What Makes Work-from-Home Work?
Evidence on Telework and Worker Tasks

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The pandemic greatly and abruptly increased the use of telework. In order to maintain operations while offices were closed, employers largely chose to expand telework opportunities to employees to the maximum feasible extent. As offices reopened, telework decreased but not immediately to its previous levels. Variation in the continued use of telework has led researchers to study the characteristics of workers and firms that are associated with telework.[1] Beyond the worker and the firm, the characteristics of a job can be what ultimately makes telework impossible or ideal. Our goal here is to utilize rich data on worker tasks to better understand the use of telework.

Using a novel source of task data in the Occupational Requirements Survey (ORS) from the Bureau of Labor Statistics, we find patterns of tasks associated with telework. Across all workers, we find that performing physical tasks on a job is negatively associated with telework while tasks associated with mental processes are positively associated with telework. Tasks in the general category of interacting with others have more nuanced relationships. More complex interactive tasks are associated with telework while interactive tasks that depend on coworkers are negatively associated with telework.

These results are further explored focusing on two occupations: customer service representatives and software developers. While some patterns between tasks and telework appear to be universally true, others depend in part on the occupation under consideration. Even occupations with high levels of telework only have telework available in around two thirds of jobs. The variation within occupations suggests that employers are arranging work weighing the costs and benefits of telework.

The key innovation in this research is developing the task data in a survey with a representative sample of jobs. Most data available on jobs classifies workers by their occupation using the Standard Occupational Classification (SOC) system. An occupation is defined by a common set of work performed by a group of jobs. These classifications are chosen to provide a framework for the collection and dissemination of data across a variety of data sources. They are not necessarily designed to capture whether a job is suitable for telework.

Beyond occupation, more detail on the work requirements of a job is available in the tasks performed. We define a task as a distinct activity assigned to or performed by workers that result in a specific outcome. Tasks have two important characteristics. Within an occupation, jobs generally perform similar sets of tasks although there is variation across jobs in the exact set of tasks. Across occupations, the same task may be performed by jobs

[1] Barrero, Bloom, and Davis (2023), Brynjolfsson et al (2023), Makridis and Schoeltzer (2024), and Pabilonia and Vernon (2024)

in different occupations. Task data is less widely available, but researchers have used Occupational Information Network (O*NET), on-line job ads and other sources.

Here we take advantage of the ORS data which contains task details for a large, representative sample of workers. The task data is collected as semi-structured text and is not suitable for research in this form. A contribution of this paper is the classification of task data into standardized categories of work activities. This is achieved by using a sentence-transformers language model to match tasks between ORS and O*NET based on their semantic similarity. The O*NET content model is then leveraged to map matched ORS tasks to one or more 37 general work activities.

This paper is related to the economics literature focused on job tasks, and in particular, the grouping of tasks into categories suitable for the research question at hand. Early papers in the literature sought to understand the impact of technology on wages and employment. Examples of this work include Autor, Levy and Murnane (2003), Spitz-Oener (2006) and Acemoglu and Autor (2011). Throughout this research, tasks were often broadly categorized into a handful of categories including routine or non-routine, and then some combination of abstract, analytic, cognitive, manual or interpersonal. These groupings reflected the focus on automation which at the time was best able to substitute for routine tasks.

Later iterations of research have subsequently focused on more detailed classification of tasks as researchers focused on newer types of technology. Examples include Frey and Osborne (2017), Arntz, Gregory, and Zierahn (2016), Bryjolfsson, Mitchell, and Rock (2018), Felten, Raj, and Seamans (2019), and Eloundou, Manning, Miskin, and Rock (2023). In this research, the focus is on tasks at a level of granularity consistent with what the newer types of technology would be able to potentially replace. The outcome of this research then ranks occupations by how likely the occupation is expected to be impacted.

This research is also closely related to recent research on telework. Early in the pandemic, researchers focused on the tasks workers do in order to categorize an occupation as feasibly being done from home. Dingel and Neiman (2020) use occupational level work context and work activity data from O*NET to assess the feasibility that a job can be performed entirely at home. They find that 37 percent of jobs meet their criteria.

