# Challenging but Connective: Large-Scale Characteristics of Cross Time Zone Meetings

***Keywords: Collaboration, remote work, time zones, connectivity, organizational science***

Organizations are becoming increasingly distributed and many need to collaborate synchronously over great geographical distances in a post-pandemic era of remote work. Despite a rich body of literature on spatially-distanced meetings, gaps remain in our understanding of temporally-distanced, cross time zone ("XTZ") meetings [1]. We therefore ask three research questions: *how prevalent and challenging* are XTZ meetings in worker calendars, *how equally distributed* are these difficulties, and *what are the connective benefits* offsetting these challenges? In this study, we characterize cross time zone collaborations by analyzing 20 million meetings scheduled at Microsoft, a multinational corporation, supported by a survey on how 119 employees perceive their scheduling needs.

**Method.** We study an *in situ* telemetric trace of 20 million meetings at the company from January 2022 to July 2022 between 300k individuals. We processed all events scheduled into employees' work calendars in Outlook, which include information about when the event was scheduled, its duration, the individuals who attended, and who organized the event. Events are restricted to those recorded as meetings (as opposed to appointments or "out of office" blocks), show as busy (as opposed to tentative), and were never cancelled. Additional metadata include attendee cities, countries, and time zone, as well as their position in the organization chart.

To supplement this trace, we deployed a 3-section survey to elicit worker perceptions of XTZ collaboration ($n = 119$). First, it solicits participants' information like job function, timezone, number of supervisees, and department, as well as participatory consent. Second, it asks employees for their self-reported typical working hours, preferred working hours, preferred hours for meetings, and an open-ended question about why they hold these preferences. Third, the survey asks employees whether they have participated in XTZ collaboration over the last two months, and how often they meet at the edge of the day, block off hours specifically for XTZ collaboration, alternate between morning and night meetings, and assign individuals to coordinate XTZ collaborations. It closes with open-ended questions about these strategies for facilitating XTZ work and the costs and benefits of XTZ meetings. All open-ended questions are analyzed using an iterative, open coding method with subsequent axial coding. To protect employee privacy, we do not link survey participants to their trace data.

**Results.** We find that one third (33%) of meetings span multiple time zones, which also have on average 36% more attendees than regular meetings. From an individual workers' perspective, one can therefore expect 47% of the events in their calendars to be XTZ. Furthermore, these XTZ meetings are much harder to hold than regular meetings. In their survey responses, workers stated clear preferences for holding meetings within the traditional 8am-6pm workday. Although they recalled working almost every hour, with 13.5% of typical hours outside of 8am-6pm, only 3.5% of these odds hours at the edge of the day were labelled as preferable for meetings. We find that meetings are empirically much more likely to be scheduled at the edge of the day as the number of attendee time zones increase, as shown in Figure 1(a). Indeed, XTZ meetings are 2.6 times more likely to be at odd hours than single time zone meetings with the same number of attendees. This is reinforced by responses to the second survey section, in which $n = 21$ (18%) participants explicitly stated that XTZ meetings are tied to odd-hour work

obligations even before they were prompted about time zones. Conversely, when eventually asked about time zones, only $n = 5$ (4%) of respondents said they never meet at odd hours.

These findings reveal the empirical challenges of XTZ meetings in a global business. Are these difficulties equitably distributed across the organization? Our analyses indicate that XTZ meeting loads are potentially inequitably distributed between employees in different geolocations. We characterize this using a bivariate Gini index given by $G = 1 - \sum_{i=0}^{n-1}(Y_{i+1} + Y_i)(X_{i+1} - X_i)$, where $X$ and $Y$ are respectively a cumulative population measure and a cumulative health indicator over $n$ population divisions. This has been used over, e.g., the number of health practitioners ($Y$) per populace count ($X$) in a country's $n$ regions. Here, we quantify the frequency of cross time zone meetings ($Y$) among all meetings ($X$) for all $n$ employees in a country. This is shown in Figure 1(b) with the index computed over all countries as one large geolocation, and the index computed only for employees located in the headquarter region. Geolocations whose time zones are further away from North American time zones generally have elevated Gini indices. For example, countries like Japan and Germany have substantially higher Gini coefficients, whereas those in North America have Gini coefficients lower than the worldwide baseline are close to the headquarter baseline. These observations are echoed by 14% of survey participants who mentioned fairness as a scheduling concern, like the need to "*accommodate everyone and make collaboration fairer*" (P118).

Given these challenges and their potential inequity, should XTZ collaborations be moved to asynchronous means like emails? In support of theories about the benefits of synchronous communications [2], we find that XTZ meetings are likely to connect diverse and organizationally-distant workers. We create an attendee embedding using Word2Vec on each meeting as a "sentence" of shuffled attendee "words", such that workers are placed closer together in a 50-dimensional space if they share more similar meeting contexts. We represent meetings as a centroid of attendee vectors, and calculate attendee similarity as the mean cosine similarity between each attendee and the centroid. Meeting diversity is then measured as $1-$ attendee similarity and normalize between meetings $z$-scores, which is shown in Figure 1(c). We find that attendees in cross time zone meetings are substantially more diverse than single time zone meetings of the same size. For instance, the attendees in a typical 2-time zone, 4-person meeting have communication patterns that are 0.5 standard deviations more diverse than attendees in a 1 time zone, 20-person meeting ($p < 0.0001$). Survey responses again reflected these observations, with 26% of employees mentioning diversity as reason for holding XTZ meetings, such as how important it is "*to have the global perspective. Hearing these thoughts and insights from international folks is vital to the business*" (P9).

