. Surgeon General Vivek Murthy declared a workplace Loneliness Epidemic in 2017. CIGNA (2020) estimated that 62% of U.S. workers were lonely in 2019.
- In a survey of global executives just prior to the pandemic, most struggled to make deep connections to others at work despite working on multiple concurrent teams (Hadley & Mortensen 2020).
- Worker loneliness is associated with debilitating health problems and work problems (e.g., lowered performance, creativity, and decision-making) (Holt-Lunstad et al. 2010).
- Loneliness is estimated to be extremely costly to economies around the world (e.g., US: $406B/year; UK: £2.5B/year) (CIGNA, 2020; Peytrignet et al. 2020).
- Remote work is often lonely. A 2021 study found that almost 2/3rds of people working from home feel isolated or lonely at least sometimes and 17% do all the time (American Psychiatric Association, 2021).
- 55% of hybrid employees and 50% of remote employees feel lonelier at work than before going hybrid or remote (Microsoft WTI, 2022).
- 59% of hybrid employees and 56% of remote employees report having fewer work "friendships" since going hybrid or remote (Microsoft WTI 2022).
- Gig or freelance workers report significantly higher loneliness rates than those working for a private company (e.g., 82% vs. 61%) (Glavin et al. 2021; CIGNA 2020).

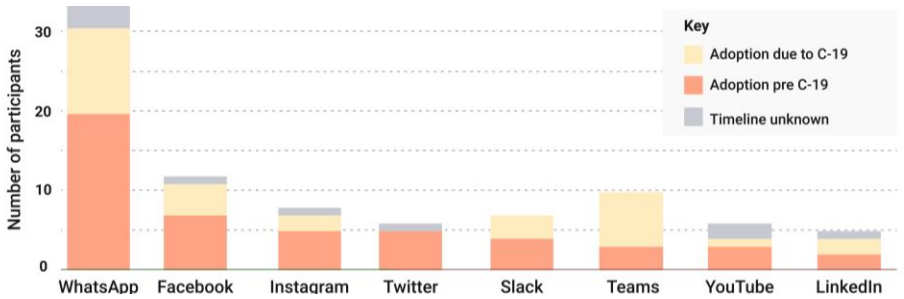


American Psychiatric Association (2021) As Americans Begin to Return to the Office, Views on Workplace Mental Health Are Mixed. *Psychiatry.org*.
CIGNA (2020). Loneliness and the Workplace 2020 US Report.
Glavin, P., et al. (2021). Über-Alienated: Powerless and Alone in the Gig Economy. *Work and Occupations*, 48(4), 399–431.
Hadley, C., & Mortensen, M. (2020) Are Your Team Members Lonely? *MIT Sloan Management Review*.
Holt-Lunstad, J., et al. (2010) Social Relationships and Mortality Risk: A Meta-analytic Review. *PLoS Med* 7(7): e1000316.
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022*.
Murthy, V. (2017) Work and the Loneliness Epidemic: Reducing isolation at work is good for business. *Harvard Business Review*.
Ozcelik, H., & Barsade S. G. (2018). No Employee an Island: Workplace Loneliness and Job Performance. *Academy of Management Journal*, 61(6) 2343-2366.
Peytrignet, S., et al. (2020). Loneliness monetization report. *Simetrica*.

Socio-tecture was essential to many SMBs during the pandemic

Globally, 80% of organizations are small and medium businesses (SMBs). In Africa, many heavily relied on socio-tecture to catalyze technology adoption and survive the pandemic.

- Socio-tecture is a fundamental quality of business activity, observed in SMBs in Africa, where the social and business are tightly coupled. It involves building for relationships and networks as integral to building for business. Key facets of socio-tecture are:
  - Heavy reliance on networks: preference of strong ties over loose ties, and loose ties over no ties.
  - Establishing strategic (instead of only transactional) relationships when conducting business.
  - People as the primary source of knowledge : The experiences of ties are heavily relied upon by SMBs for tech use and tech purchase decisions, as opposed to e.g., YouTube ads or feature emails. As summarized by an SMB, "It's only when somebody I know says a tool worked for them that I believe it will work for me" (Awori et al. 2022).
- During the pandemic, technology adoption was guided by socio-tecture.
  - When choosing communication tools, SMBs preferred WhatsApp over others, as it better enabled them to build trusted relationships and strengthen loose ties – for example, requiring users' phone numbers to connect on WhatsApp helped the SMB engage more personally with their customers; WhatsApp groups helped SMBs build closed networks with people they could verify (Awori et al. 2022).
  - Many SMBs and their customers prefer social commerce – a development in e-commerce that leverages social media and participatory Web 2.0 technologies to enable interaction between businesses and their customers, and among customers (Turban et al. 2010) – because it affords better social engagement and interaction (Pon 2020; Naghavi 2019).



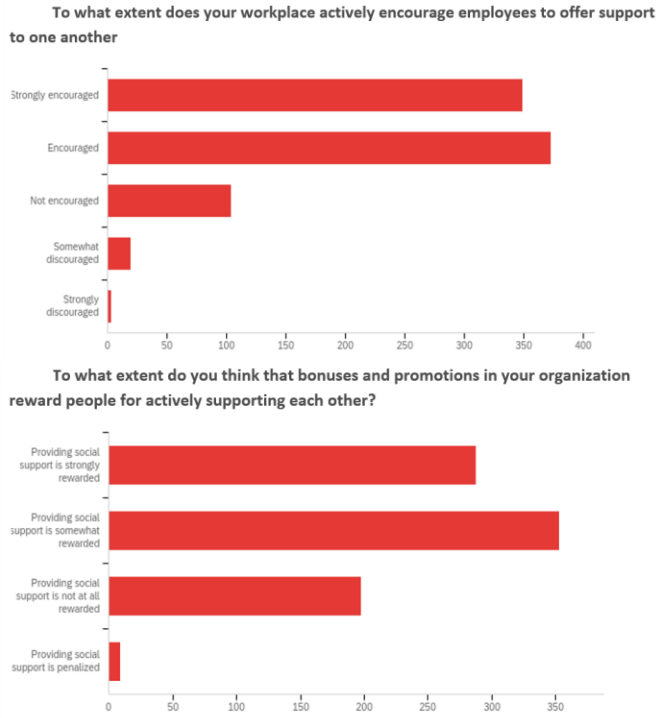
Based on a study with SMBs in Kenya during the pandemic, SMBs prefer communication tools that better afford the creation/management of strong ties, a key facet of socio-tecture
(Awori et al. 2022)

Microsoft Study: Awori, K., et al. (2022). "It's only when somebody says a tool worked for them that I believe it will work for me": Socio-tecture as a lens for digital transformation. (Under Review)
Turban, E., et al. (2010). Social Commerce: An e-Commerce Perspective. *ICEC '10 Association for Computing Machinery*, 33-42.
Naghavi, N. (2019). Social commerce in emerging markets: Understanding the landscape and opportunities for mobile money. *GMSA*
Pon, B. (2020). The race to digitize commerce in sub-Saharan Africa: How Jumia and Facebook are competing, even though they're playing different games. *Medium.com*

The work of building social capital increased, but was often unrecognized

Social capital is essential to the success of organizations, but social capital builders are often uncredited and unrewarded. These dynamics likely got worse during the pandemic.

- Social capital is a collective good. It is both a resource exchanged within relationships and a structure of relationships (Adler & Kwon 2009). Organizational networks rich in equitable strong and weak ties can lead to less absenteeism and turnover, better performance, more creativity, more efficiency, and more revenue (Ben Hador 2016; Sözbilir 2017; Westlund & Adam 2010).
- In on-site work, relationship building often happens alongside the formal events of the day (Kraut et al. 1990). Without opportunities for spontaneous informal interaction in remote work, it takes additional effort to build and maintain relationships (Charalampous et al. 2019).
- 43% of leaders say building social capital is the biggest challenge of remote and hybrid work (Microsoft WTI 2022), yet organizations often privilege work that produces products and services directly over "nonmonetized production" (Jarrett 2014) such as building relationships. This kind of "connective labor" (Pugh 2021) is often disproportionately expected of women (Jarrett 2014).
- In a survey of 850 American office workers, 51% indicated they have made greater efforts to provide support for their colleagues than before the pandemic, while only 15% said they were doing less. 85% of employees said their organizations encouraged or strongly encouraged people to support each other and 80% said they felt somewhat or strongly obligated to go above and beyond to support co-workers. Yet nearly 25% indicated that in their organization, providing support for others was not at all rewarded, and only 34% said providing such support was strongly rewarded (Baym et al. in progress).
- New tools aim to help by suggesting potential weak ties, such as Bridger (Portenoy et al. 2022), which is designed to facilitate discovery of scholars in areas somewhat related but also somewhat novel to a researcher's current areas of work.



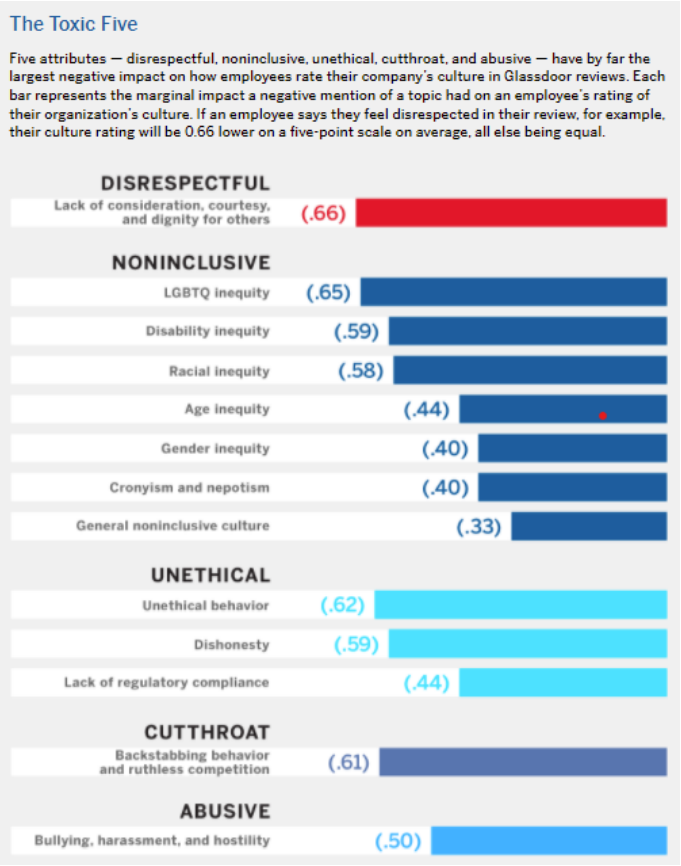
People report being expected to provide support more than they report being rewarded for it (Baym et al.)

Adler, P. S., & Kwon, S. W. (2009). *Social Capital: The Good, The Bad, and The Ugly* (Working Paper MKT 03-09; Marshall Research Paper Series, pp. 89–115). University of Southern California.
Microsoft Study: Baym, N., et al. (in progress). Social Support Among Co-workers: A survey of American Office Workers.
Charalampous, M., et al. (2019). Systematically reviewing remote e-workers' well-being at work: A multidimensional approach. *European Journal of Work and Organizational Psychology*, *28*(1), 51-73.
Ben Hador, B. (2016). How intra-organizational social capital influences employee performance. *Journal of Management Development*, *35*(9), 1119–1133.
Jarrett, K. (2014). *The Digital Housewife*, Routledge.
Kraut, R., et al. (1990). Informal communication in organizations: Form, Function, and Technology in *Human Reactions to Technology: Claremont Symposium on Applied Social Psychology.*
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*
Pugh, A. (2021). Emotions and the systematization of connective labor. *Theory, Culture & Society.*
Sözbilir, F. (2018). The interaction between social capital, creativity and efficiency in organizations. *Thinking Skills and Creativity*, 9.
Westlund, H., & Adam, F. (2010). Social Capital and Economic Performance: A Meta-analysis of 65 Studies. *European Planning Studies*, *18*(6), 893–919.
Portenoy, J. et al. (2022) Bursting Scientific Filter Bubbles: Boosting Innovation Via Novel Author Discovery. *ACM SIGCHI 2022.*

Culture is a leading driver of the Great Reshuffle

Several studies have found strong correlations between toxic company culture and people's decisions to seek new jobs.

- A Pew Research Center poll found that 57% of Americans who resigned 2021 cited feeling "disrespected at work" as a reason for leaving; 35% said it was a "major reason" (Parker & Horowitz 2022).
    - Globally, while the Microsoft (2022) Work Trends Index survey did not ask about culture specifically, it found that the top two reasons employees quit were: personal wellbeing or mental health (24%) and work-life balance (24%).
- In an analysis of 500 of the largest US companies, researchers found that companies whose Glassdoor descriptions indicated healthier organizational cultures had lower-than-average turnover (estimated from Revelio Labs profiles) relative to other companies in the same industry. Furthermore, in this NLP analysis, toxic corporate culture was 10.4 times more important than compensation in predicting attrition (Sull et al. 2022a).
- A variety of factors can contribute to cultural toxicity. The strongest predicters of employees' ratings of a culture and company attrition rates were Glassdoor reviews referring to disrespectful, non-inclusive, unethical, cutthroat and abusive elements (Sull et al. 2022b). A qualitative analysis of Glassdoor reviews similarly highlighted how normalizing racism, sexism, and discrimination contributes to cultural toxicity (Bergstrom 2022).
- In surveys, employees who feel cared for at work are 3.2x more likely to be happy at work and 3.7x more likely to recommend working at their company. Both of these likelihoods increased 35% over the course of the pandemic (LinkedIn 2021).



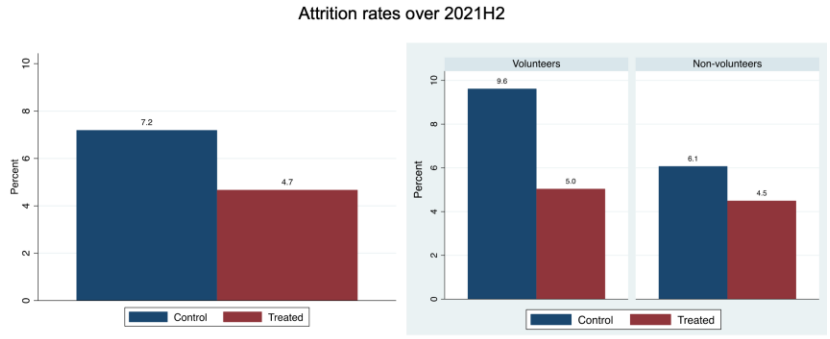
Sull et al. (2022b)

Microsoft Study: Baym, N., et al. (in progress). Social Support Among Co-workers: A survey of American Office Workers.
Bergstrom, K. (2022). When a Door Becomes a Window: using Glassdoor to examine Game Industry Work Cultures. *Information, Communication and Society.*
Microsoft Study: LinkedIn (2021). *Internal employee engagement research.*
Parker, K., & Horowitz, J. M. (2022). Majority of workers who quit a job in 2021 cite low pay, no opportunities for advancement, feeling disrespected. *Pew Research Center.*
Sull, D., et al. (2022a). Toxic Culture is Driving the Great Resignation. *Sloan Management Review.*
Sull, D., et al. (2022b) Why Every Leader Needs to Worry About Toxic Culture. *Sloan Management Review.*

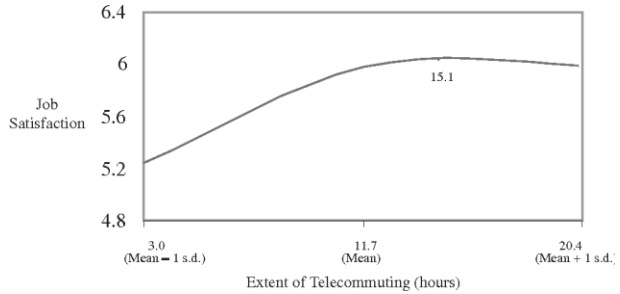
New data points to hybrid work helping to reduce employee turnover

A recent experiment, backed by prior work, suggests hybrid work may be one way for firms to keep their employees, although it is unclear how market dynamics will evolve.

