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Developer Productivity for Humans, Part 2: Hybrid Productivity

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From the Editors

The COVID-19 pandemic created conditions for us to learn a lot about productivity, but was far from a controlled experiment. We leveraged our existing data/sources to understand it and added new sources and projects. We learned some things, but they're more guidelines than anything.—*Ciera Jaspan and Collin Green*

IN THIS INSTALLMENT of our column, we discuss the COVID-19 pandemic with a focus on the future of hybrid work. Before discussing that topic, we'd like to address employee privacy.

Privacy Principles

In a recent article in which we described how we use cross-tool logs to track and measure engineers' behavior and productivity, we described a number of principles that we follow to protect employees' privacy.[1] We encourage anyone who seeks to measure productivity to consider those principles. In studying remote work during the pandemic, we were challenged more than ever to understand how the world in which work exists and individual engineers' life circumstances might be shaping the data we collect, analyze, and use to draw conclusions. In our own research discussions and in communicating our findings to stakeholders, we had to thoughtfully consider confounding factors (age, parental status, and health information) that might shed light on our results but that we could not measure or analyze because of ethical, privacy, and legal constraints. This limitation on the scope of our work means that we cannot help specific teams or leaders know what is working or not for their own engineers. It also means that we sought to identify best practices that are generally helpful across individuals, regardless of personal circumstances. We mention all this so that readers may anticipate these challenges if they seek to do similar work and to reassure readers that the work we describe here was—to the best of our ability—done with sensitivity and ethical consideration for the humans we study.

Learning From the Pandemic

The last several years were a particularly interesting time to study developer productivity. While researchers in both industry and academia

sought to understand the productivity impact of remote work, the COVID-19 pandemic and accompanying shift to remote work were far from a normal "work-from-home" ("WFH") experiment. Instead, it was "work from pandemic," and much of what we learned about work during this time was not applicable to a standard (nonpandemic) WFH environment.[2] Indeed, our own research

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(and our review of external research and media) suggests a few key takeaways about how the pandemic affected Google engineers:

- Productivity was negatively impacted by working from a pandemic, but not as much as we might have anticipated. The direction and magnitude of productivity changes were quite variable across individuals. Before the pandemic, engineers at Google were less likely to WFH than other Google employees and more likely to work in a colocated group than others. The abrupt shift to fully remote work saw engineering productivity decline even as work days got longer, especially for junior engineers who struggled to get unblocked on a technical problem, to find colleagues with specific expertise, and

to effectively prioritize and manage their work. As engineers and teams gained experience with remote work, productivity began to recover, though work days remained lengthened.

- Communication, collaboration, and connection were difficult for engineers during the pandemic. The shift to fully remote work was significant for most engineers at Google, as, on average, they worked from home infrequently and tended to work in colocated groups. Without in-person signals of being busy (e.g., IDE open or headphones on), many struggled to understand when colleagues were available for questions or collaboration, and many of the informal, just-in-time interactions that happened to keep work moving and people unblocked became formalized, pre-planned meetings. While we heard from engineers that they and their teams worked over time to address some of these challenges, pain points in this space proved to be some of the most enduring to spring from the pandemic.

- Well-being was a significant challenge during the pandemic, due to both work circumstances and global circumstances. Internal research revealed that Googlers are interested in maintaining or restoring their well-being as they think about future work arrangements. Three themes emerged from engineers' responses to survey questions about their desires for post-COVID work arrangements: engineers want in-person work and connection; balance between work and personal obligations; and flexibility and choice, especially in location and schedule. When asked about changes their team made during WFH, engineers talked about intentional structure around communication and documentation, the promotion of flexibility to enable self-care, and balancing focus time with collaboration and questions.