Further research has looked more closely at jobs to determine the impact of work from home (WFH) on productivity, promotions, and training.[2] Researchers in this literature have

[2] Research in this area includes Bloom et al (2015), Yang et al (2022), Emanuel, Harrington, and Pallais (2023), Gibbs, Mengel, and Siemroth (2023), Emanuel and Harrington (2024), and Chouhury, Khanna, Makridis, and Schirmann (2022)

focused on detailed information for a particular group of workers at a particular firm, some variation on whether workers worked from home often due to a shock such as the pandemic, and in addition, measures of workers productivity in terms of calls answered, code produced, and so on. With this carefully measured data, researchers found mixed impact of WFH on productivity. Negative impacts were found on training, promotions, and internal communications. However, this research is specific to the firms and occupations studied, and it is not clear if all the results are generalizable.

Using the task data from ORS builds on the task research, explores suitable groupings for tasks, expands on research focused on telework at individual firms, and tests for generalizabilty. The rest of the paper is organized as follows. Section I describes the telework and task data from the ORS. Section II describes the methodology to classify ORS tasks into work activity categories and validates the results. Section III includes results on the relationship between telework and tasks looking at all workers. Section IV presents results looking more in depth at two occupations. Section V concludes.

I Data

Our source of telework and task data is the Occupational Requirements Survey which is an establishment survey focused on collecting data for the Social Security Administration (SSA) to make decisions for their disability programs. The data contains over 70 elements dictated by SSA's needs. These elements fall into four categories: Education, training, and experience; Environmental conditions; Physical demands; and Cognitive and mental requirements including the availability of telework.

The data are collected over multiple years to balance SSA's needs for up-to-date information on jobs performed in the national economy while maintaining reasonable costs for data collection. We use the second wave data, which was collected over a five-year period between 2018 and 2022.

The goal is to collect the on-going requirements of jobs under the assumption that job requirements generally change slowly over time. The pandemic in 2020 was a test of this assumption. Research by Gittleman (2022) suggests a limited impact of the pandemic on job requirements broadly. A question added to the survey shortly after the beginning of the pandemic directly asked respondents if any of the requirements of their jobs had changed. Only a very small number (1 percent) reported permanent changes, which would be captured in the task and job requirements data. A larger fraction, 22 percent, noted temporary changes (which would not be captured in the job requirements) while 77 percent reported no changes.

Additionally, Gittleman (2022) further analyzed job requirements which might be expected to change by looking at 2-digit SOC estimates in the pre-pandemic and post-pandemic period. For telework, there were four 2-digit SOCs where telework increased, zero where it decreased, and 17 where there was no statistically significant difference. We attempt to control for the increased use of telework over this time period by assuming that these changes can be captured as a shift in the overall level of telework and include year dummies in our analysis. Regardless, our focus is on the relationship between telework and job tasks and not on estimating levels of telework.

Telework is defined in the ORS data by the question "Are workers in this job permitted to work from home or telework?" Workers must be able to regularly perform their critical job function off premises during the regular workday even if some critical tasks must be performed at the employer's site.[3] The rate of telework across all workers is 11.4 percent. Out of the 438 detailed occupations for which the telework estimate is available, 229 have fewer than 0.5 percent of workers with telework available. At the opposite end of the spectrum, Table 1 lists the ten detailed occupations with the highest percentage of workers with telework available. These occupations include many computer-related occupations as well as research analysts, lawyers, and fundraisers.

How do these estimates of telework compare to other sources? We first compare with estimates from Hansen et al (2023) that rely on job vacancy postings classified as to whether the job allows work from home based on a language processing model. While their data are based on job vacancies which are a flow of new jobs rather than a stock of jobs as found in ORS, the telework construct from the posting entails a statement of intent that extends into the future which closely matches the construct in the ORS data. In Figure 1, we see that 2-digit SOCs with high rates of telework have similarly high rates in both data sources, although ORS has higher rates of telework overall.

Conversely, when compared to most survey sources of telework rates, ORS has a lower overall level. This can be due to several factors. Estimates which capture the current extent of work from home during this time period will include workers whose employers expanded the use of telework temporarily.[4] Other estimates ask workers about their perception of their employer's future plans regarding telework which are more similar to the ORS

[3] ORS defines critical job function as "the main purpose and the primary pay factor for the job," and critical tasks as "activities workers must perform to carry out their critical job function(s)."