**Conclusion.** Although geographically-distanced work is salient for global organizations in the post-pandemic era, our work suggests that more attention needs to be paid to the tensions of challenging but necessary temporally-distanced collaboration. These results also suggest key opportunities for employees, policy makers, and system designers to better facilitate cross time zone meetings. In responding to questions about XTZ meeting strategies, over 50% of employees reported using no scheduling methods beyond meeting at the edge of the day. Furthermore, policy makers need to support workers who take on the skewed XTZ workloads found across the world to build equitable workplaces. Finally, existing schedulers are agnostic to temporal preferences, whereas the design of calendaring systems should be informed by empirical scheduling patterns, such as recommending hours that people find optimal for meetings.

[1] S. Morrison-Smith and J. Ruiz, "Challenges and barriers in virtual teams: A literature review," *SN Applied Sciences*, vol. 2, no. 6, pp. 1–33, 2020.

[2] A. R. Dennis, R. M. Fuller, and J. S. Valacich, "Media, tasks, and communication processes: A theory of media synchronicity," *MIS quarterly*, pp. 575–600, 2008.

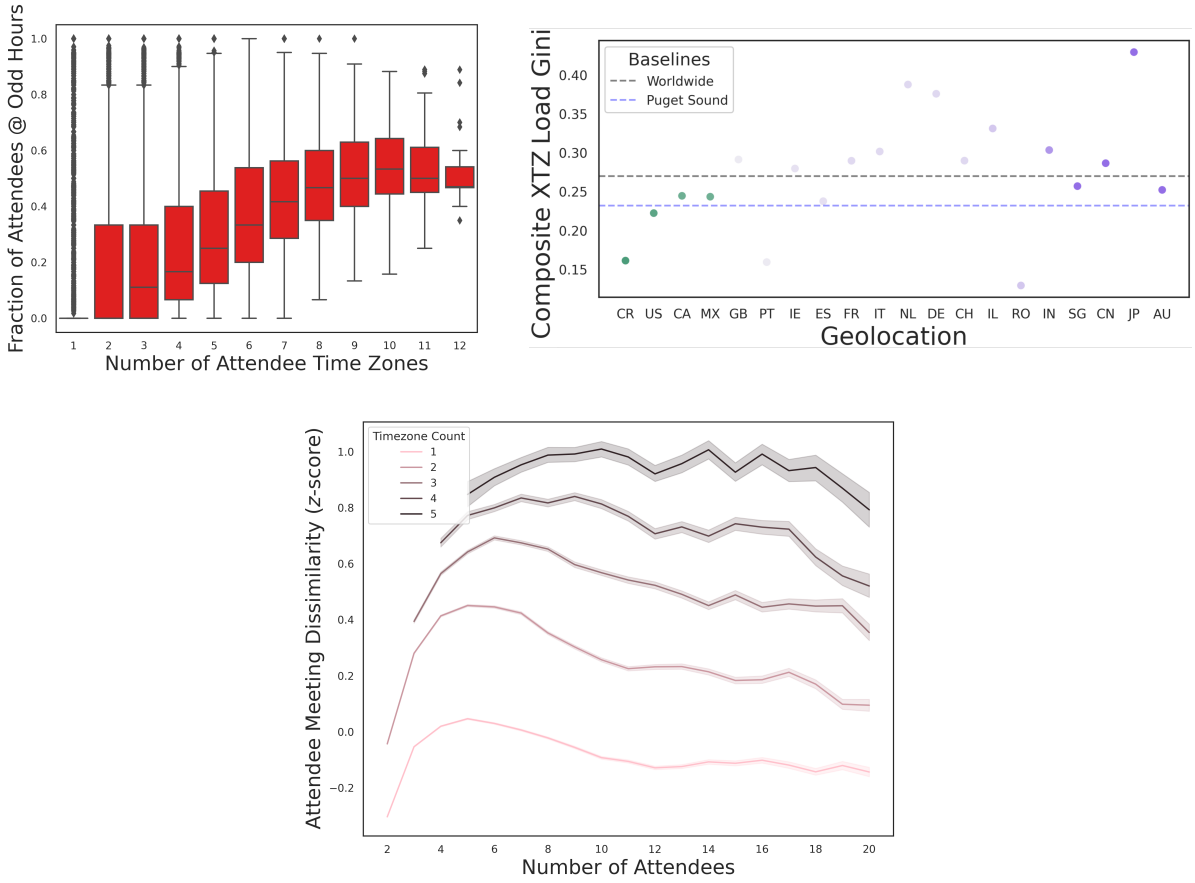


Figure 1: *Left (**a**)*: Fraction of attendees needing to meet at odd hours in meetings with multiple time zones. *Right (**b**)*: Composite Gini index of XTZ meeting distribution in the top 20 geolocations by meetings held. *Bottom (**c**)*: Employee diversity in meetings, divided by number of attendees and time zones.