Now—in the midst of transitioning into a post-COVID world—Google and many other companies are moving into a hybrid-first posture: anticipating that most software developers (and perhaps knowledge workers more broadly) will be hybrid workers, with smaller numbers working entirely from home or entirely from company offices. We're reviewing the lessons that we learned about remote work and thinking about how they will apply going forward in a new era of hybrid work. Here, we review the recommendations we've made to leaders, teams, and individual engineers about how to facilitate productivity for the hybrid workforce. First, however, we talk a bit about the basis for our insights: how we measure productivity at Google and how that evolved during the pandemic.

Measuring the Productivity Impacts of Remote and Hybrid Work

The best time to start measuring productivity is 20 years ago, the next best time is now.
—Not a real quote

The COVID-19 pandemic presented an opportunity to learn a lot about remote and hybrid work. It also provided an opportunity to reflect on how we track and measure productivity. When the pandemic started and there was an abrupt shift to WFH, people across many industries became concerned about productivity and started thinking about how to measure the impacts. Unfortunately, almost all of them faced two substantial challenges: First, measuring productivity is hard, so starting to do so in the midst of crisis and urgency is stressful. Second, assuming one can make some headway on measurement during a crisis, it remains the case that interpreting productivity measures is much harder when there isn't a good baseline for comparison.

We were fortunate to have some established foundations for measuring productivity. As part of our regular productivity research, we run a quarterly survey, we collect logs from all of our developer tools, and we run diary studies and interviews with developers. We use all three of these data sources (survey, logs, and diary studies) to triangulate on productivity: we can confirm whether the log data matches up to the diary study; we can see whether any log data correlate with survey items; and, if we see a survey item or log metric that we need more context on, the diary studies provide context on developers' behaviors and beliefs. We're also able to draw upon human resources data to analyze (or, more often, control for) factors such as job role, tenure, seniority (tech level), team/organization (org), and number of direct reports. This gives us a more complete and comprehensive picture of developer productivity: even if all our of metrics are just proxies for productivity, we can feel more confident in what they're telling us if everything is pointing in the same direction.

This regular tracking and analysis provided us with some useful baselines so that we can compare the prepandemic, during-pandemic, and postpandemic time periods. Additionally, as our systems and processes were already set up, we were able to quickly augment these foundational data sources to explore the differences between home and office environments and prepare for the inevitable questions that we'd be facing about the future of work.

Engineering Satisfaction Survey

The Engineering Satisfaction Survey (EngSat) is a longitudinal survey program to understand the needs of Google engineers; to evaluate the effectiveness of tool, process, and org improvements; and to provide feedback to teams that serve Google engineers. We've run EngSat every quarter since the first quarter of 2018, collecting nearly a hundred thousand survey responses in that time. (We get around 5,000 responses each quarter, on average.) The survey asks respondents a wide variety of questions about their experience, tasks, tools, productivity, velocity, and satisfaction in their job.

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After the pandemic started, we augmented EngSat to collect new information about developers' experiences with remote work. In different quarters, we've asked engineers questions ranging from the experience of onboarding engineers remotely, to how the developer tools could be modified to better support remote work, to their preferences for different working locations. We were able to quickly modify the questions so that, each quarter, we were getting timely information to understand the current state and inform future directions for the company.

Logs and the In-Session Pipeline

Our team has invested heavily in building and curating a unified data pipeline that captures logs from developer activity as well as in creating and validating metrics about engineer work from the data. We collect detailed logs from many developer tools, including all popular

command line tools, our code review tool, the most popular IDE, our code browsing and documentation tools, and many others. In combination, these logs can give us a picture of a developer's day. This data stream enables us to create detailed metrics, such as the amount of time engineers spent actively coding a given change, including not just the time spent in the IDE but also the time spent looking up information, checking test results, responding to comments from

survey sent to more than 1,000 developers. This lets us distinguish between working from the office, WFH, and "not a work day," and it lets us analyze the differences in how engineers choose to utilize their time across office and home locations.

Diary Studies and Interviews

We regularly perform diary studies in which we ask engineers to tell us about a detailed view of their day. We ask about a wide variety of top-

Finally, because we had a substantial foundation of structured data (from surveys and logs) upon which to build, we were able to allocate resources to dedicated qualitative research and analysis. For example, we used data from EngSat and our log pipeline to select teams that got more productive during the pandemic, and we interviewed them about their teams' practices to better understand what made them resilient during the pandemic.