[4] The Survey of Working Arrangements and Attitudes (SWAA) from Barrero, Bloom, and Davis (2021) estimate that just over 30 percent of full paid working days are done from home in July of 2022 (the final date of collection for the ORS data). The Current Population Survey estimates that 17.9 percent of workers teleworked in September 2022 (the first month the data series is available).

construct but focused on the employee's viewpoint.[5] Additional factors which might lead to differences include the timing of the survey, whether the self-employed are included, whether the extensive or intensive margin of telework is being captured, the exact wording of the survey question, and the collection mode.[6]

The main advantage of using the ORS data is that in addition to the telework information, there is also detailed task data available for the same job. Task data is collected for every job in ORS. Interviewers begin their conversation with the employer by first selecting a set of jobs to collect detailed data and then by asking "What is the main purpose of this job?" "What are the tasks that workers are required to do as part of their work?"

The task data are captured as semi-structured text. Interviewers are provided with guidance to capture the how, where, what, who interacted with, and structure the task statements starting with a verb, identifying the object of the action and its purpose. This data contains rich information on jobs and provides potential for additional research and other data products but is not useful in its collected state.

II Task classification and validation

Data are often classified into various categories for the purpose of producing statistics or conducting analysis, such as using the Standard Occupational Classification (SOC) system to categorize jobs into occupations and the North American Industry Classification System (NAICS) to categorize establishments into industries. A contribution of this paper is the classification of ORS task data into standardized work activity categories.

We achieve this by using a sentence-transformers language model to match ORS tasks with O*NET tasks based on their semantic similarity. Once tasks are matched, we leverage the O*NET Content Model to map matched ORS tasks to one or more work activity categories. This approach does not use any of O*NET's collected data but rather uses the O*NET Content Model, which includes tasks and their mapping to work activity categories, to ultimately classify ORS task data into 37 generalized work activities (GWA).

The O*NET Content Model consists of six major domains of occupational information. O*NET tasks, which are defined as "specific work activities that can be unique for each occupation," are listed under the "Occupation-Specific Information" domain. They are predetermined lists of tasks for each occupation and are mapped to one or more work activities listed under the "Occupational Requirements" domain. O*NET defines work

[5] The SWAA also asks respondents how often their employer is planning for them to work full days from home. The July 2021 estimates are 1.25 days. Barrero, Bloom, and Davis (2021)
[6] Brynjolfsson et al (2023) detail several measurement issues which lead to different estimates.

activities as "the kinds of tasks that may be performed across multiple occupations." As shown in Appendix 1, work activities are structured hierarchically starting from detailed work activities (DWA) to generalized work activities (GWA), and the generalized work activities are further aggregated into higher levels, which we informally refer to as minor and major GWA groups. For the purpose of this paper, we focus on the 37 generalized work activities and their higher aggregations.[7]

To match the tasks between ORS and O*NET, a sentence-transformers model called *all-MiniLM-L6-v2* is employed to measure semantic similarity between two texts.[8] This is a language model—given an input text, it outputs a 384-dimension vector that captures the semantic information, or the meaning, of the text. The distance between two vectors is calculated using cosine similarity, with two vectors being considered more similar as the score approaches one.

Recognizing that similar tasks are performed across similar occupations, ORS task data are matched to O*NET tasks using not just the task statements but also using the SOC titles. This enables the model to prioritize similar tasks from similar occupations. Furthermore, the *all-MiniLM-L6-v2* model is fine-tuned using 812 manually matched SOC-task combinations between ORS and O*NET, helping the model to recognize idiosyncratic differences between the two data sources.

Ultimately, 555,081 unique SOC-task combinations in ORS are matched against 18,396 in O*NET. We find 93 percent of O*NET tasks are matched with at least one task in ORS, indicating that ORS tasks are not being matched to just a few O*NET tasks. Furthermore, 40 percent of tasks matched between ORS and O*NET are in the same SOC, supporting our understanding that while the jobs in the same occupation perform similar tasks, similar tasks are also performed across occupations.