- In a preliminary analysis of a randomized experiment with college graduates at a large multinational firm based in China, Bloom et al. (2022) found that fixed weekly 3-2 hybrid (three days at work, two days at home each week, with those days fixed across the firm) reduced quit rates by 35% and sick leave by 12%. There was no statistically significant effect on performance or promotions.
- This work builds on prior research that also saw reduced turnover with alternative working arrangements (Bloom et al. 2015; Moen et al. 2012), as well as earlier work that found that job satisfaction at a large IT firm peaked at 2 days WFH per week (Golden and Veiga 2005).
- Hybrid work arrangements are much rarer in China, and this may have affected attrition rates. It is unclear whether similar effects would be observed in a market in which hybrid work is much more common.



Bloom et al. 2022



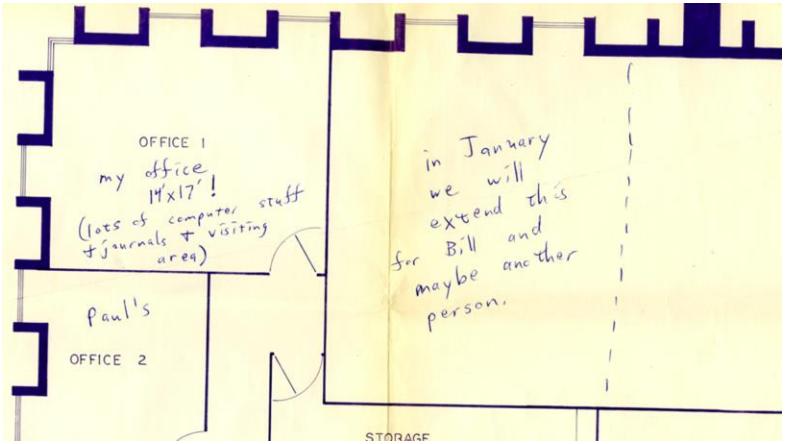
Golden & Veiga (2005)

Bloom, N. et al. (2015). Does Working from Home Work? Evidence from a Chinese Experiment. *The Quarterly Journal of Economics*. 130(1), 165–218.
Bloom, N. et al. (2022). How Hybrid Work From Home Works Out (Preliminary).
Golden, T.D. & Veiga, J.F. (2005). The Impact of Extent of Telecommuting on Job Satisfaction: Resolving Inconsistent Findings. *Journal of Management*. 31(2), 301–318.
Moen, P., et al. (2011). Does Enhancing Work-Time Control and Flexibility Reduce Turnover? A Naturally Occurring Experiment. *Social problems*. 58(1), 69–98

Microsoft's history with hybrid reinforces the role of managers and technology

Since its founding in 1975, Microsoft has had remote and hybrid employees, yet much of the company experienced a pandemic learning curve that was not that different from many other organizations.

- Microsoft's original mission of "a computer on every desk and in every home" included an emphasis on supporting at-home business activities.
- Microsoft has done research on remote work and telepresence for 30+ years (Teevan & Hecht 2020). Microsoft product offerings reflect that, starting with MS-DOS support for modems in 1981.
- The company began in a hybrid fashion, with co-founder Bill Gates working remotely from Harvard.
- However, remote work was not a norm for all but a few functions, like sales. That is because the physical workplace has historically been an important enabler of work. Microsoft developers needed to go into the office since that was where the computers and connectivity were fastest, and even the field was dependent on business equipment at the office in the 80s and 90s. The ability to work from home depended on the reliability and performance of the expanding internet infrastructure.
- Work hours at Microsoft have always been flexible. An early employee handbook from Fall 1985 states: "You should establish your normal working hours with your manager and agree with him/her on the degree of acceptable variance in those hours."
- Microsoft employees did not historically spend all of their time at the office working, however. Code compilation used to mean many minutes of downtime for developers. Personal activities at work remain culturally acceptable.



A snippet of the floor plan from the first Microsoft office in Albuquerque,1976, shows Bill Gates' future workspace.

Microsoft Study: Stevenson, A. (2022). Microsoft's Pre-Pandemic History of Hybrid 1975-2020: A Perspective from the Corporate Archivist. [Internal]
Microsoft Study: Teevan, J. & Hecht, B, (2020). "How research can enable more effective remote work." *Microsoft Research Blog*.

Leaders may not be keeping up with evolving employee expectations

Employees are increasingly seeking flexibility, autonomy, and to be heard, but there are gaps between their expectations and what organizations are currently offering them.

- Over half of managers in Microsoft's global Work Trend Index (external survey) reported that leadership at their company is out of touch with employee expectations. Even more say they lack the influence or resources to create change in their team. Half of surveyed leaders plan to require full-time in-person work, despite 52% of surveyed employees being likely to consider going hybrid or remote in year ahead (Microsoft WTI 2022).
  - For the 18% of respondents who quit their jobs in 2021, work-life balance and lack of flexible work hours/location were among the top five reasons, with pay near the bottom of the list.
  - The survey also found while over 80% of employees feel they have been just as or more productive since the shift to remote or hybrid, 54% leaders fear productivity has been negatively impacted.
- A 2021 Gartner study of 4000 employees showed a significant difference between executives' and employees' perceptions: 75% of executives said their companies offered flexibility, but only 57% of employees did (Baker 2021).
- An internal survey for Citrix's Work 2035 Project in May 2021 showed that while 86% of employees prefer to work for a company that prioritizes outcomes over output, only 50% of HR directors said their organization would be more productive if employees felt their employer/senior management team trusted them to get the job done without monitoring their progress (Minahan 2021).
- Many organizations still rely on one way organization-to-employee relationships, but organizations with means for employees to communicate upwards build stronger organization-employee relationships and are more resilient (Kim 2021). Insights from customer interviews reinforce this increasing need to adapt and think differently about employees, as encapsulated by this participant comment:
  - *"Trust people to do the job they are employed to do. We moved forward 10-15 years in how the organization thinks about employees just in the past 18 months"* - Senior Wealth Manager | Banking | UK (Coleman 2021).

50%

of leaders say their company requires or plans to require full-time in person work in the year ahead

74%

of managers say they don't have the influence or resources to make change for employees

54%

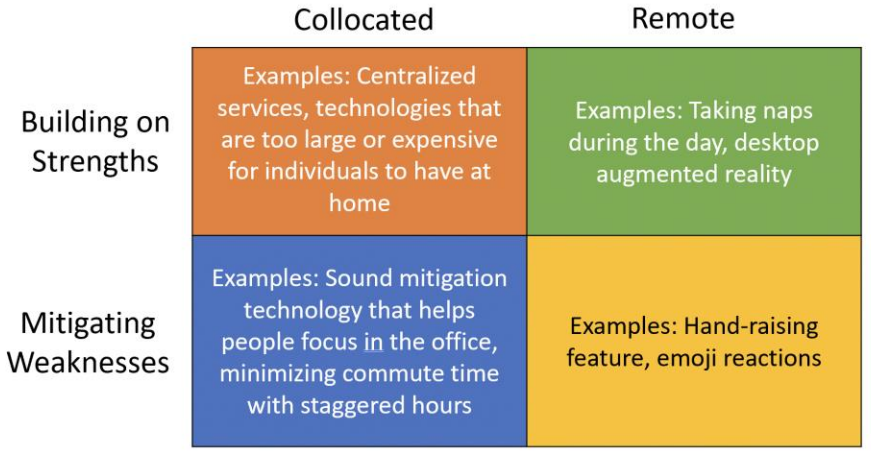
of managers say leadership is out of touch with employees

Citrix citation in HBR (2021). What Your Future Employees Want Most. *Hybrid Business Review*.
Microsoft Study: Coleman, A. (2021). How business leaders are preparing for a new period of workplace uncertainty. *Microsoft Research*.
Baker, M. (2021). What is work really like today? Leaders and employees see things differently. *Gartner*.
Kim, Y. (2021). Building organizational resilience through strategic internal communication and organization-employee relationships. *Journal of Applied Communication Research*.
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022*.
Minahan, T. (2021). What Your Future Employees Want Most. *Harvard Business Review*.

Organizations must eschew common misconceptions about hybrid work

Below are a few common misconceptions about hybrid work, and how to rethink them.

- Misconception: *"Where to work is purely a 'personal decision'."*
  - Network effects like the ability to collocate with a colleague make work location a team and organizational conversation, not purely an individual one. Hybrid work can provide additional individual flexibility, but it must be balanced with the needs of one's coworkers and one's organization.
- Misconception: *"All workers should have the same experience, regardless of their work location."*
  - The literature makes clear that remote and collocated work have very different strengths and weaknesses (Allen et al. 2015). Policy and technology should seek to accentuate the benefits and mitigate the weaknesses of each separately. An analogy can be drawn to the different experiences afforded by smartwatches, smartphones, and desktop computers. See graphic for one way we operationalize this idea.
- Misconception: *"Hybrid work is only about flexibility in work location."*
  - Hybrid work should also involve flexibility on the temporal dimension (i.e., *when* people work). A major implication is that many teams should agree on collocated hours (e.g., 10-3pm), not days, as this will allow for people to avoid traffic and dramatically cut down on time spent commuting, one of the most significant downsides of collocated work (Ford et al. 2021).
- Misconception: "*The office is only useful for collaboration.*"
  - While offices certainly have some important affordances for collaboration, and these are one of the reasons hybrid work can be so powerful, offices are also useful for a number of other reasons. For instance, offices provided much-desired work/life separation for some and, for those who do not have adequate focus space at home (remote work can require larger residences), they make it possible to focus while doing one's job. Relatedly, home offices are likely be better for collaboration than offices for certain types of meetings, e.g., large read-out style meetings.



The "Window" into Hybrid Design

can be used for both product and policy design

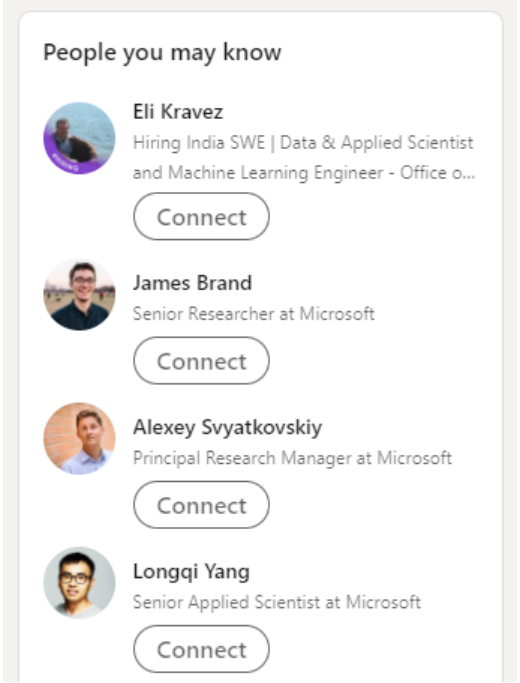
Instead of designing products (and policy) to provide the same experience for remote and collocated workers, instead think about how to accentuate the unique strengths of each mode and mitigate each mode's unique weaknesses

Allen, T. D., et al. (2015). How Effective Is Telecommuting? Assessing the Status of Our Scientific Findings. *Psychological Science in the Public Interest* 16(2) 40–68.
Microsoft Study: Ford, D., et al. (2022). A Tale of Two Cities: Software Developers Working from Home During the COVID-19 Pandemic. *ACM Transactions on Software Engineering and Methodology* 31(2).

Workplace recommendation systems can help with remote work challenges

Sustaining interpersonal connections has been challenging during remote work. Workplace recommendation systems can help facilitate meaningful connections by suggesting related people, content, and knowledge.

- Cross-industry analysis showed that workplace social media improves organizations' operational efficiency and innovativeness (Lam et al. 2016).
- "People You May Know" recommendations in LinkedIn (Yin et al. 2021) helped members, regardless of their network strength, make effective professional connections.
- Recommendation systems have the potential to drive positive behavior change that improves productivity, e.g., surfacing alternative choices, prioritizing actions (Schrage 2021).
- Workplace recommendation systems are the core AI engine for social platforms that can improve business outcomes. (See slide 69 on AI-powered social platforms.)



LinkedIn's "People you may know"

Lam, H. K., et al. (2016). The impact of firms' social media initiatives on operational efficiency and innovativeness. *Journal of Operations Management*.
Schrage, M., (2021). The Transformational Power of Recommendation. *MIT Sloan Management Review*, 62(2), pp.17-21.
Microsoft Study: Yin, Q., et al. (2021). Optimizing People You May Know (PYMK) for equity in network creation. *LinkedIn Engineering*.

Technology choices may trade off intra-team and cross-org effectiveness

When teams choose different sets of remote collaboration tools, they are trading off intra-team against inter-team effectiveness. Practical facilitation and technical solutions are needed to bridge teams.

- Hu et al. (2022) conducted a large ethnography of multiple scientific teams within an organization during the COVID-19 pandemic, using the "Distance Matters" framework (Olson & Olson 2000, 2013).
  - They found that while sets of remote collaboration tools, such as the Microsoft 365 ecosystem, have improved intra-team remote work, inter-team remote work can suffer when different teams use different sets of tools (e.g., one team might use only Microsoft tools and another uses only open-source tools).
- Hu et al. (2022) propose there is a need for facilitation and technical bridges between teams, and a broader understanding of the ramifications of technology choices for intra- and inter-team goals. Market factors are likely to limit technical connections unless major players can agree on shared standards or access.
- Cross-team tool alignment also facilitates mobility within the organization.

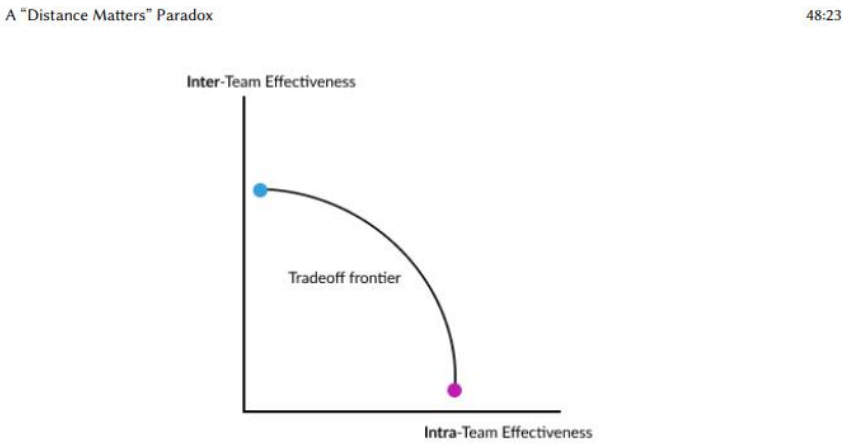


Fig. 3. Diagram of a tradeoff frontier between intra-team effectiveness and inter-team effectiveness. When closer to the blue dot, the inter-team layer is more effective, at the cost of intra-team effectiveness; closer to the magenta dot, the opposite is true.

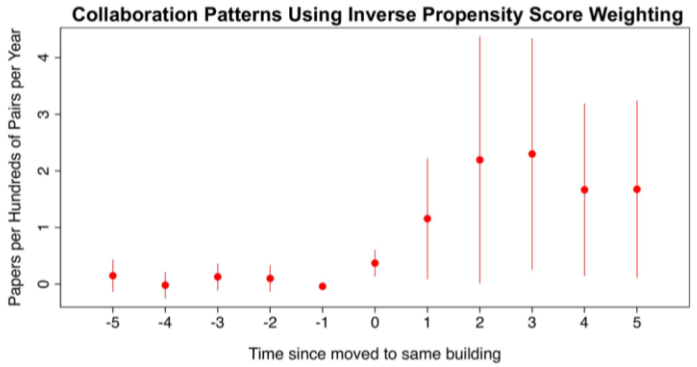
There is a trade-off between intra-team and inter-team effectiveness when they use different sets of remote collaboration tools (Hu et al. 2022)

Olson, J. S., & Olson, G. M. (2013). Working Together Apart: Collaboration over the Internet. *Synthesis Lectures on Human-Centered Informatics* 6(5), 1–151.
Olson, G. M., & Olson, J. S. (2000). Distance matters. *Human-Computer Interaction* 15(2), 139–178.
Xinlan E. H., et al. (2022). A "Distance Matters" Paradox: Facilitating Intra-Team Collaboration Can Harm Inter-Team Collaboration. *Proceedings of the ACM on Human-Computer Interaction*, 6(CSCW1), Article 48.