How You Can Improve Productivity in Hybrid Work

Individual Developers

In our diary studies, we found that, while working from home, many engineers enjoy the flexibility of being able to adjust their work hours around their personal schedules. Engineers report taking slightly more break time during their work day (and report taking more healthy-living breaks to meditate or exercise), but their overall workday is longer. These same benefits are also a drawback for some people: some people find it harder to separate work time and personal time, getting pulled too far one way or the other. We recommend that engineers utilize their calendar to explicitly mark out personal time to maintain a healthy balance.

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code reviewers, and other relevant activities. Jaspan et al.[1] describe this system in more detail.

Once we realized that the future of work was going to look very different from the prepandemic world, we augmented our data pipeline to include whether someone is working from home or from the office. Instead of using people's "official" locations, we use badging data to determine whether someone is in an office on a given day; this accounts for both remote workers who are visiting an office in person and hybrid workers who are taking a WFH day. However, this still does not distinguish between engineers who are working from home versus taking a day off (for vacation, local holidays, illness, or weekends). To distinguish between these, we set thresholds of activity in our log data that determine how many minutes of activity get counted as a work day; we validated these thresholds against a

ics, including what they're working on, who is interrupting them, what's blocking them, when they take breaks, when they are in "flow," and when they're experiencing friction. This provides us with a means to validate our log metrics, but it also provides us with a means to understand why engineers choose to work in a particular way and how our tools and processes affect them.

Our diary studies turned out to be of particular use. Six months into the pandemic, we reached out to engineers who had previously been part of our diary studies to repeat the process so that we could understand how their experience had changed under "work-from-pandemic" conditions. Now that many engineers are working hybrid, we have also asked engineers to participate in diary studies for two days (one at home and one at the office) so that we can get a better idea for how engineers schedule their time differently across these locations.

We also see that the nature of interruptions changes when working from home. There were fewer interruptions from colleagues but more interruptions from home. In both cases, office or home, we recommend that engineers block off focus time and organize their schedule based on where they will be best able to focus. For some, it might be that the office is better (fewer home distractions); for others, it might be

that home is better (a quieter space with fewer colleague interruptions).

The biggest recommendation we can make to individuals is that they thoughtfully allocate time for focused work and for collaboration based on whatever works best for them and that they respect the calendars of others, who may be in a very different situation or role.

Managers and Teams

Managers and team leaders have a large role to play in increasing productivity for remote and hybrid workers. In particular, our internal research has found that, while many engineers are more productive when working from home, new engineers and junior engineers are more likely to encounter difficulties.

During COVID, our internal research found that new engineers to the company were ramping up three to six weeks slower than those who ramped up before the pandemic. While finding mentors for new engineers is always important, it is even more important when teams are remote or hybrid. To ramp people up faster, managers should dedicate mentors who will actively pair-program with new engineers on a regular basis. If the new employee is located in an office, managers should also encourage increasing in-person time during this critical time period, not just for the new employee but also for any senior people who sit in the same office.

Junior engineers also struggled more during WFH compared with their more senior peers. Interestingly, junior engineers' challenges were not related to task execution but, rather, were related to knowing which task they should be working on. Our survey data indicate that the percentage of all engineers who were satisfied with their ability to manage their workload dropped by more than 10% during the pandemic. Junior engineers also reported being more reluctant to reach out to colleagues to get unblocked. Without the regular, casual check-ins that might occur within an office environment, junior engineers may be more likely to spend time on tasks that are lower priority or that could have been completed in a faster way.

We recommend that managers and senior team members regularly reach out to junior team members in a way that feels like a natural check-in without micromanaging. The goal here is to replicate the conversations that occur over coffee or lunch or en route to meetings so that senior engineers have an opportunity to "unstick" junior engineers who may be wasting their time. Google engineering managers also found that one-on-one meetings between engineers and their skip-level managers (their manager's manager) that emphasized project goals and bilateral communication about how decisions are made were helpful in instilling a sense of stability and an understanding of (and sense of investment in) project priorities.