To test the match quality, we manually reviewed a sample of 230 matches by checking whether the O*NET task matched with an ORS task is agreeable. Based on this review, we estimate the overall match quality to be 83.8 percent. That is, 83.8 percent of ORS tasks are estimated to be matched to similar O*NET tasks. Going further, we can observe from Table 2A that cosine similarity score is positively associated with the likelihood of a task match being agreeable. Therefore, by setting our cosine similarity score threshold at > 0.5, Table 2B shows that we can avoid using 4.3 percent of ORS tasks that are more likely to be matched to incorrect O*NET tasks and marginally improve the estimated overall match quality to 84.7 percent.

[7] See Appendix 2 for a full list of generalized work activities and their descriptions.
[8] Reimers and Gurevych (2019)

ORS tasks, each now matched to an O*NET task, are classified into one or more generalized work activities and aggregated to occupation-level estimates for validation against the information available from O*NET. We use two GWA measures from O*NET: relevance and importance ratings. The relevance rating captures the percentage of job incumbents who rated the provided tasks as relevant to his or her job, and the importance rating indicates the degree of importance a task is to the occupation, ranging from "Not Important" (1) to "Extremely Important" (5).[9] Table 3 is a correlation matrix between ORS and O*NET GWA. Between O*NET's relevance and importance ratings, the Pearson correlation coefficient is 0.976. ORS GWA estimates have correlation coefficients of 0.694 and 0.700 with O*NET importance and relevance ratings, respectively.[10] Figure 2 is a binned scatter plot, visualizing the relationship ORS GWA estimates and O*NET ratings.

When examining the alignment of ORS GWA to O*NET GWA, it is important to consider some distinctions between the two data sources. Specifically, regarding the data collection method, ORS is an establishment survey that captures task information through an open-ended question while O*NET surveys incumbents and occupational experts and analysts by providing them with a predetermined list of tasks for each occupation. The open-ended nature of how ORS captures task data may result in a non-exhaustive list of tasks, which could be a limitation of ORS task data. However, in converse, the open-ended nature allows ORS to better capture the variation of tasks across jobs including novel tasks that a predetermined list of tasks would not be able to capture.

In addition to the difference in how task data are collected, ORS and O*NET also differ in terms of the measurement calculated at the occupational level. ORS provides an estimate of the percentage of workers who perform a specific work activity for an occupation while O*NET returns the max relevance and importance ratings of the work activity for an occupation. Despite these qualitative differences between the two data sources, a strong relationship between ORS GWA and O*NET GWA can still be observed.

III Results

Our analysis of the relationship between telework on the task content of jobs takes advantage of this classification of task data. The matching of ORS tasks to O*NET tasks allows us to categorize ORS tasks by the different levels of generalized work activities from the O*NET Content Model. For each job collected in ORS, we have information on each of

[9] For comparison, task-level importance and relevance ratings are used, and the highest ratings are carried forward to higher aggregation (i.e., GWA).

[10] These results are comparable to those from Autor and Handel (2013), where they compare PDII survey task measures against O*NET.

the GWA their tasks fall into, whether they telework, and the year of data collection which is included as a control in the regressions. We first focus on linear regressions of the telework indicator on tasks at different aggregations of GWA. Additionally, we tie this work back to the earlier work on tasks in the economics literature by considering the aggregation of tasks to the familiar routine/non-routine/manual/analytic groupings.

The highest aggregation of the task categories is the major GWA groups which include Information Input, Mental Processes, Work Output and Interacting with Others. Results are shown in Table 4. We see no significant relationship between Information Input and telework, a positive relationship between both Mental Process and Interacting with Others and telework and a negative relationship with Work Output. At this level, it is hard to determine what types of tasks are associated with each of the groups, but general relationships are emerging.

Table 5 is focused on the minor GWA groups which take the four original categories and further break them down into nine. There are stronger relationships at this level as the categories more closely fit with distinction among tasks that are relevant for work from home. Tasks in the major activity of Information Input are broken out into Looking for and Receiving Job-Related Information with a negative and significant coefficient and Identifying and Evaluating Job-Relevant Information which is insignificant. Mental Processes are broken into two further categories, and both remain positive and significant. Conversely, Work Output, which was negative and significant in the earlier regression, is broken into Performing Physical and Manual Work Activities which are negatively associated with telework and tasks which involve Performing Complex and Technical Activities which are positively associated with telework. And finally, Interacting with Others originally had a positive, significant coefficient and broken into three categories retains two positive and significant coefficients and one negative and significant for Administering.