Office space can pay for itself with improved productivity

Focusing too much on cost-savings when thinking about space can be counterproductive.

- Rent and facility costs are often a small fraction of payroll. A useful rule of thumb is that facility costs are 10% of wages (JLL 2016).
  - If an office can boost productivity by 10%, it pays for itself. Conversely, if eliminating an office reduces productivity by 10%, it hasn't improved net revenue.
- Many studies point to properties of work environments boosting productivity at 10% or more.
  - Office noise can reduce memory, motivation and energy by about 10% (Jahncke et al. 2011).
  - Academics are approximately 20-30% more likely to get a grant for every 100ft of additional overlap in common paths they travel in the office (Kabo et al. 2014).
  - Sharing a building increases collaboration among MIT scientists by a significant margin (Miranda & Claudel 2021).
- Putting two people nearby each other might be the most powerful easily-available way to catalyze collaboration outside of top-down methods.
- New technologies that make the office even more useful will likely increase the productivity effect of the office.
- An important implication is that decisions about reducing office space should be made for reasons other than cutting costs. Reducing space might be the right decision, but because it's right for an organization for other reasons, not cost savings.



Miranda & Claudel (2021)

Jahncke, H., et al. (2011). "Open-Plan Office Noise: Cognitive Performance and Restoration." *Journal of Environmental Psychology* 31(4), 373–82.
JLL (2016), A Surprising Way to Cut Real Estate Costs.
Kabo, F. W., et al. (2014). "Proximity Effects on the Dynamics and Outcomes of Scientific Collaborations." *Research Policy* 43(9), 1469–85.
Miranda, A. S., & Claudel, M. (2021). "Spatial Proximity Matters: A Study on Collaboration." *PLOS ONE* 16, no. 12.

Spatial environments are conducive to ad hoc engagement, at least in bursts

Spatial environments allow natural transitions between focused and ad hoc interactions, both for work and social purposes, but all-day use and accessibility are still in question.

- Students prefer learning in the 2D videogame style spatial environments of systems like Gather.Town or Sococo in comparison to other learning platforms. An important aspect of this preference is the ease of moving between social encounters (Latulipe & De Jaeger 2022; McClure & Williams 2021).
- Spatial environments are reported to encourage both focused and ad hoc collaboration (Najjar et al. 2022).
- More abstract spatial environments that do not have illustrated characters and maps, but do have spatial audio, are also rated highly for enabling quick transitions between focused presentations, workshops, and networking at events (Rogers et al. 2021).
- Jacobs and Lindley (2021) report that such spaces tend to be popular in bursts – for short periods in a day or for a few days for a conference. However, it remains to be seen if such spaces are fatiguing or lose their novelty throughout full workdays and over weeks and months.
- Being based on a videogame paradigm, most also require significantly more accessibility support for blind and low vision (BLV) users, users with motor impairments, and other people with disabilities.

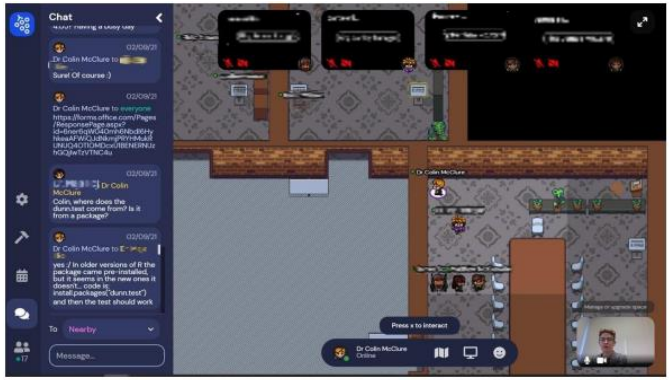


Figure 1: The GT environment designed for the data analysis sessions.

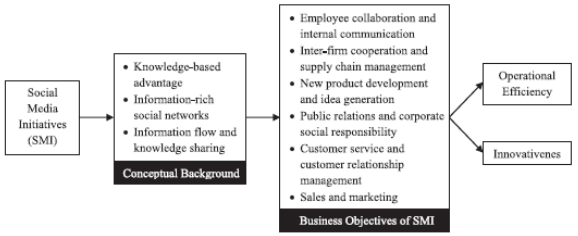
2D videogame style environments such as Gather enable transitions between different kinds of talk

Jacobs, N. J., & Lindley, J. (2021). Room for improvement in the video conferencing "space." *AoIR Selected Papers of Internet Research*.
Latulipe, C., & De Jaeger, A. (2022). Comparing Student Experiences of Collaborative Learning in Synchronous CS1 Classes inGather.Town vs. Zoom. *SIGCSE* 2022.
McClure, C. D., & Williams, P. N. (2021). Gather.town: an opportunity for self-paced learning in a synchronous, distance learning environment. *Journal of Learning and Teaching*.
Najjar, N., et al. (2022). Evaluating Students' Perceptions of Online Learning with 2-D Virtual Spaces. *SIGCSE* 2022.
Rogers, B., et al. (2021). BubbleVideo: Supporting Small Group Interactions in Online Conferences. In Human-Computer Interaction – *INTERACT 2021, Springer International Publishing, Cham*, 67–75.

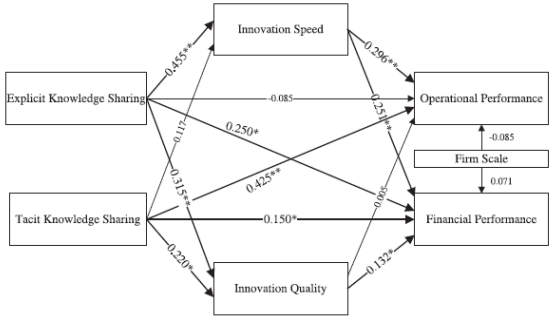
AI-powered social platforms have potential for improving business outcomes

There is growing evidence suggesting that algorithmically curated online communities, enterprise knowledge collections, and company feed have great potential for improving business outcomes and employee experiences.

- A study across 281 firms found that launching enterprise social platforms (e.g., internal communication platforms, external customer community platforms) can improve organizations' operational efficiency (transforming operational resources to output) and innovativeness (innovation ratings by *Fortune*) (Lam et al. 2016).
- A survey conducted across 89 high-tech enterprises in China revealed that knowledge sharing practices, through institutionalized knowledge collections and social interactions, are positively associated with organizational innovation and firm performance (Wang & Wang 2012).
  - Explicit knowledge sharing (e.g., through institutionalized knowledge collections) has more significant positive effects on innovation speed (e.g., speed in new product launching) and firm financial performance (e.g., average profit, profit growth).
  - Tacit knowledge sharing (e.g., through social interactions) has more significant positive effects on innovation quality (e.g., quality of new product development) and firm operational performance (e.g., customer satisfaction, cost management).
- A structurally diverse ego-network with both strong/bonding ties and weak/bridging ties can provide access to new knowledge and resources, possibly affecting firm productivity, innovation, and performance (Burt, 2007).
- Quantitative simulations on Twitter data showed that AI-powered recommender systems can be designed to balance engagement and outcomes that are important to healthy networks: they diminish engagement only a marginal amount and increase information flow, diversity, novelty, and efficiency across the network (Sanz-Cruzado & Castells 2018).



Lam et al. (2016)



Wang & Wang (2012)

Lam, H. K., et al. (2016). The impact of firms' social media initiatives on operational efficiency and innovativeness. *Journal of Operations Management*.
Wang, Z., & Wang, N. (2012). Knowledge sharing, innovation and firm performance. *Expert Systems with Applications*, 39(10), 8899-8908.
Burt, R. S. (2007). *Brokerage and Closure: An Introduction to Social Capital*. Oxford University Press.
Sanz-Cruzado, J., & Castells, P. (2018). Enhancing structural diversity in social networks by recommending weak ties. In *Proceedings of the 12th ACM conference on recommender systems*.

Employee-centered privacy is a major priority in remote and hybrid work

In remote and hybrid work, technology mediates more of people's work than ever before. This offers opportunities to support workers and organizations in new ways, but also presents privacy risks. Employee-centered privacy is about maximizing the reward and minimizing the risk.

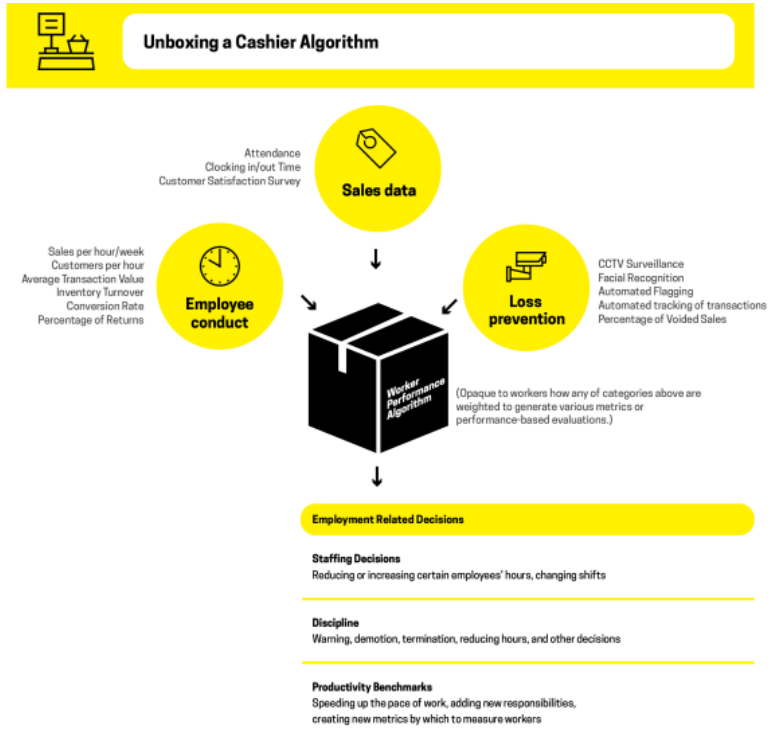
- Potential benefits of increased technological mediation of people's interactions with other people and information at work include intelligent scheduling assistance, work-life balance support, more personalized intelligent technologies, and others.
- However, increased mediation also presents risks to employee privacy. Reductions of employee privacy has been associated with higher worker stress levels, reduced organizational commitment, reduced trust in management, paradoxically increased deviance, reduced short-term productivity, reduced creativity, and other negative outcomes (Thiel et al. 2021; Chory et al. 2015; Ravid et al. 2020).
- Employee-centered privacy seeks to unlock the benefits of technological mediation while minimizing the risks.
- The literature on privacy at work points to some design principles that can enable worker-centric privacy, such as maximizing transparency and end user control, protecting against mission creep, educating stakeholders about the risks and benefits of recording certain types of information, and educating stakeholders about the specific inferences that can (and cannot) be made from specific types of data (Ravid et al. 2020).

Chory, R. M., et al. (2016). Organizational Surveillance of Computer-Mediated Workplace Communication: Employee Privacy Concerns and Responses. *Employee Responsibilities and Rights Journal* 28(1):23–43.
Microsoft Study: Ravid, D. M., et al. (2020). A Meta-Analysis of the Effects of Digital Surveillance of Workers: A Psychology Focused Approach. *In New Future of Work Symposium, Microsoft*.
Thiel, C., et al. (2021). Stripped of Agency: The Paradoxical Effect of Employee Monitoring on Deviance. *Academy of Management Proceedings*, 1.

Employee-centered privacy matters across the socioeconomic spectrum

Past research has found that privacy risks at work are more severe for lower wage, hourly employees than for those with more autonomy over their work.

- According to a 2021 report from the European Commission, workers with low levels of autonomy in their jobs (such as low wage service workers) were more at risk of the negative psycho-social effects of worker privacy issues than those with high levels of autonomy (such as information workers) (Ball 2021).
- Interviews with workers, scholars, and labor organizations found that low-wage, hourly workers are particularly at risk of precarity, work speedups, and racial profiling due to employee privacy issues (Nguyen 2021).
- Through participant observation, documentary research, and 40 in-depth interviews, Vargas (2017) found that managers used invasive technologies to treat low-wage, marginalized dollar store employees with suspicion, creating an environment in which these vulnerable workers were set up to fail.
- Risks in this domain have particularly negative impact on workers who already face discrimination in the workplace; female employees have reported discomfort with facial recognition (Stark et al. 2020) and workers of color are more at risk of negative pyscho-social outcomes (Ball 2021).



Nguyen (2021)

Ball, K. (2021). Electronic monitoring and surveillance in the workplace: Literature review and policy recommendations. *Joint Research Centre of the European Commission*.

Nguyen, A. (2021). The Constant Boss: Work under digital surveillance. *Data & Society Research Institute*.

Stark, L., et al. (2020). "I Don't Want Someone to Watch Me While I'm Working": Gendered Views of Facial Recognition Technology in Workplace Surveillance. *Journal of the Association for Information Science and Technology*, 71: 1074– 1088.

Vargas, T. L. (2017). Employees or Suspects? Surveillance and Scrutinization of Low-Wage Service Workers in U.S. Dollar Stores. *Journal of Labor and Society*, 20(2), 207–230.

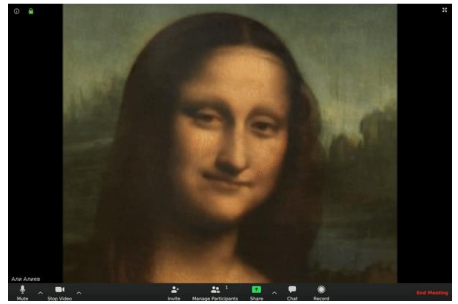
Threats to security of video meetings: Network scraping and deepfakes

Real identities determined from posted images of meetings and faked identities created through AI may allow malicious activities.

- Network scraping attacks use publicly posted images of meetings as a seed for identifying and maliciously acting upon individuals or teams. Kagan et al. (2020) show how a person's face and other extracted features may be compared against social media posts to enable identification. Photos from multiple meetings may also identify co-workers and content. This may then be used against individuals, families, teams, and organizations.
  - Organizations should inform employees about risks from posting meeting photos/videos to social media. Platforms could support more privacy modes.
- Deepfakes in video meetings (Westerland 2019) are AI-generated realistic-appearing artificial representations of people generated from image, video, and/or voice samples. They allow one person to appear as another and have potential for misuse when team members meet with unknown others (Mullen 2022). They also may be used for cultural identity appropriation (Bode et al. 2021), such as a white person representing themselves as a black person, which could affect team trust and morale. Creating and detecting deepfakes is an ongoing arms race (Zhou 2021; Kagan 2022; Mullen 2022). (See slide 45 on avatar acceptance.)
  - Industry coalitions like the Content Authenticity Initiative and C2PA (of which Microsoft is a founding member) working on digital content provenance present possible strategies for mitigating these and related risks.

Figure 1: Zoom Image Collage with Detected Information, Along with Extracted Features of Gender, Age, Face, and Username.