Leadership

Company leadership has several key areas where they can play a role in developer productivity, especially for remote and hybrid teams. First, they can support individuals and managers in the goals we have set out. Second, they can adopt tools, processes, and cultural norms that will allow developers to work asynchronously and lower communication barriers. Finally, they can themselves increase their communication across multiple channels to keep orgs on a clear set of priorities.

Soon into the pandemic, we discovered that engineers who already worked across time zones were finding collaboration easier than before. WFH allows for flexible working hours and fewer commute hours, so remote teams are better able to schedule meetings that accommodate everyone's schedules. However, colocated teams were more negatively impacted and needed to adjust to a new style of working. We recommend that engineering leaders invest in communication tooling that will support remote collaboration better, particularly ones that lower the barrier of entry to chatting and make it easy to go from chat to a video conference, ideally also supported by a virtual whiteboard and remote pair programming tools.

Engineering leaders should also invest in tools that enable asynchronous work so that engineers are not blocked by team members in other time zones. At Google, this meant increasing investment in tooling that would allow engineers to continue on later commits of a project while earlier commits were being reviewed as well as investing in tooling that would ping an engineer when it was their turn to take action on a code review. Our development tools need to take a "remote first" approach and provide engineers with strategies to keep working while they are blocked on others while also helping them find out quickly whether they are blocking someone else.

Partway into the pandemic, we saw an unusual event happen. In our quarterly engineering survey, we ask the following question: "In the last three months, how much have changing or unclear product requirements hindered your team's productivity?" We had run this survey for two years, and the results for this question were fairly stable. However, several months into the pandemic, this improved for 6%

of developers! Moreover, it was not a single quarter blip; the improvement was sustained through the pandemic.

This was not entirely a surprise, as our leadership had made a large effort to have people concentrate on stability, especially given the unstable environment we were all working in. Therefore, we presumed that engineering directors had slowed requirements changes. However, when we interviewed engineering directors whose teams had shown substantial improvement, we found that this was not the case! Instead, those directors had not changed the rate of requirements changes, but they had put extra effort into communication because everyone was remote. These directors held extra one-on-ones with their skip reports, and they held more "town halls" with their org. This increased intentional communication about org strategy and product direction led to an increase in a sense of stability for the entire org, even if nothing had changed in the strategy from before. Due to this, we strongly recommend that leaders continue to overcommunicate about the org strategy using multiple methods, as there's nothing "over" about it.

The Future of Work

As we look forward, the future of work is not going to be the same as work prepandemic.[3] There are a few lessons we've learned so far that we shouldn't forget:

- Colocation isn't as important as togetherness and collaboration.
- Workload management and prioritization are particularly hard for new employees and junior engineers, and remote work makes these tasks even more difficult.
- Communication matters even when we are colocated; we

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should not assume that being physically present in the same building eliminates the need to thoughtfully and intentionally communicate with each other.

Of course, there's still a lot that we don't know about hybrid work. We've started to understand how hybrid work impacts individuals, but we don't yet know what "common patterns" of team structures may emerge. What are the best practices for teams that are fully colocated, globally remote, remote in the same time zone, or distributed in clusters across a small number of offices?

We also don't know how hybrid work will impact concepts like "innovation" and "creativity." One of the concerns during the pandemic was that remote work might stifle innovation due to fewer serendipitous meetings in an office environment . . . but is that even true? We don't yet know how to measure concepts like innovation and creativity, which means we

can't be sure of how, or even if, these are affected by different working environments. Our group at Google is working now on measuring collaboration quantitatively; getting a better handle on how to measure creativity and innovation in the development process; and building a better, more complete method for measuring productivity. There's a lot to discover as we explore hybrid work and a lot we can learn from each other as we move forward. 🔳

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