Finally, in Table 6 we consider a more detailed level with 37 GWA. We consider them by their four major groupings. For Information input, the significant coefficients are for tasks associated with Getting Information, which are positively associated with telework, and tasks associated with Monitoring Processes, Materials or Surroundings or Inspecting Equipment, Structures or Materials, which are negatively associated with telework. Mental Processes generally include GWA with positive significant relationships with telework with the exception of Scheduling Work and Activities. The tasks associated with Work Output are generally negatively associated with telework with the exception of Interacting with Computers and Documenting/Recording Information. The other task categories generally involve physically interacting with objects, which are obviously not conducive to telework.

Interacting with Others has more complicated results with both positive and negative associations. More complex interactions like Establishing and Maintaining Interpersonal Relationships, Selling or Influencing Others, and Resolving Conflicts and Negotiating with others are positively associated with telework. Activities focused on interacting with coworkers or clients like Training and Teaching Others and Coaching and Developing Others are negatively correlated with telework. Other tasks such as Guiding, Directing, and Motivating Subordinates do not reflect this pattern and are positively associated with telework. There may be correlates of these tasks, such as being a supervisor, that are influencing these results. We'll further consider tasks associated with Interacting with Others in the context of the two detailed occupations we focus on below.

For comparison with the larger economics literature on tasks, we also aggregate the tasks into categories which were the focus of research on the impact of automation on workers. We map each of the 37 GWA to one of the following categories: Non-routine Analytic, Non-routine Interactive, Routine Cognitive, Routine Manual, and Non-routine Manual. These mappings are reflective of the groupings used by others.[11] Unsurprisingly, the Non-routine activities are associated with telework while Routine and Manual activities are negatively associated with telework.

IV Occupation results

Finally, we switch to looking at variation within two occupations studied in the literature, customer service representatives and software developers. We focus on these two occupations as there is research available on telework that includes aspects of the job that we can also identify in the ORS data. By seeing if the results are replicable with the ORS data, we can both test if the results found in the literature are generalizable and also if the ORS data is able to capture similar variation in jobs.

Looking further into the relationship between tasks and telework for these two occupations also allows us to take full advantage of the job-level data available in ORS. O*NET provides

[11] Non-routine Analytic includes Getting Information, Judging qualities, Processing information, Analyzing data, Making decisions, Thinking creatively, Updating knowledge, Developing objectives, Working computers, Staffing organizational, Monitoring resources. Non-routine Interactive includes Interpreting meaning, communicating internal, Communicating external, Establishing relationships, Assisting others, Selling others, Resolving conflicts, Performing public, Training others, Guiding subordinates, Coaching others, Providing consultation. Routine Cognitive includes Identifying objects, Inspecting equipment, Estimating quantifiable, Evaluating information, Scheduling work, Organizing work, Documenting information, Performing administrative. Routine Manual includes Monitor Processes, Performing physical, Handling objects, Controlling machines, Operating vehicles. Non-routine Manual includes Repairing Mechanical.

extensive detail on many occupational characteristics. However, the data is only available at the occupation level which prohibits any within-occupation research.

The first occupation we focus on is customer service representatives. Research by Emanuel and Harrington (2024) involved a set of workers who were remote and a set that were in office and included a period of time during the pandemic when all workers went remote. While their research is primarily focused on productivity, we focus here on their results which try to explain productivity differences and include task-related measures such as consulting with coworkers and training.

The second occupation we focus on is software developers, referred to as software engineers in the research paper by Emanuel, Harrington, and Pallais (2023). Here the paper is focused on teams of software engineers, some of which are co-located and others that are divided in separate buildings both before and during COVID lockdown. The outcomes the researchers focus on are coding output and comments provided on others code. Commenting on code is characterized as helpful feedback to develop younger developers. In the ORS task data, we again focus on internal communication and mentorship.

Descriptive statistics for customer service representatives and software developers are provided in Table 7. Both occupations have significant amounts of telework in ORS, with 24 percent of customer services representatives and 65 percent of software developers having telework available. The two occupations have different education, training and experience requirements however. The modal minimum education category is a high school diploma for customer service representatives while it is a Bachelor's for software developers. Similarly, software developers have longer periods of on-the-job training on average and are both more likely to require prior work experience and the experience required is longer. Focusing on an element within cognitive demands, 13 percent of customer service representatives are required to solve a problem that takes more than 5 minutes to think of a good solution more than once a week while the same statistic for software developers is 89 percent.