Public posting of video meeting images allows malicious aggregation (Kagan et al. 2020)



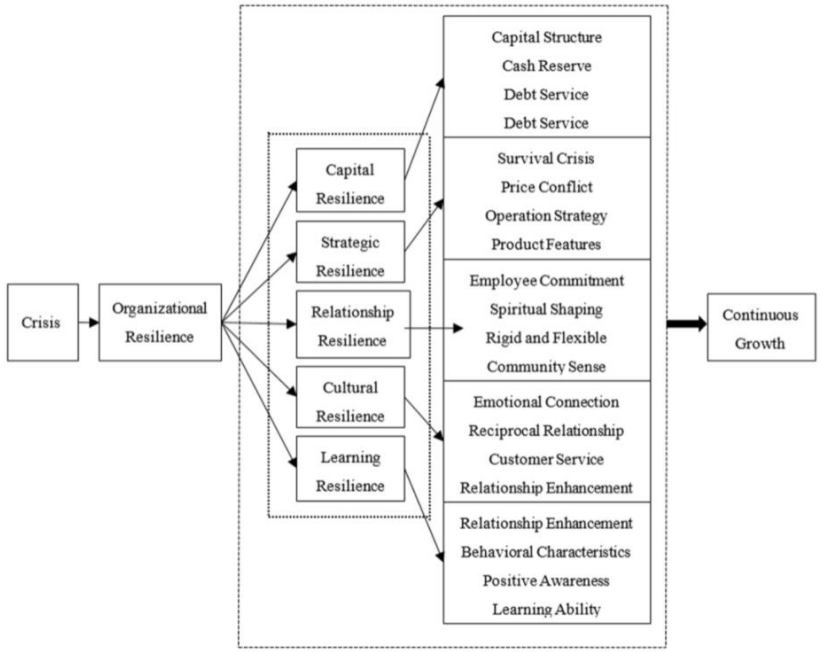
Aliev's (2022) Avatarify Python's deepfake video of the Mona Lisa as a videoconferencing participant

Aliev, A. (2022). Avatarify Python.
Kagan, D., et al. (2020). Zooming Into Video Conferencing Privacy and Security Threats. *arXiv preprint,* arXiv:2007.01059.
Mittal, T., et al. (2020). Emotions Don't Lie: An Audio-Visual Deepfake Detection Method using Affective Cues. In *Proceedings of the 28th ACM International Conference on Multimedia.*
Mullen, M. (2022). A New Reality: Deepfake Technology and the World Around Us. *Mitchell Hamline Law Review* 48(1), Article 5.
Westerlund, M. (2019). The Emergence of Deepfake Technology: A Review. *Technology Innovation Management Review* 9(11),, 40–53.
Zhou, Y., & Lim, S. (2021). Joint Audio-Visual Deepfake Detection. *IEEE/CVF International Conference on Computer Vision,* 14800–14809.

Organizations will need to be prepared for ongoing disruptions beyond COVID-19

With climate disasters and public health crises on the horizon, organizations must foster resilience

- Margherita & Heikkilä (2021) investigated the actions undertaken by 50 world-leading corporations to respond to COVID-19 to develop a five-level framework to ensure continuous collaboration in the face of disruption. The levels are: operations, customer, workforce, leadership, and community-related responses.
- A report by McKinsey highlighted disruptions due to climate change as a major future trend that will shape how organizations function and present a potential barrier to thriving (Pinner et al. 2020).
- Chen et al. (2021) conducted exploratory case studies (using textual data, such as company materials, media coverage, employee accounts, and annual reports) of six major companies deemed highly resilient, including Microsoft. They found five dimensions of resilience—capital, strategic, relationship, cultural, and learning—that allowed these companies to continue growing after a crisis.
- Organizational resilience has direct impacts on employees. A study of 2,225 software developers from 53 countries found that for these employees, fear of both the current pandemic and future bio-events might be facilitating lower productivity and well-being. Disaster preparedness among employees was correlated with higher perceived productivity and organizational support was deemed essential (Ralph et al. 2020). Furthermore, a survey of prospective employers by Krasna et al. (2020) found that 91.7% of respondents thought that the need for employees with training that encompasses both public health and climate change responses will grow over the next decade.



The organizational resilience process (Chen et al. 2021)

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Krasna. H., et al. (2020). The Future of Careers at the Intersection of Climate Change and Public Health: What Can Job Postings and an Employer Survey Tell Us? *International Journal of Environmental Research and Public Health*.
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Societal Impacts

Key Contributors: Siddharth Suri, Scott Counts, Mia Bruch

We are likely entering a new era in the geography of work

There have been roughly five eras in the geography of work in the history of the United States. There is evidence we are now beginning a sixth: *the Hybrid Work Era*.

- Although geographers may quibble about the specifics, prior to the pandemic, there were roughly five eras in the geography of work since the founding of the United States.
  - 1) Industrial Revolution, 2) Skyscraper, 3) Suburbs, 4) Edge City, 5) Superstar City.
  - The coming Hybrid Work Era will be our sixth.
- New technologies often drive the transition between eras.
  - Steel-frame construction helped bring about the Skyscraper Era.
  - Democratized access to cars enabled people to commute to work in the Suburbs Era.
  - Digital technologies like Office, Outlook, and Teams will shape the Hybrid Work Era.
- The key spatial relationships in the Hybrid Work era are those between digital technologies and space. There are three ways digital and spatial technologies can interact:
  - Digital technology can help people *understand* changes in how space is used for work,
  - Digital technology can *substitute* for space (e.g., replace meeting rooms), and
  - Digital technology can *complement* space (e.g., help people use offices in new ways).
- New eras in the geography of work generally bring many large benefits (e.g., better living standards), but also new challenges (e.g., uneven distribution of those standards). Those in the tech ecosystem will need to work hard to not repeat past mistakes by ensuring that the benefits are not limited to some groups of people and other challenges are minimized.

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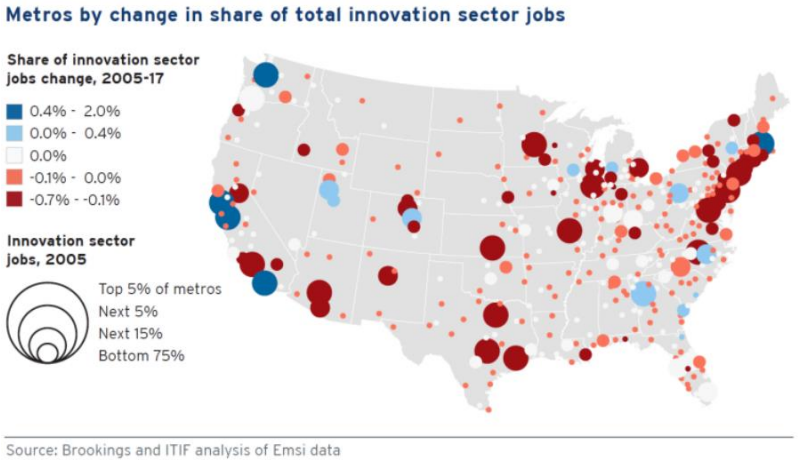
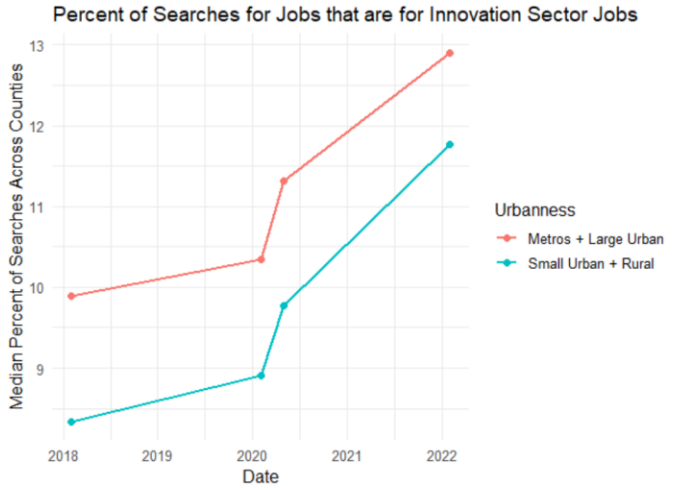
Interest in innovation sector jobs is spreading geographically

Cities with less of a historical tech presence are seeing growth in hires and interest.

- In 2005-2017, 90% of US innovation sector (highest-tech, highest-R&D 'advanced' industries) job growth was in 5 cities: Seattle, Boston, San Francisco, San Diego, and San Jose (Atkinson et al. 2019).
  - As a result, the gap in wages between top earning metros and others increased.
  - By 2017 "One-third of the nation's innovation jobs resided in just 16 counties, and more than half are concentrated in 41 counties."
- More recently, LinkedIn data shows areas like Miami, FL (+17%), Jacksonville, FL (+14%), and Tampa, FL (+10%), emerged as the biggest gainers of talent inflows, while San Francisco, CA (-15%), Portland, OR (-13%), and Seattle, WA (-11.7%) saw the greatest outflows of workers (Kimbrough 2022).
- Since 2020, interest in U.S. innovation sector jobs (technology, science, engineering) has grown everywhere, especially in rural counties, shrinking the urban/rural gap (Counts 2022; Chancellor & Counts 2018 for method).
  - Huge spike in interest as reflected by job searches on Bing – years of growth in just a few months (see graph).
  - The spike precedes a late 2020 labor-market rebound.
  - Interest in innovation sector jobs has also become more evenly distributed across U.S. counties.
- The new NSF directorate on Technology, Innovation, and Partnerships may contribute to this trend with its goal of "tapping into the full breadth of the nation's demography and geography" (National Science Foundation 2022).



Source: Brookings and ITIF analysis of Emsi data



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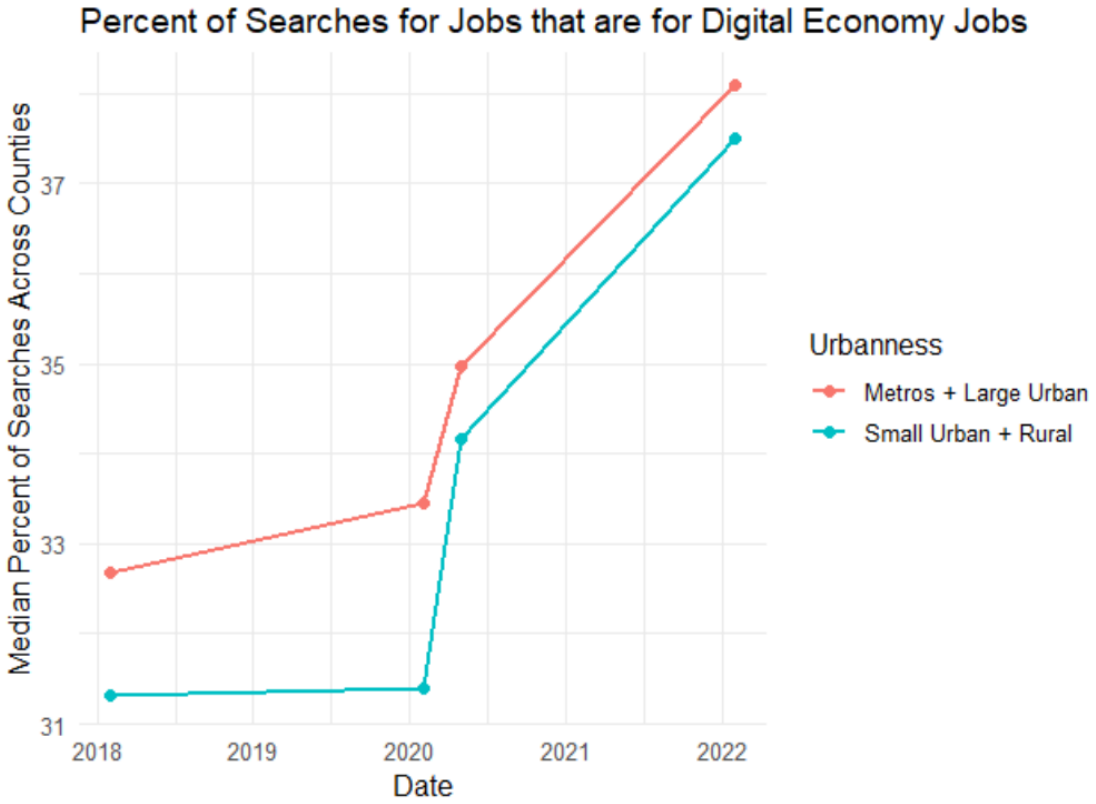
National Science Foundation (2022). Meet TIP – Technology, Innovation and Partnerships.

Interest in digital economy jobs broadly is also increasing

Years' worth of growth in interest happened in just a few months.

- Similar to innovation sector work, job interest in all remote-capable digital economy employment sectors (innovation sector + business, finance, art) in the U.S. spiked during the onset of the pandemic.
- Searches for digital economy jobs on Bing jumped by about 5% compared to before the pandemic, including sustained growth following the initial pandemic shock (Counts 2022; Chancellor & Counts 2018 for method).
  - The interest surge was most pronounced for small urban and rural areas.
- LinkedIn reports a 5x increase in remote job postings, and that people in cities across the Sun Belt in particular are applying to remote jobs at a rate substantially higher than the national average (Anders 2021).



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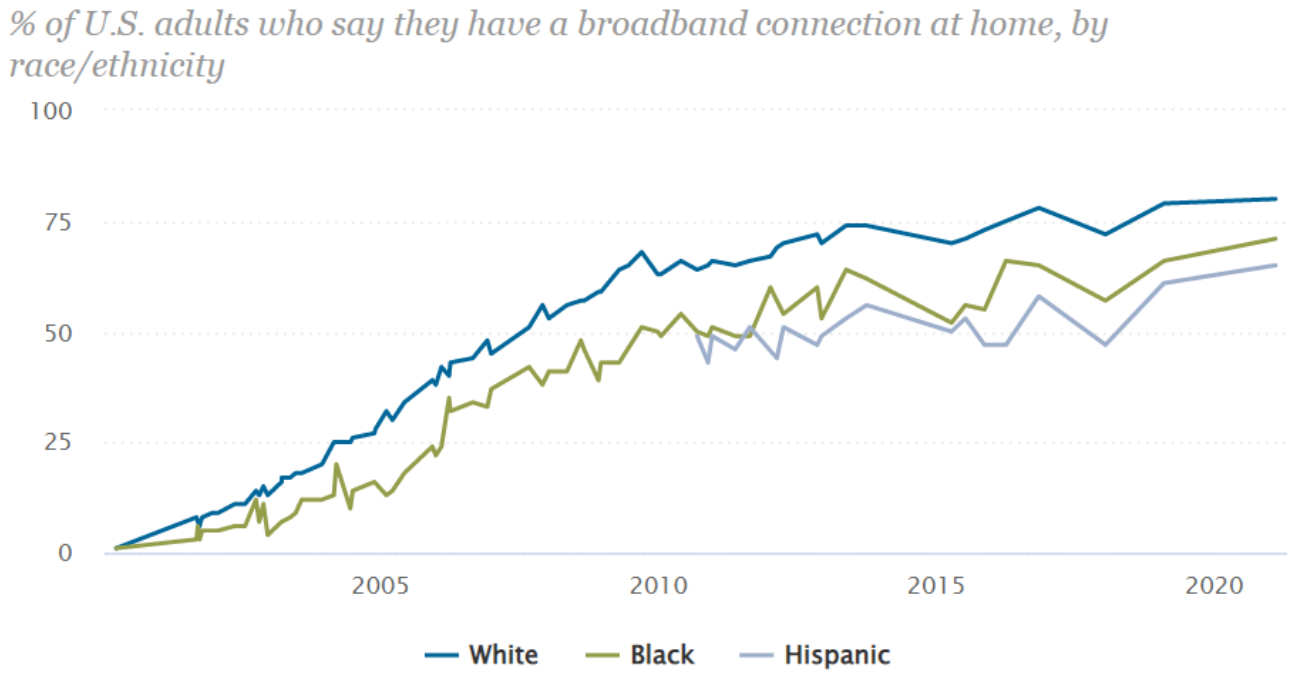
Those without broadband may be left out of geographic expansion of tech

Fast and reliable internet is not yet ubiquitous and not evenly spread around the U.S.

- In a 2020 survey, only 65% of Americans reported having fast enough internet to support video calls. The remaining 35 percent do not have sufficiently good home internet to work from home (Bloom 2020).
- In the U.S. 24% of rural adults say access to high-speed internet is a major problem in their local community, compared to 9% of suburban adults and 13% of urban adults (Anderson 2018).
- 80% of white households have broadband access compared to 71% of Black households and 65% of Hispanic households (Pew 2020, see graph).
- Because of broadband infrastructure inequalities already present in the U.S. today, remote work policies could disproportionately exclude Black, Hispanic, and rural workers from entering the innovation sector.
- Government agencies (e.g., USDA) and other organizations (e.g., Microsoft's Airband initiative) are working to expand broadband access, with equity concerns a primary driver.



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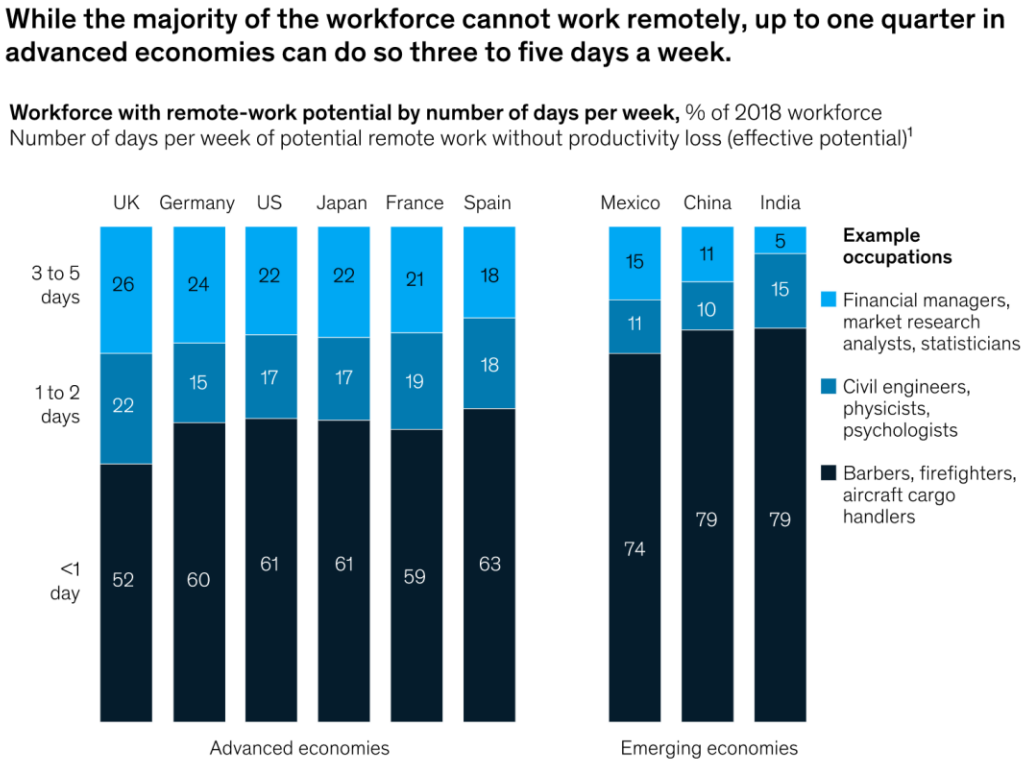
Only a minority of global jobs can be done remotely on a day-to-day basis

Remote work is not an option for many types of jobs such as frontline work among others.

- Across countries, between 5% and 26% of workforce can work remotely more than half the time without productivity loss (Lund et al. 2020).
- Globally, 80% of the workforce is "deskless." It is difficult to do these jobs remotely. Top 8 deskless industries: Agriculture, Education, Healthcare, Retail, Hospitality, Manufacturing, Transportation, and Construction, employing 2.7B employees (Emergence 2018).
- In the U.S. only 37% of jobs can be done remotely, far less in countries with lower per capita GDP (Dingel & Neiman 2020).
  - Even among high-GDP countries, the numbers vary depending on the mix of industries and professions.



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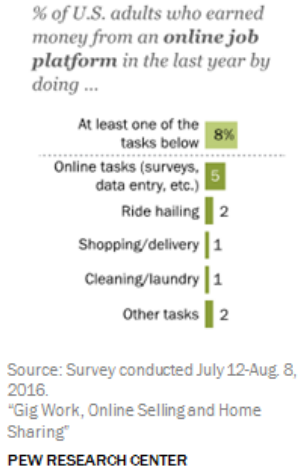
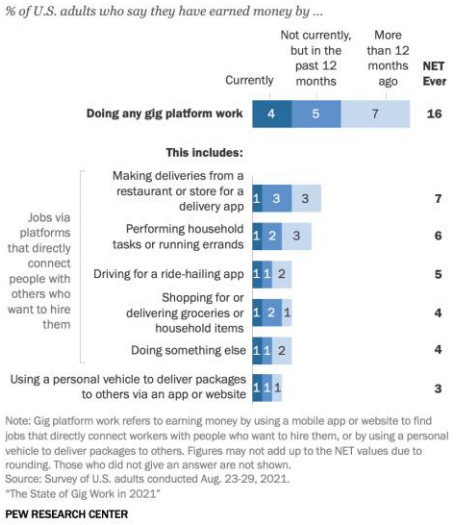
There was a shift in the types of gig jobs done during the pandemic

The gig economy as a whole did not grow during the pandemic, but there was an increase in the number of people doing in-person gig work as opposed to online work.

- The gig economy showed only moderate, if any, growth during the pandemic. In the 12 months prior to August 2021, 9% of U.S. adults reported earning money in the gig economy compared to 8% in the year before that and 8% in 2016. These numbers are within the margin of error of each other (Pew 2021, 2016). So, the substantial job losses early in the pandemic (April 2020) did not result in a large or sustained shift in the overall population of gig workers.
  - By August 2021 unemployment had dropped to a low of 5.2% (BLS 2022), so it is possible that people temporarily found gig work in April 2020 but returned to non-gig work prior August 2020. They would not have been counted in the 9%.
  - For example, Upwork had two spikes in worker registrations during the pandemic but did not see sustained growth (Ozimek 2022).
  - In 2021 and in 2016, 58% and 60%, respectively, of gig workers said the money they earn was "essential" or "important" (Pew 2016, 2021).
- Between 2016 and 2021 there was a dramatic shift in the type of gig work done. In 2016 the most common types of gig work were online tasks like surveys, data entry, etc. In contrast, in 2021 the most common types of gig work were in-person tasks like deliveries, shopping, household tasks, and ride-hailing (Pew 2016, 2021).



Smith (2016



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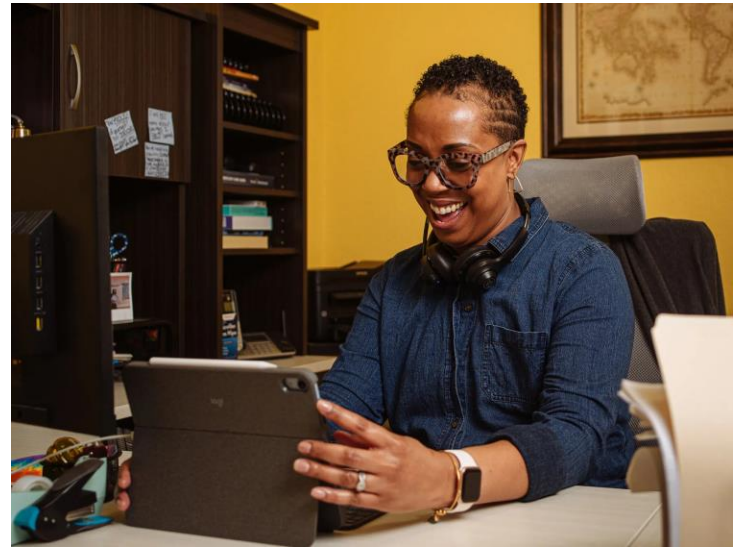
The traditional location-based workplace was better for some than others

People of color and women are more likely to prefer remote work.

- Studies have shown that compared to white men, people of color and women prefer remote work slightly more (Subramanian et al. 2021).
    - In the United States, 86% of Hispanic and 81% of Black knowledge workers said they prefer remote work preferred hybrid or remote work, compared to 75% of white knowledge workers.
    - Globally, 50% of working mothers said they preferred to work remotely, compared to 43% of fathers.
- In a LinkedIn study, women (28%) reported flexibility in location as a driver for changing employer more often than men (20%) (Anders 2022).
- For these demographics, some have a sense that remote work means an opportunity to be judged more based on their contribution, rather than their ability to "fit in" to prevailing office culture.
    - Since May 2021, a sense of belonging at work increased for 24% of Black knowledge workers, compared to 5% of white knowledge workers (Future Forum 2022).
- The emphasis hiring managers place on perceived "culture fit" can mean that some demographics are more likely to be excluded from consideration because they don't match the existing model of an employee. Remote work could mitigate this type of exclusion (Goldberg 2022).



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Future Forum Pulse (2022). futureforum.com/pulse-survey.

Proximity bias could disproportionately impact people of color and working parents

Organizations need to actively combat the proximity biases observed pre-pandemic or they will disadvantage certain groups of workers.

- In Bloom et al.'s (2015) study of a call center, conditional on performance, working from home caused 50% lower rates of promotion.
  - Wider acceptance and adoption of remote work could potentially mitigate this presence bias going forward.
- For the reasons discussed on the previous slide, Hispanic, Asian and Black knowledge workers in the US may spend less time in the office under hybrid work than white knowledge workers.
- 75% of working parents prefer work remotely or hybrid, compared to 63% of non-parents (Future Forum 2022).
- In the US, white knowledge workers are spending the most time in the office by a significant margin – as great as 17 percentage points (Future Forum 2022).
- Forty-one percent of executives cite the potential for inequities to develop between remote and in-office employees as their top concern (Future Forum 2022).

Future Forum (2022)

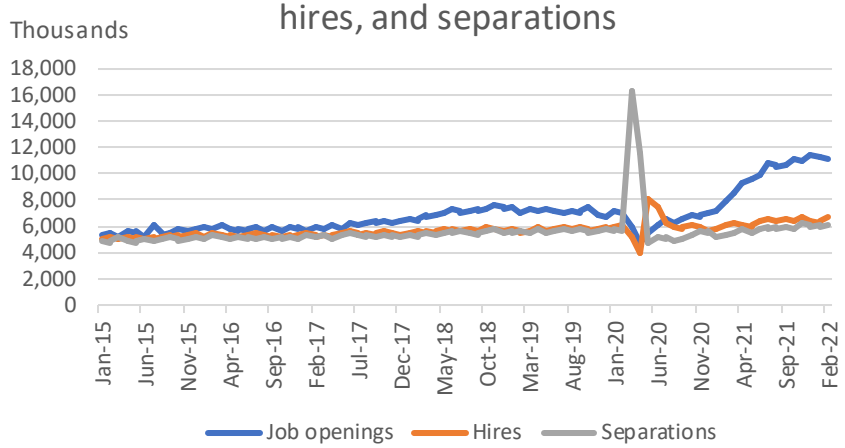
Bloom, N., et al. (2015). Does Working from Home Work? Evidence from a Chinese Experiment. *The Quarterly Journal of Economics* 130(1), 165–218.
Future Forum (2022). Leveling the playing field in the hybrid workplace. *Future Forum Pulse*.

Organizations are struggling to keep roles filled amid the Great Reshuffle

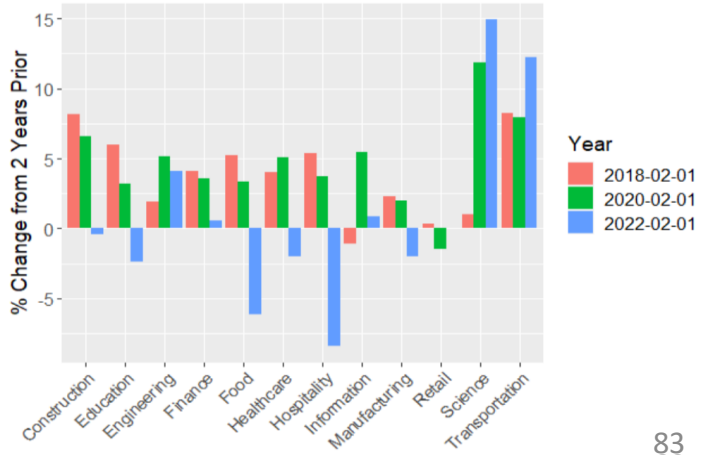
Both quit rates and hires have increased, though it varies by industry.

- In the US, a record 47.8 million people quit their jobs in 2021. However, hires increased as well, with 75.6 million individuals finding new work (Bureau of Labor Statistics 2022).
- Globally, the Microsoft WTI (2022) external survey found that the top five reasons employees quit were: personal wellbeing or mental health (24%), work-life balance (24%), risk of getting COVID-19 (21%), lack of confidence in senior management/leadership (21%), and lack of flexible work hours or location (21%).
  - Somewhat surprisingly, "not receiving promotions or raises I deserved" was number seven on the list at 19%.
  - However, in a Pew Research Center survey of Americans, the top 3 reasons for quitting a job in 2021 were low pay (63%), no opportunities for advancement (63%) and feeling disrespected at work (57%) (Parker 2022). (Differences could be due to the question phrasing or study recruitment, not necessarily a global / US difference.)
- Trends and reasons vary by industry:
  - Industry data show marked employment decreases in the Food, Hospitality, Healthcare, and Education sectors; increases in Transportation and Science sectors (BLS data, see bottom figure).
  - In the leisure industry the steep increase in quits was driven by people going directly to a new job, but in manufacturing they were not (Birinci & Amburgey 2022).
  - A study of human service workers proposed high levels of emotional labor as a mechanism (Costakis et al. 2021). Research on nurses (a group who might experience similar emotional burnout) found lack of autonomy over schedules to be key (Bergman et al. 2021).

Seasonally-adjusted nonfarm openings, hires, and separations



Graph based on data from BLS (2022b)



Graph based on data from BLS (2022b)

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Birinci, S., & Amburgey, A. (2022). The Great Resignation vs. The Great Reallocation: Industry-Level Evidence. *Economic Synopses* 2022, 4.

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Bureau of Labor Statistics (2022b) Current Employment and Earnings data.

Costakis, H. R., et al. (2021). Implications of Emotional Labor on Work Outcomes of Service Workers in Not-for-Profit Human Service Organizations. *Human Service Organizations: Management, Leadership & Governance* 45(1), 29–48.

Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*

Parker, K., & Horowitz, J. (2022). Majority of workers who quit a job in 2021 cite low pay, no opportunities for advancement, feeling disrespected. *Pew Research.*

Corporate impact on society is becoming more important to workers

Employees are placing increased importance on employers contributing to society.

- In a global survey of approximately 3k English-speaking LinkedIn members, females were more likely than males to report that it has become more important to them that organizations advocate for and make changes to support social justice issues (40% vs 31%; p<.01), as well as regularly contribute (money or products/services) to charities or causes (30% vs 26%; p<.05) (Glint 2021).
- In addition to energy poverty and broadband access, many more social responsibility issues increasingly are aligned with corporate goals.
  - More than 300 companies have joined the Amazon Climate Pledge, committing to net-zero carbon emissions by 2040 (Amazon 2022).
  - 38% of 8,500 companies in the MSCI All Country World Index are aligned with the United Nations Sustainable Development Goals (World Economic Forum 2021).

Compared to one year ago, how important is it to you that a potential employer do the following?