The top task categories for each of the occupations fit well with what one would assume to be part of jobs in each of the occupations. Customer service representatives' top GWA include Performing for or Working Directly with the Public; Communicating with People Outside the Organization; Interpreting the Meaning of Information for Others; Documenting/Recording Information; and Performing Administrative Activities. For software developers, the top GWA are Thinking Creatively; Guiding, Directing, and Motivating Subordinates; Communicating with Supervisors, Peers, or Subordinates; Developing Objectives and Strategies; and Analyzing Data or Information.

The one unexpected GWA is Guiding, Directing, and Motivating Subordinates for software developers. Looking into the data, this GWA stems from several of the ORS tasks for software developers matching to the O*NET task "Develop or direct software system testing or validation procedures, programming, or documentation." This O*NET task maps to the GWA for Guiding Subordinates in the O*NET Content Model. This mapping highlights a potential limitation of using the O*NET Content Model as a classification for tasks.

Briefly summarizing the research on customer service representatives by Emanuel and Harrington (2024), the researchers have access to records from call centers of a Fortune 500 firm that had both remote and on-site workers pre-pandemic. All workers were remote during office closures in 2020. On-site workers' productivity dropped during this switch to close to that of the remote employees during this time. In surveys of workers the researchers find that remote work made it more difficult to quickly consult with coworkers. Additionally, remote work reduced the time employees spent with their manager and the time employees spent in training.

We explore these patterns in the ORS data by regressing telework on the full set of 37 GWA and year dummies but focus on four of the GWA most closely related to the research to see if we find similar patterns. In Table 8, we find a negative and significant relationship between Communicating Internally and Assisting Others and telework within the customer service representative jobs. The relationship is also negative for Coaching Others and positive for Training Others but neither is statistically significant. Overall, these results support the findings of the research in that it appears that among the jobs in which remote work is offered, job tasks are less centered on internal communications and assisting others. This can be seen as support for the research findings and additional validation that the ORS tasks can convey meaningful variation in job tasks within occupation.

A second paper by Emanuel, Harrington and Pallais is focused on software engineers at a Fortune 500 firm. In this case, pre-pandemic, some software engineering teams are co-located within a single building while other software engineering teams are separated between buildings that are several blocks apart. During this time period, co-located teams share more coding feedback with each other than teams that are dispersed over multiple buildings. When the offices are closed due to the pandemic, this difference in feedback disappears. The comments in the code are characterized as a type of feedback that provides mentorship in developing junior employees. In addition, with the switch to remote work, senior software engineers output increases as they spend less time providing comments for others.

In Table 9, we show results of the regression of telework on the 37 GWA and year, and focus on the same set of task categories in the ORS data as before. We find a negative and

significant relationship between telework and Communicating Internally and Training Others, a positive but insignificant relationship between Coaching Others and telework and no variation in telework and Assisting Others as there are no tasks for software developers that fall under the category of Assisting Others. Again, it's important to remember that the mapping of tasks to categories relies on the O*NET Content Model making that link, which doesn't seem to appear for tasks associated with software developers. However, overall, the results are again supportive of the research findings.

Focusing still on these key tasks that were identified in the literature as being impacted by telework, Table 10 presents results with all occupations. In the All column, we repeat the results shown in Table 6 with a regression of telework on all tasks but focus on the coefficients of interest. In the All(within) column, we still consider all jobs but additionally include a full set of SOC fixed effects so that we are only considering variation in task content within occupation. In the All column, we see negative and significant effects for Assisting, Training and Coaching Others, but a positive effect for Communicating Internally. In the second column, we see the same sign for each of the coefficients, but the only significant one is Assisting Others. The large number of SOC fixed effects makes it challenging for there to be sufficient variation in both the tasks and the telework offering to find this effect. Still these results serve as a caution that the patterns found for particular occupations are not necessarily broadly true for every occupation.