	Never was important	Less important	Equally important	More important	Not sure
Give back to the communities in which it does business	5%	4%	51%	38%	3%
Deliver its products/services in environmentally sustainable ways	5%	3%	45%	45%	2%
Advocate for and make changes to support social justice issues	11%	6%	44%	33%	6%
Encourage community volunteer activities for employees	10%	6%	50%	29%	4%
Regularly contribute (money/products/services) to charitable causes	10%	5%	54%	27%	4%

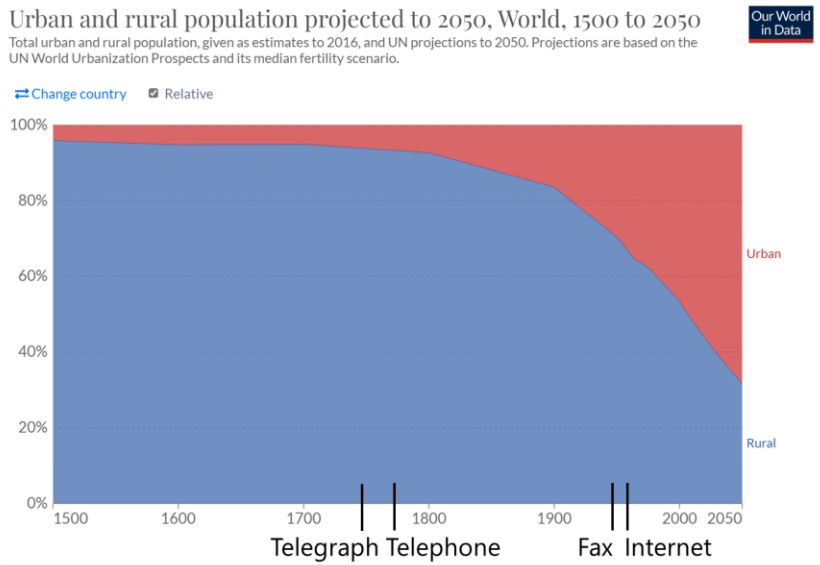
Glint (2021)

Amazon (2022). The Climate Pledge.
Microsoft Study: Glint (2021). Expectations of Corporate Social Responsibility. *Linkedin*. [Internal]
Neufeld, D. (2021). UN Sustainable Development Goals: How Do Companies Stack Up? *World Economic Forum*.

Work is only one reason people live in cities

Remote work will permit some people to move away from their location of work, as we saw in 2020, but other forces still push for urbanization.

- There is a centuries-old worldwide trend towards urbanization despite the invention of many groundbreaking communications technologies.
- People move to cities for a variety of reasons. In the U.S. in 2000, only 1/3 of moves between counties were for job-related reasons. The rest are for family, housing, amenities and other reasons (Schacter 2001).
- The pandemic caused moves overall to decrease in 2020, but Haslag & Weagley's (2022) analysis of data from a major moving company (more representative of upper-income and inter-state moves) find a decrease in the share of moves that survey respondents report were for a job as well as a few percentage point drop in the share of moves to urban areas.
- In the short term, the 20% of jobs (Deskless Workforce 2018) that could potentially be done remotely may affect the global trend towards urbanization (see figure) slightly. But since most jobs cannot be done remotely and people move to cities for reasons besides jobs, the overall trend will likely continue.



Ritchie & Roser (2018)

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Schacter, J. (2001). Why People Move: Exploring the March 2000 Current Population Survey. *U.S. Census Bureau*.

Forecast

Looking ahead: Challenges and opportunities

Work isn't going to snap back to the way it was pre-pandemic

As workplaces open back up, the jobs that shifted to remote work during the pandemic are unlikely to return to pre-pandemic practices. Instead, people and organizations will carry forward their learnings from the past two years and develop new hybrid work practices that are fundamentally different.

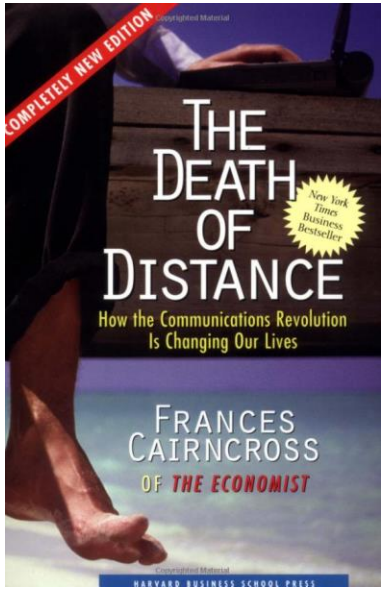
- As restrictions lift, many companies have adjusted their policies to accommodate employee preferences (Barrero et al. 2021).
- During the pandemic people made decisions to accommodate an increase in remote work that will have long-term ramifications on what in-person and hybrid work look like moving forward.
  - Some organizations made decisions about office space that will make returning hard (e.g., giving up leases).
  - Many employees made decisions that make it easier for them to work remotely (e.g., setting up home offices or purchasing larger houses) and that will make it hard for them to return in the future (e.g., moving to remote locations).
  - In Microsoft's global Work Trend Index study, 47% of respondents say they are more likely to put family and personal life over work than they were before the pandemic. And 53%—particularly parents (55%) and women (56%)—say they're more likely to prioritize their health and wellbeing over work than before (Microsoft WTI 2022).
- Future waves of Covid are likely to continue to disrupt work practices in a localized manner. For example, a surge of Omicron infections has recently prompted lockdowns in China (Bradsher 2022).
- Given the scale of the disruption experienced during the pandemic, if work practices return to the way they used to be, it will represent a failure to capture an opportunity to improve work.

Barrero, J. M., et al. (2021). Why Working from Home Will Stick. *National Bureau of Economic Research Working Paper Series,* 28731.
Bradsher, K. (2022). Surge of Omicron infections prompts lockdowns in China. *The New York Times*.
Microsoft Study: Microsoft WTI (2022). Great Expectations: Making Hybrid Work Work. *Microsoft WorkLab: Work Trend Index 2022.*

The future is uncertain and full of possibilities

All evidence in the social science literature suggests that it is very difficult to make very-high-confidence predictions about the state of work even a few years from now. But forecasts can help us understand the wide range of possible outcomes.

- As the saying goes, the "social sciences *are* the hard sciences": work is the outcome of (and input to) a huge variety of societal processes, each of which is difficult to predict and is affected by all the others.
- Some societal processes that can dramatically change future of work outcomes include: housing policy (e.g., cost of housing near offices), immigration law (e.g., can people work across borders more easily?), tax law (e.g., which jurisdiction gets income taxes for remote work?), network effects that alter work location preferences (e.g., if everyone is in the office, you might want to be there too), and of course, the course of technological development.
- Highlighting uncertainty does not mean giving up. Organization leaders around the world know how to handle situations like this: diversification. Now is likely not the time for a single huge bet on the future of work – rather, it is a time for experimentation and planning for a range of possible outcomes.
- Predictions can help us understand this range even if most predictions are highly unlikely to manifest as stated. Some predictions are also implicit or explicit attempts at self-fulfilling prophecies (Weyl 2022), for better or worse.



In 2001, it was predicted that technology would make distance / co-location irrelevant. And yet, in the subsequent 20 years, it has only become more relevant (Greenstein et al. 2018).

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Greenstein, S, et al. (2018). How Geography Shapes—and Is Shaped by—the Internet. In *The New Oxford Handbook of Economic Geography*.

We will learn from an unprecedented level of experimentation in work models

We are likely entering the biggest period of experimentation in work models in decades. Some companies will see a willingness to try new things as a differentiator in a tight labor market, others will try for a productivity edge.

- In addition to many variations of remote / hybrid / onsite work, we expect to see companies trying
  - Alternative pay structures – expecting a certain output from employees rather than a time spent working
  - Remote work may accelerate transition to gig work
  - Alternative organizational structures, perhaps similar to those that have been used in the entertainment industry (Baym 2018)
- But, importantly, "trying new things" is not the same as true experimentation. To learn as much as possible moving forward, companies should implement new policies within the context of a scientific framework of experimentation and learning.


THE FUTURE OF EVERYTHING

MARC BENIOFF SAYS A RANCH MAY BE WHAT SALESFORCE'S WORK CULTURE NEEDS

(Weber, WSJ 2021)


Why a California Congressman Has Proposed a Four-Day Workweek

After two years of life under the coronavirus pandemic, some in Congress believe it's time to reduce the hours we put in.

(Albeck-Ripka, NYT 2022)


CORNER OFFICE

How Freelancing Is Changing Work

"When you talk to workers, they don't want to sign up for a 9-to-5 job," said Hayden Brown, who runs Upwork, a site that matches freelancers with employers.

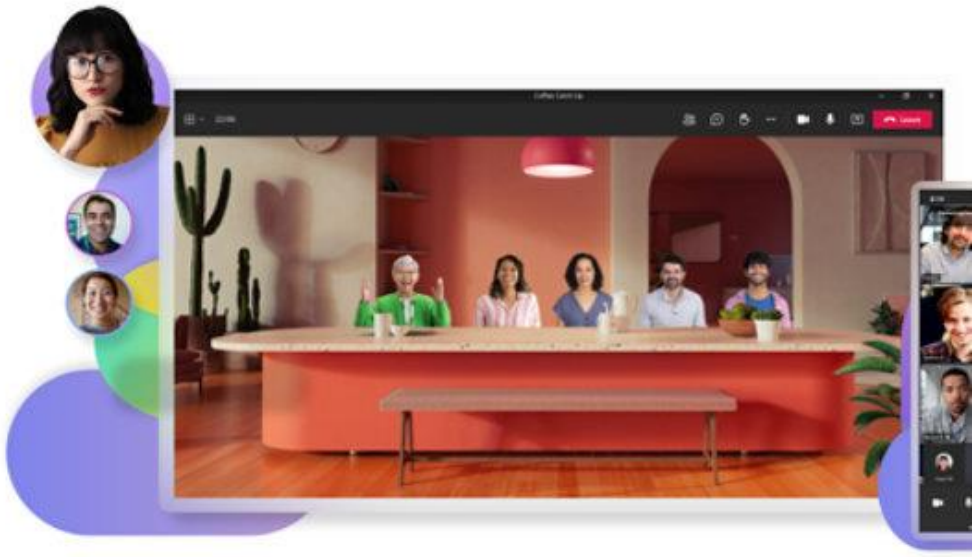
(Gelles, NYT 2021)

Microsoft Study: Baym, N. K. (2018). *Playing to the Crowd: Musicians, Audiences, and the Intimate Work of Connection*. 1st Edition. New York: NYU Press, 2018.

In the tech industry, forecasting is just the first step

Our job in the tech industry is not just to forecast the future of work but to create it. The tools we are building right now will shape how our customers, our employees, and people around the world get things done in the future.

- The future of work is very difficult to predict given the number of socioeconomic and sociotechnical variables involved. One great way to predict the future of work with some accuracy is to create it.
- In the tech industry, we have more agency in shaping what the future of work looks like than people in many other industries. With this comes the responsibility to ensure that it is a better future of work for all.
- The next time someone asks, "What will the future of work look like in {2025, 2030, etc.}?", it might be more useful to ask, "What *should* the future of work look like, and what do we need to do to get there?"
- Forecasts certainly have a great deal of value – they can help us see the wide variety of potential outcomes – but they are just a first step towards selecting and shaping outcomes for the better.

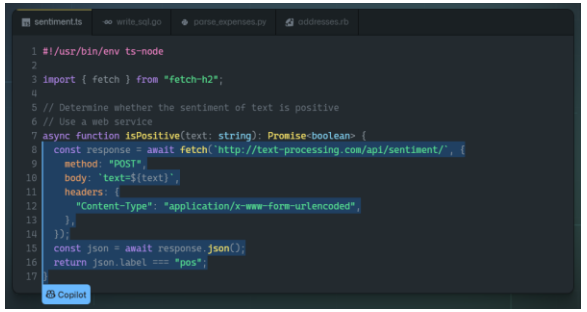


The capabilities of Teams and other hybrid work experiences and devices could play a role in defining the character of work for a generation.

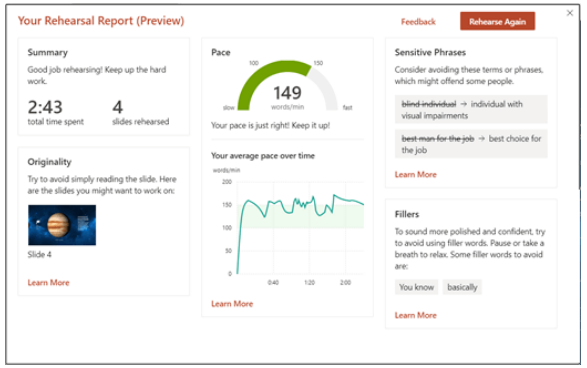
Remote and hybrid work increase the opportunity for AI to transform work

The pandemic significantly accelerated the digital transformation already underway at many companies, and work-related data is now generated at an unprecedented pace. Combined with significant advances in AI, this will drive a significant change in how people work.

- The rapid digital transformation of the past two years across a variety of industries enabled the capture of training data at scale for a broad range of work. For example, the monthly use of meeting recordings in Microsoft Stream more than doubled from March 2020 to February 2022 (Microsoft WTI 2022).
- AI is good at learning and scaling patterns, meaning for these activities people can instead focus on doing things in new ways and generating novel ideas. For example, someone might:
  - Write a document by merely listing the ideas it should include. The details can be fleshed out automatically, much like developers use Copilot to flesh out ideas through code (Github 2022).
  - Attend a meeting asynchronously by, before the meeting, asking the system to capture ideas on their behalf to share at the meeting, and, after the meeting, hearing the responses people had to those ideas in the meeting summarized by a large-scale language model (Tang 2012).
  - Learn a new skill from an AI-based coach that increase their cognitive abilities and improves their performance. E.g., Speaker Coach helps improve people's presentation skills (Microsoft 2021).
- Uncertainty will be become a fundamental part of productivity systems, as correcting mistakes made by AI and training AI models becomes an increasingly important part of how people get things done.
- Because AI systems will not just support work but change people's work practices, they will need to be designed in a way that is privacy-preserving, responsible, and equitable.



Github Copilot (2022)



Speaker Coach (2021)

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Github (2022). GitHub Copilot: Your AI pair programmer.
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Guest Forecasts

To provide a broad range of perspectives, we asked leading external experts from relevant research fields to forecast what the future of work might hold based on recent findings in their areas of expertise. Forecasting the future of work is a very difficult task, and we are grateful to the below experts for accepting this challenge to help us understand the range of possible outcomes:

- Jeremy Bailenson (Stanford University)
- Nathan Benaich (Air Street Capital)
- Ethan Bernstein (Harvard Business School)
- Michael Bernstein (Stanford University)
- Nicholas Bloom (Stanford University)
- Tawanna Dillahunt (University of Michigan)
- Benjamin Laker (Henley Business School)
- Nale Lehmann-Willenbrock (Universität Hamburg)
- Paul Leonardi (University of California, Santa Barbara)
- Gloria Mark (University of California, Irvine)
- Alexandra Samuel (alexandrasamuel.com)
- Jane Shakespeare-Finch (Queensland University of Technology)
- Willem Standaert (University of Liège)
- Melissa Valentine (Stanford University)

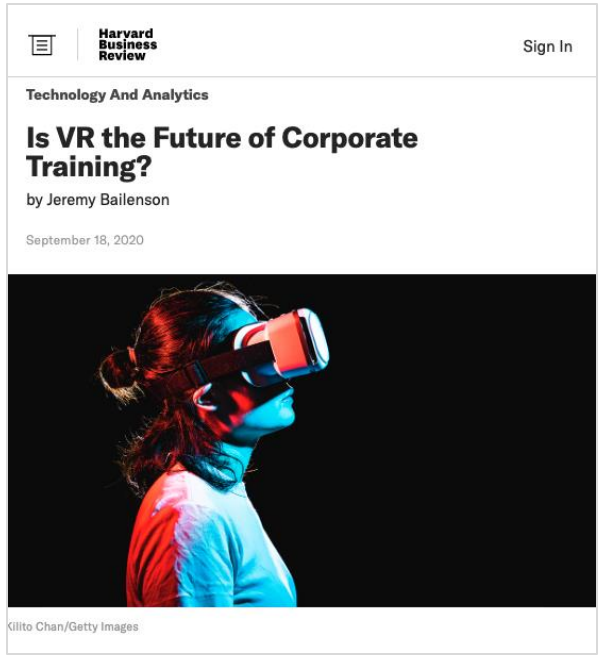
The guest forecasts reflect the contributors' views of future scenarios, not those of Microsoft. They are not legal analyses and are only a discussion of possible trends.

Jeremy Bailenson (Stanford University)

The metaverse will mostly be for training and work

When you go through the history of VR, it's all about training – starting with the Flight Simulator in 1929. This won't change, given VR's success training people, but rather will grow into more interactive, collaborative immersive training.

- Current metaverse platforms are home to hundreds or sometimes thousands of daily users, not millions. On the other hand, VR training is already touching millions and that number will increase over the next 2-3 years.
- Workers will increasingly access their corporate training via the metaverse, and will benefit from new capabilities within immersive training, such as learning in teams, that will lead to a new wave of workforce skills.
- The metaverse comes with a set a difficult challenges around consumer data privacy, security, and even climate change.



HBR article highlights specific case studies to demonstrate why training is such a valuable use case for VR and the metaverse.

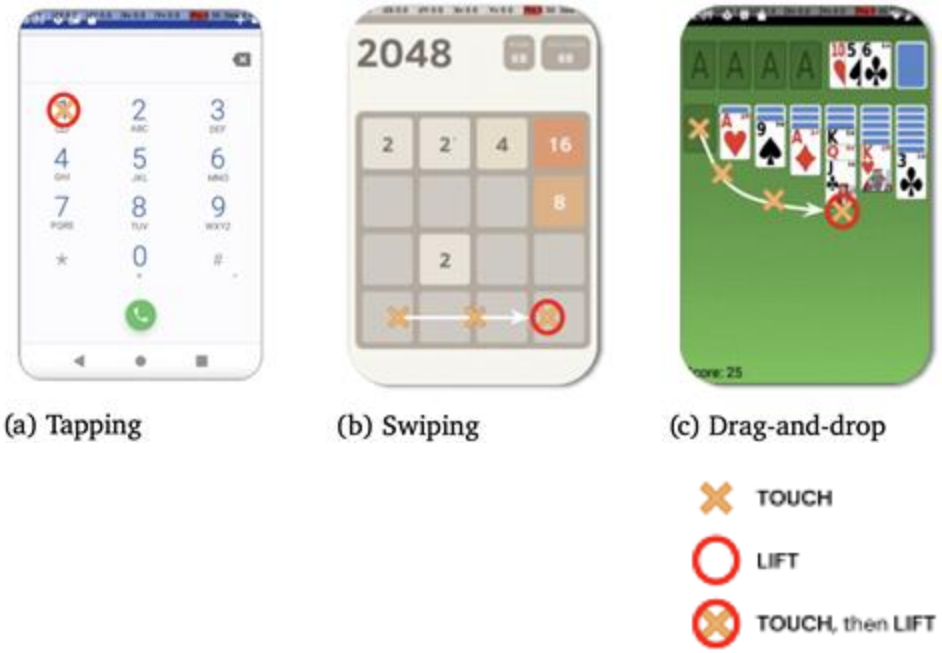
Bailenson, J. (2020). Is VR the Future of Corporate Training? *Harvard Business Review*.

Nathan Benaich (Air Street Capital)

Beyond programming, more general AI assistants could revolutionize work

OpenAI's programming assistant Codex brought hope of making the life of millions of developers easier. But future AI assistants will be much more general, and could revolutionize the workflows of billions of users.

- Google has been steadily adding new machine learning features to Google Workplace. Among others: text completion and summarization on Google Docs, formula prediction on Sheets.
- In other Google offices, DeepMind developed the AndroidEnv environment in 2021 where they trained RL agents to perform various tasks such as setting alarm clocks, booking flights, playing games, all while virtually swiping on a screen, clicking on icons, etc.
- UiPath is already making incredible strides in task automation, but an AI-first approach could make work assistants more generally capable.
- Future work assistants will use their navigation agility at the operating system level in order to perform tasks across different AI-powered apps/software. By mimicking human gestures and workflows, assistants will be easier to interact with and instruct.



(a) Tapping (b) Swiping (c) Drag-and-drop

Hassan, H. (2019). Google Brings AI-powered Auto-Complete to Google Docs *Thurrott.com*
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AIR STREET CAPITAL

Ethan Bernstein (Harvard Business School)

Talent, particularly elite talent, will continue to become more impatient

To remain competitive (as the Great Resignation – or Great Attraction—continues), organizations will finally leave behind traditional, organization-centric approaches to succession in favor of new talent development paradigms that are more human-centric.

Among other trends, this will manifest in the following ways:

- Ladders of progression will be replaced by individualized pathways that allow employees to make progress as they define it.
  - Successful organizations will stop focusing on what an employee can be (e.g., a manager, a VP, etc.) and instead enable a path to what they want to do.
  - That will put pressure on talent leaders to figure out how to appropriately recognize work and progress.
- Side hustles and side gigs will become even more mainstream, as demands for flexibility continue.
  - Successful organizations will embrace employees' side gigs as learning and experimentation environments that can complement the main gig; "On the Job Training" may happen in side gigs with credit accruing to the main gig.
  - The most forward-thinking companies may even restructure jobs to allow employees to turn their main gig for the organization into a side gig from time to time.
- Careers will become a patchwork of experiences (composed of distinct S-curves), and responsibility for piecing them together into a meaningful quilt will fall increasingly on individuals rather than organizations.
  - Successful organizations will provide more opportunities for employees to experiment and prototype more 'unusual' career moves.
  - Demands for coaching and mentorship will continue to rise.
  - Most employees will, at some point, have at least one fully virtual role.
- A Note of Caution: These opportunities are unlikely to be distributed evenly; without intervention, these trends are likely to amplify differences between office work and front-line work; between white collar and blue collar work; between haves and have-nots.

Bernstein, E., et al. (Expected Spring 2024). *Hire Your Next Job (Working Title)*. New York: Harper Collins.

Michael Bernstein and Melissa Valentine (Stanford University)

Software will help support rapid organizations: *OrgOS*

As organizations make increasing numbers of data- and AI-driven decisions, the traditional organizational designs that we use to support these decisions will become dynamic.

- Organizations are adapting their structures based on data: as customer data surfaces patterns in behavior and needs, teams are getting dynamically assembled and staffed. (Think: Netflix creating shows for the data-driven customer segments that they identify.)
- These "rapid response" organizational changes are high velocity, as needs evolve: teams grow and shrink, they shift goals, they adapt.
- In computing, operating systems translate high-level goals into low-level implementation decisions. Imagine an organizational operating system, OrgOS, that aids teams in navigating these rapid response challenges: helping with critical basic building blocks (e.g., staffing teams) and tracking health (e.g., early warning systems of team interpersonal issues).

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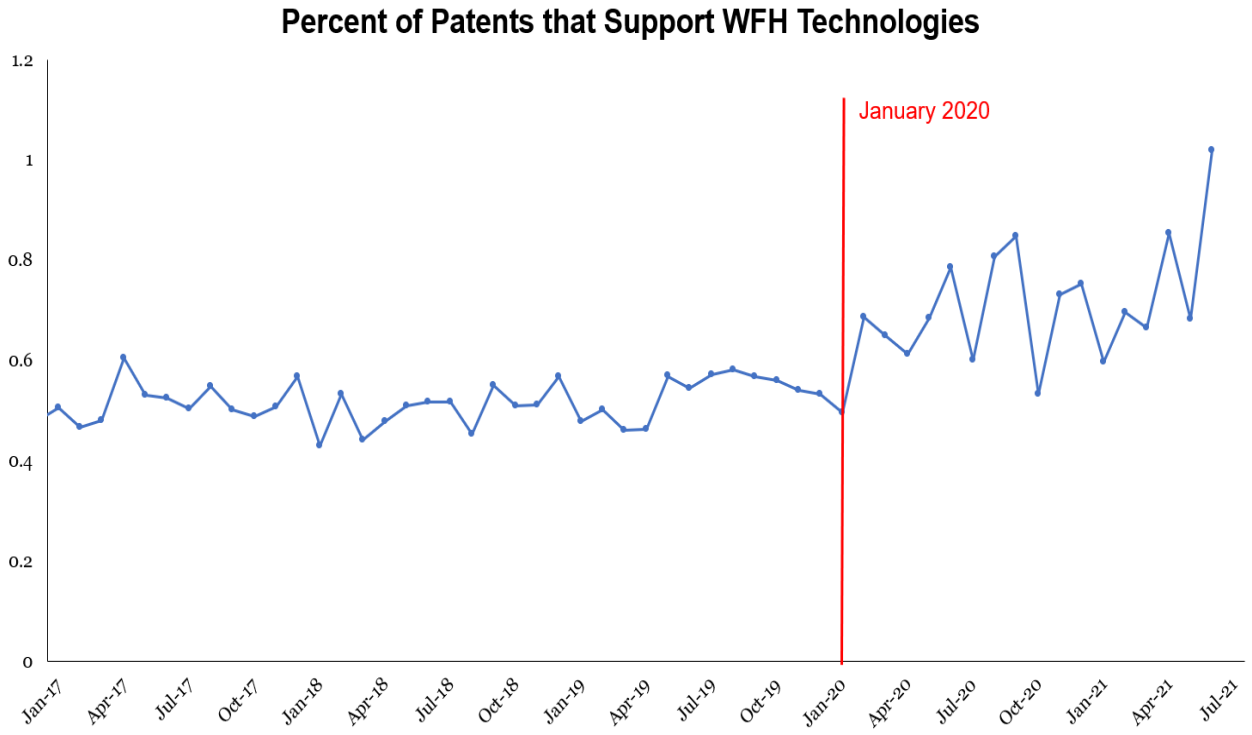
Nicholas Bloom (Stanford University)

Working from home will continue to grow as the technology improves

During the pandemic WFH has continued to grow as firms and employees adapt to this. Better equipment and new technology will continue this growth of WFH over the next decades.

- The number of full WFH days will rise from 5% pre-pandemic in 2019 to 25% post-pandemic in 2023, generating a 5x increase in the market for WFH technology.
- This is driving increases in development of hardware and software to support WFH as the market for these technologies expands.
- So the next 20 years will involve impressive improvements in WFH technologies like VR, holograms, and portable compute.
- These technologies will radically improve WFH, just as videocalls and cloud file-sharing did over the past 20 years.



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Tawanna Dillahunt (University of Michigan)

Inclusive, accessible, and sustainable work environments must be imagined

In addition to supporting job seekers in navigating the existing labor market, we must seek alternatives to support what work *could* look like

- New methods of technology development must center marginalized job seekers and account for their unique situations, strengths, and everyday resilience (Putnam et al. 2022; Lu et al. 2022).
- Future interventions must consider existing social and human infrastructures, reinforce and amplify community-based mentorship and support, training, skilling, and entrepreneurship (Dillahunt et al. 2022; Hui et al. 2020; Ogbonnaya-Ogburu et al. 2019).
- Inclusive work environments will require accessible and nurturing interventions to recruit, support, and retain talented marginalized employees (Dillahunt et al. 2021).

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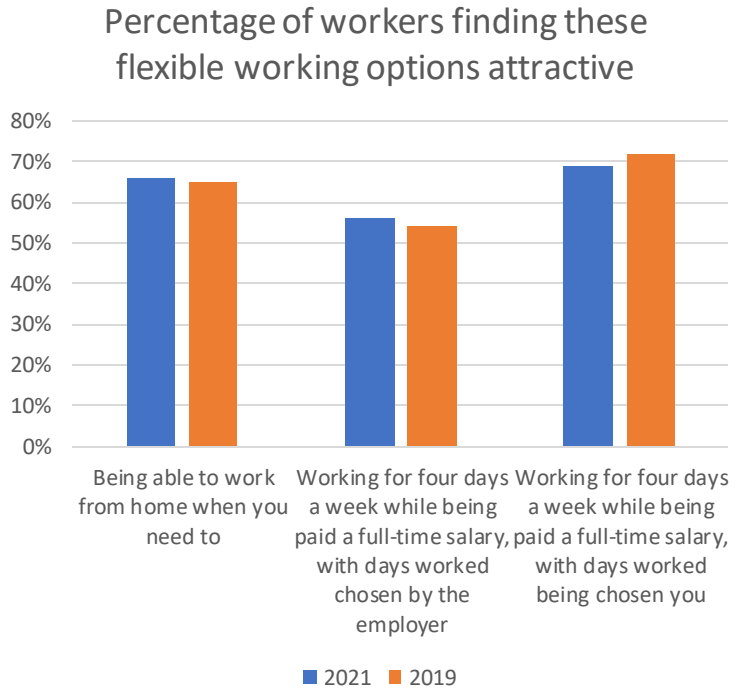
Putnam, M., et al. (2022). New Directions in Employment and Training Research and Evaluation: Digital Employment Tools Created with Approaches from Human-Computer Interaction.

Benjamin Laker (Henley Business School, University of Reading)

Workers will be willing to pay to avoid commuting

If the pandemic has taught us anything is that far more work can be done remotely than we previously thought. The steep global rise in commuting costs and the willingness of employees who have grown accustomed to working from home seek to cement the shift away from office working.

- Research from the U.K. and U.S. has shown perhaps the most significant impact of the pandemic on working lives has been the shift in the amount of time spent working from home and in shifting to flexible working options (Barrero et al. 2021). Researchers have found that the most loathed aspect of working in the office is not working in an office itself.
- A 2022 Henley Business School report shows workers are willing to sacrifice compensation to work from home. The work suggests that about a quarter of employees (27%) would be willing to take a salary reduction to work from home.
- This timely research illustrates the amount that workers are willing to give up is not trivial, with employees being willing to forgo over $4,300 per annum to be able to work from home full time. As costs rise, employers may be eager? Last year, Google was reputed to have considered cashing in on employees' willingness to pay to work from home. So, how much are you willing to pay? It may not be that long until your employer asks you (Henley Business School 2022).



Data from Henley Business School (2022)

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Henley Business School (2022). The four-day week: The pandemic and the evolution of flexible working. *Henley Business School*. White Paper.

Nale Lehmann-Willenbrock (Universität Hamburg)

Metaverse meetings will boost team dynamics and meeting effectiveness

As team members experience presence and entitativity when meeting in the metaverse, the limited group dynamics of remote team meetings will be overcome

- Effective team meetings are important for team and organizational functioning.
- Entitativity, the feeling of *groupness* or being part of an actual group, is the prerequisite for positive team meeting dynamics such as cohesion, mutual trust, and team flow. Entitativity is typically limited in virtual meetings.
- Immersive meeting platforms with realistic avatars can overcome this by promoting a sense of presence and provide a basis for experiencing entitativity in the metaverse.
- Based on enhanced entitativity, metaverse meetings will enable positive team dynamics that are equal to F2F interactions, while allowing additional possibilities for collaboration and inclusion.

Cross-Disciplinary Lab Computational Human Dynamics (CHD) @Universität Hamburg

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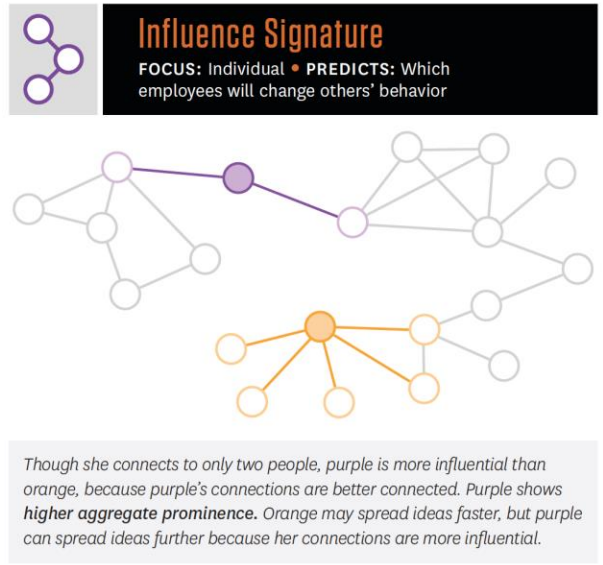
Paul Leonardi (University of California, Santa Barbara)

Relational analytics will begin to revolutionize HR and management practice

People analytics is growing. But the focus is typically on employees' individual attributes. The best predictors of performance and wellbeing don't come from data about people themselves, but from the structure of their relationships at work.

- To date, people analytics has focused mostly on employee attribute data, of which there are two kinds: (1) Trait: facts about individuals that don't change, such as ethnicity, gender, and work history (2) State: facts about individuals that do change, such as age, education level, company tenure, value of received bonuses, commute distance, and days absent.
- Decades of research show that the relationships employees have with one another—together with their individual attributes—can better explain their workplace performance and wellbeing. The key is finding *structural signatures*: patterns in the data that correlate to some form of good (or bad) performance or wellbeing
- The rich digital trace data that employees generate while working on and through digital platforms provides social network data on actual working relationship that have been extremely difficult to capture in the past, and have made relational analytics difficult to compute. The digital work revolution has changed that.
- Workplace leaders will need tools to analyze these data and use them to identify structural signatures that can help them mentor employees and make key staffing decisions. Questions about privacy and data ownership will loom large.