V Conclusion

In conclusion, we explore the relationship between telework and tasks, and there are two main takeaways. The first is that the relationship between telework and tasks generally confirms expectations. This serves as evidence that the process of collecting the task data in ORS and mapping it to work activity categories retains meaningful detail about jobs. Second, we can also find meaningful variation across jobs within an occupation. We focus on two occupations that are studied in the literature and find that others' research results are generalizable beyond the firm they studied and the exact time-period for which they had data. For these two occupations we found variation in tasks correlated with telework consistent with earlier research. However, these results are weaker when looking across all occupations.

We find that, within an occupation, important differences in tasks between jobs with and without telework were found in interactive tasks. Jobs with telework available were less likely to have tasks associated with assisting, training, and coaching others. These results are consistent with other research focused on the importance of social skills (Deming 2017), team work (Weidman and Deming 2021), face-to-face communication (Battiston,

Vidal, and Kirchmaier 2021), and interactive tasks (Atalay, Sotelo, and Tanenbaum 2022) for a variety of different labor market outcomes.

Returning to the title, "What makes work-from-home work?," it's important to remember that for half of the occupations for which ORS has telework estimates there is essentially no telework available. For other occupations, there is variation in the availability of telework that is correlated with the tasks associated with those jobs. This evidence suggests that employers may be organizing jobs within their businesses weighing the costs and benefits of telework. Telework may make some tasks associated with interacting with co-workers more difficult. However, employees who telework may be able to devote more time to core tasks. Employers must weigh the costs and benefits of telework when designing jobs.

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Table 1

Top 10 telework occupations

Occupations	Telework (%)
Web developers	80.4
Sales representatives, wholesale and manufacturing, technical and scientific products	70.8
Market research analysts and marketing specialists	67.5
Lawyers	67.1
Fundraisers	66.8
Compensation, benefits, and job analysis specialists	66.8
Web and digital interface designers	66.5
Computer science teachers, postsecondary	66.5
Computer and information systems managers	64.9
Software developers	64.6

Source: Occupational Requirements Survey, second wave estimates available on www.bls.gov/ors.

Table 2

Percent of tasks and match quality by cosine similarity score

A. Match quality

Cosine Similarity Score Bin	Match Quality (%)
≤ 0.1	-
(0.1, 0.2]	-
(0.2, 0.3]	-
(0.3, 0.4]	40
(0.4, 0.5]	65
(0.5, 0.6]	73
(0.6, 0.7]	85
(0.7, 0.8]	94
(0.8, 0.9]	100
> 0.9	100

Notes: Percentage of agreeable matches from a sample of 230 ORS tasks that are matched with O*NET tasks.
Source: Occupational Requirements Survey microdata, authors' calculations.

B. Percent of tasks and estimated overall match quality

Threshold	Percent of Tasks (%)	Match Quality (%)
> 0.2	100.0	83.8
> 0.3	100.0	83.8
> 0.4	99.9	83.8
> 0.5	95.7	84.7
> 0.6	69.6	89.2
> 0.7	27.7	95.1
> 0.8	5.8	100.0
> 0.9	0.9	100.0

Notes: Simulation of the percentage of available ORS tasks and their overall match quality for each cosine similarity score threshold.
Source: Occupational Requirements Survey microdata, authors' calculations.

Table 3

Correlations between ORS and O*NET GWA

	(1)	(2)	(3)
1. ORS GWA Estimates	1.000		
2. O*NET Importance Ratings	0.694	1.000	
3. O*NET Relevance Ratings	0.700	0.976	1.000

Notes: n = 17,791 SOC-GWA combinations. Task-level importance and relevance ratings are used, and the highest ratings are carried forward to higher aggregation (i.e., GWA).

Source: Occupational Requirements Survey and O*NET 25.2 Database available on https://www.onetcenter.org/db_releases.html, authors' calculations.