Example of Structural Signature computed from digital trace data (Leonardi & Contractor 2018)

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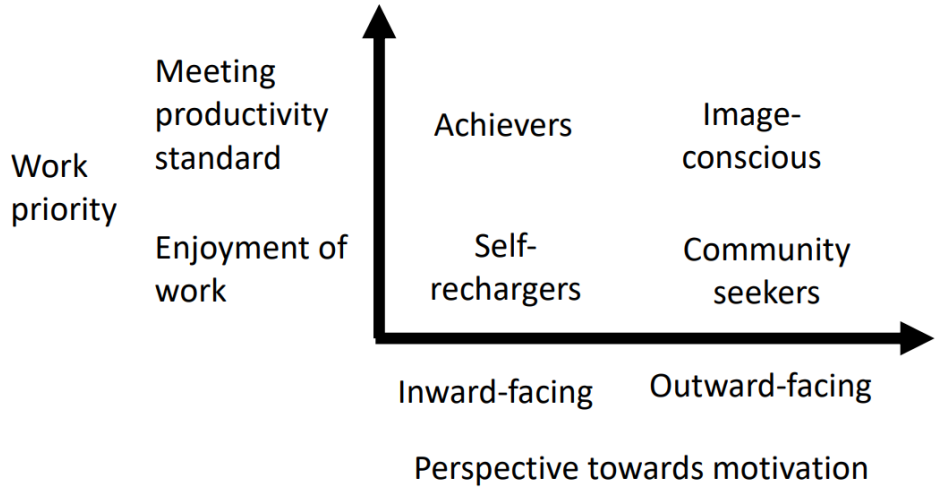
Gloria Mark (University of California, Irvine)

New management practices and new awareness technologies will be needed to handle challenges posed by WFH settings

WFH settings provide flexibility but present new challenges. Managers will develop new strategies to manage emerging diversity and to increase motivation using integrative team management approaches. New awareness technologies will be developed to increase visibility and sociability of coworkers in remote settings, providing personalized and relevant information for supporting remote WFH teams.

Important challenges will be:

- New types of diversity will become relevant: deeper-level diversity is emerging in WFH settings and will become consequential for teamwork (Breideband et al. 2022). These types include differing home life responsibilities which affect communication, coordination and performance. Different personal work rhythms in WFH settings will require additional coordination to maintain team performance.
- Work motivation will change. In WFH settings, there is less opportunity to draw on social interaction to motivate work, through maintaining a positive work image to others and informal discussions of work (Borghouts et al. 2022). Personalized approaches will be used to motivate workers (see figure).



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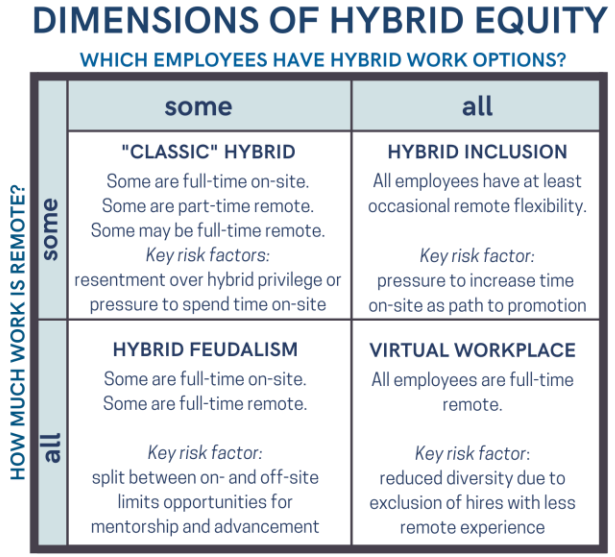
Alexandra Samuel (alexandrasamuel.com)

Hybrid equity will be the key to a thriving organization

At least 50% of employees in industrialized countries are in jobs that can only be done on site. Bridging the divide between on-site and hybrid employees is key to organizational cohesion, culture and collaboration. Employers need strategies and tactics that foster hybrid equity.

- Hybrid work opportunities are not distributed evenly: in the US, employees who are white, male, older and higher educated are more likely to be in "teleworkable" jobs (Gezici & Ozay 2020)
- In the majority of high-employment US industries, at least 1 in 5 jobs can be done remotely (Dingel & Neiman 2020) - which means most employers face a potential hybrid equity challenge.
- The divide between remote-friendly and on-site work compounds obstacles to advancement in a labor market that is already polarized between high- and low-skill workers (Chuang & Graham 2018).
- For on-site workers, working with remote/hybrid colleagues can negatively affect work experience and retention (Golden 2007).
- Employers can prevent or address these resentments with strategies and tactics like transparency and flexibility on work arrangements, and more sick time for on-site workers (Kelly & Shoemaker 2021).



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Jane Shakespeare-Finch (Queensland University of Technology)

Employers will be pressured to provide comprehensive mental health care

Employers will be increasingly held accountable if they fail to provide proactive and reactive mental health care to their employees.

- Mental ill-health in the workplace has costs beyond productivity. Psychological problems impact not only individuals, but also their families, organizations and communities. Psychological issues are also linked to physical problems such as cardiovascular and respiratory diseases, drug and alcohol abuse disorders, and diabetes (Goetzel et al. 2018).
- Providing psychological education and support is not only a contributor to positive workplace environment and economic productivity, and an ethical duty, but also a legal requirement in many jurisdictions (Freckelton & Poppa 2018), especially in workplaces where there is a foreseeable risk of psychiatric injury.
- Employers need to do more than react when it has already become evident that an employee is psychologically unwell. Proactive mental health education and interventions can prevent problems before they arise, building an environment of resilience, connection and care (Foster et al. 2018; Shakespeare-Finch & Daley 2017), and improving organizational culture overall.

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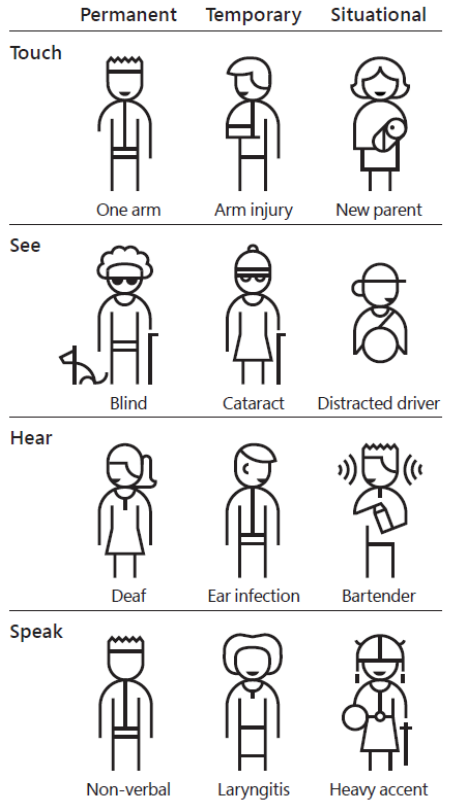
Willem Standaert (University of Liège)

There will be adaptable virtual meeting technology for diverse disabilities

By designing virtual meetings for inclusion of people with (permanent) disabilities, many others can benefit as they are faced with situational sensory constraints

- Because of ubiquitous connectivity, participants can join meetings from anywhere. However, adaptable capabilities are key for effective participation when facing temporal or situational disabilities (see picture).
- Indeed, virtual meeting technology design choices have a significant impact on the experience and representation of people with (permanent) disabilities (Tang 2021).
- Through IoT sensors and artificial intelligence technologies, meeting technology will be able to automatically detect such situations and adapt the offered communication capabilities in response.
- For instance, while driving in a car, the shared screen is disabled from the car entertainment system, to avoid dangerous distraction. But when the car is parked, this is automatically switched on. Likewise, noise coming from big trucks or from kids in the backseat of the car will not be transmitted to other participants.
- Other useful dynamic capabilities include switching from speech to text when in a noisy environment or zooming in on particular areas of a shared screen when on a phone.
- Moreover, additional information will need to be displayed to generate mutual situational awareness (e.g., add icon for people unable to watch the screen, similar to the muted icon) (Gergle et al. 2013).



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Gergle, D., et al. (2013). Using Visual Information for Grounding and Awareness in Collaborative Tasks. *Human-Computer Interaction*, 28(1), 1-39.
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Microsoft Study: Tang, J. (2021). Understanding the Telework Experience of People with Disabilities. *Proc. ACM Hum.-Comput. Interact. 5, CSCW1*, Article 30, 27 pages.

Appendix

Glossary

API: Application Programming Interface – a programming interface that allows two computers or pieces of software to communicate.

Asynchronous/Async communication: Communication between members of a team that does not happen " in real time."

Augmented Reality (AR): Technology that supplements reality, by integrating 3-D objects into the user's real environment (Azuma 1997).

Avatar: An icon or image meant to represent a particular person within a computer-mediated environment.

Chat: In this report, this refers to messaging via Microsoft Teams or similar applications where people type text-based messages to each other. "Parallel chat" refers to the chat stream that appears during meetings.

Cognitive Science: The study of thought, learning, and mental organization.

Collegiality: Companionship and cooperation between colleagues.

Deepfakes: AI-generated, realistic-appearing representations of people, created using image, video, and/or voice samples (Westerland 2019).

Design fiction: Explorations of speculative scenarios that are expressed in design artifacts such as images and objects.

Gig work: Contract work that is short-term, without benefits, and often mediated through a platform, like Uber or Upwork (Bajwa et al. 2018).

Hybrid Work: Refers to a mix of co-located (in office or facility) and non-co-located work or workers, see What is hybrid?

Inclusion: Fostering a welcoming, empowering environment for all employees. (Microsoft 2021).

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Glossary

IoT: Internet of Things – refers to a web of everyday objects, connected by the Internet.

Onboarding: The process of integrating new hires into the organization.

Productivity: A measure of output divided by units of input (such as hours worked, number of workers or cost of labor). Output is hard to measure in the case of intangible work products. Certain types of inputs (e.g., hours worked) may also be difficult to measure

Prosody: Patterns of voice stress and intonation.

Remote Work: Work that does not require an employee to commute to an office or workplace.

Social Capital: A resource created by the makeup and qualities of a social network, which can be utilized by both individual actors, like employees, as well as collective ones, like a company (Adler & Kwon 2009).

Socio-tecture: A heavy reliance on social networks in which the relational is prioritized over the transactional, and people are viewed as the primary source of knowledge (Awori et al. 2022).

Ties (Strong and Weak): A connection between two actors in a social network, the strength of which is determined by the amount of time, intimacy, emotional intensity, and reciprocity of the relationship (Granovetter 1973).

Transitional Interfaces: Interfaces that enable seamless integration of systems along the reality to virtual reality continuum, depending on users' tasks and needs (Jetter et al. 2021).

Virtual Reality (VR): Technology that completely immerses the user in a virtual environment (Azuma 1997).

Workload: The work that an individual employee is responsible for at any given time.

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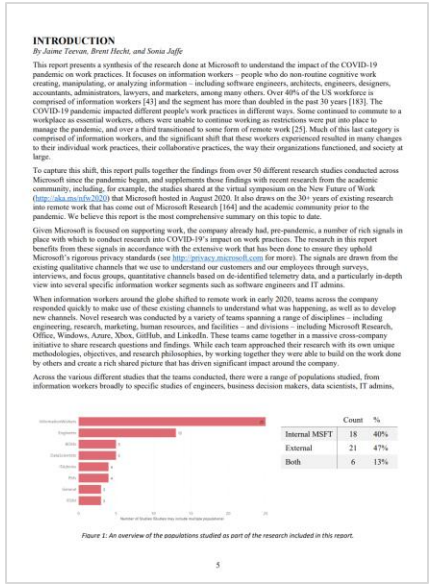
Limitations

This report draws on numerous different studies using diverse methodologies to identify phenomena across a wide range of employees and organizations. However, the report does have its limitations: We draw primarily on English language research, often focused on the United States. We also focus mostly on information workers. The future of work undoubtedly includes a wider range of workers than those addressed in depth here, including frontline workers, freelancers, contractors, gig workers, creative workers, agricultural workers, and more. We hope that this report provides useful insights or counterpoints to those seeking to understand these and other dimensions of the future of work.

Ultimately, the future of work is yet to be determined. Technologies, practices, and norms are rapidly evolving. We hope this report helps nurture a better future of work, one in which all kinds of workers in all places can thrive.

This is the second annual New Future of Work Report

This report builds on the first annual New Future of Work report, which summarized research from the peak of the pandemic-driven work-from-home period and remains a valuable resource for us here at Microsoft. This year, inspired by the State of AI Report (https://stateof.ai), we decided to use a slide deck format. Our hope is that this will make it easy to skim through the significant body of new research and focus on what interests you most, as well as support the sharing of self-contained, bite-sized findings.



INTRODUCTION

By Jaime Teevan, Brent Hecht, and Sonia Jaffe

This report presents a synthesis of the research done at Microsoft to understand the impact of the COVID-19 pandemic on work practices. It focuses on information workers – people who do non-routine cognitive work creating, manipulating, or analyzing information – including software engineers, architects, engineers, designers, accountants, administrators, lawyers, and marketers, among many others. Over 40% of the US workforce is comprised of information workers [43] and the segment has more than doubled in the past 30 years [183]. The COVID-19 pandemic impacted different people's work practices in different ways. Some continued to commute to a workplace as essential workers, others were unable to continue working as restrictions were put into place to manage the pandemic, and over a third transitioned to some form of remote work [25]. Much of this last category is comprised of information workers, and the significant shift that these workers experienced resulted in many changes to their individual work practices, their collaborative practices, the way their organizations functioned, and society at large.

To capture this shift, this report pulls together the findings from over 50 different research studies conducted across Microsoft since the pandemic began, and supplements those findings with recent research from the academic community, including, for example, the studies shared at the virtual symposium on the New Future of Work (http://aka.ms/nfw2020) that Microsoft hosted in August 2020. It also draws on the 30+ years of existing research into remote work that has come out of Microsoft Research [164] and the academic community prior to the pandemic. We believe this report is the most comprehensive summary on this topic to date.

Given Microsoft is focused on supporting work, the company already had, pre-pandemic, a number of rich signals in place with which to conduct research into COVID-19's impact on work practices. The research in this report benefits from these signals in accordance with the extensive work that has been done to ensure they uphold Microsoft's rigorous privacy standards (see http://privacy.microsoft.com for more). The signals are drawn from the existing qualitative channels that we use to understand our customers and our employees through surveys, interviews, and focus groups, quantitative channels based on de-identified telemetry data, and a particularly in-depth view into several specific information worker segments such as software engineers and IT admins.

When information workers around the globe shifted to remote work in early 2020, teams across the company responded quickly to make use of these existing channels to understand what was happening, as well as to develop new channels. Novel research was conducted by a variety of teams spanning a range of disciplines – including engineering, research, marketing, human resources, and facilities – and divisions – including Microsoft Research, Office, Windows, Azure, Xbox, GitHub, and LinkedIn. These teams came together in a massive cross-company initiative to share research questions and findings. While each team approached their research with its own unique methodologies, objectives, and research philosophies, by working together they were able to build on the work done by others and create a rich shared picture that has driven significant impact around the company.

Across the various different studies that the teams conducted, there were a range of populations studied, from information workers broadly to specific studies of engineers, business decision makers, data scientists, IT admins,

	Count	%
Internal MSFT	18	40%
External	21	47%
Both	6	13%

Figure 1: An overview of the populations studied as part of the research included in this report.

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https://aka.ms/nfw2021

https://aka.ms/nfw2022

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- This report was a company-wide effort. In addition to our authors and contributors already listed, we are grateful for the help and support we received from the broader Microsoft team. This was truly a One Microsoft effort!