Table 4

Telework regression results, major GWA groups

Major GWA	Telework	
Information Input	-0.008	(0.005)
Mental Processes	0.083 **	(0.005)
Work Output	-0.106 **	(0.008)
Interacting w/ Others	0.040 **	(0.005)
Observations	102,000	

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses.
Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

Table 5

Telework regression results, minor GWA groups

	Minor GWA	Telework	
Information Input	Looking for and Receiving Job-Related information	-0.021 **	(0.005)
	Identifying and Evaluating Job-Relevant Information	-0.015	(0.006)
Mental Processes	Information and Data Processing	0.031 **	(0.006)
	Reasoning and Decision Making	0.042 **	(0.006)
Work Output	Performing Physical and Manual Work Activities	-0.139 **	(0.006)
	Performing Complex and Technical Work Activities	0.027 **	(0.005)
Interacting w/ Others	Communicating and Interacting	0.013 **	(0.005)
	Coordinating, Developing, Managing and Advising	0.034 **	(0.005)
	Administering	-0.056 **	(0.005)
Observations		102,000	

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses.
Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

Table 6
Telework regression results, GWA

		GWA	Telework	
Information Input	Looking for and Receiving Job-Related information	Getting Information	0.025 **	(0.007)
		Monitoring Processes, Materials, or Surroundings	-0.050 **	(0.005)
	Identifying and Evaluating Job-Relevant Information	Identifying Objects, Actions, and Events	0.027	(0.019)
		Inspecting Equipment, Structures, or Materials	-0.038 **	(0.005)
		Estimating the Quantifiable Characteristics of Products, Events, or Information	-0.001	(0.011)
Mental Processes	Information and Data Processing	Judging the Qualities of Objects, Services, or People	-0.022	(0.009)
		Processing Information	0.007	(0.007)
		Evaluating Information to Determine Compliance with Standards	0.058 **	(0.018)
		Analyzing Data or Information	0.087 **	(0.011)
	Reasoning and Decision Making	Making Decisions and Solving Problems	0.008	(0.008)
		Thinking Creatively	0.051 **	(0.009)
		Updating and Using Relevant Knowledge	0.023	(0.014)
		Developing Objectives and Strategies	0.070 **	(0.014)
		Scheduling Work and Activities	-0.030 **	(0.009)
		Organizing, Planning, and Prioritizing Work	-0.003	(0.016)
Work Output	Performing Physical and Manual Work Activities	Performing General Physical Activities	-0.072 **	(0.004)
		Handling and Moving Objects	-0.063 **	(0.003)
		Controlling Machines and Processes	-0.030 **	(0.006)
		Operating Vehicles, Mechanized Devices, or Equipment	-0.042 **	(0.007)
	Performing Complex and Technical Work Activities	Interacting with Computers	0.080 **	(0.013)
		Repairing and Maintaining Mechanical Equipment	-0.034 **	(0.005)
		Documenting/Recording Information	0.021 **	(0.005)
Interacting w/ Others	Communicating and Interacting	Interpreting the Meaning of Information for Others	0.003	(0.008)
		Communicating with Supervisors, Peers, or Subordinates	0.027 **	(0.006)
		Communicating with Persons Outside the Organization	0.017 *	(0.007)
		Establishing and Maintaining Interpersonal Relationships	0.181 **	(0.025)
		Assisting and Caring for Others	-0.068 **	(0.004)
		Selling or Influencing Others	0.024 *	(0.010)
		Resolving Conflicts and Negotiating with Others	0.050 **	(0.016)
		Performing for or Working Directly with the Public	-0.014	(0.008)
	Coordinating, Developing, Managing and Advising	Training and Teaching Others	-0.060 **	(0.007)
		Guiding, Directing, and Motivating Subordinates	0.034 **	(0.006)
		Coaching and Developing Others	-0.084 **	(0.011)
		Providing Consultation and Advice to Others	0.038 **	(0.008)
	Administering	Performing Administrative Activities	-0.033 **	(0.005)
		Staffing Organizational Units	0.063 **	(0.018)
		Monitoring and Controlling Resources	-0.056 **	(0.004)
Observations			102,000	

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses. Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

Table 7

Descriptive Statistics

	Customer Service Representatives	Software Developers
Telework	24%	65%
Education	HS diploma (77.7)	Bachelors (87.2)
OJT	38 days	55 days
Prior work experience	54%, 1.25 years	84%, 4.13 years
Problem Solving		
>=1 week	13%	89%
<1 week	87%	11%

Source: Occupational Requirements Survey, second wave estimates available on www.bls.gov/ors.

Table 8

Customer Service Representatives, telework regression results, GWA

	Telework	
Getting Information	-0.042	(0.061)
Monitoring Processes, Materials, or Surroundings	-0.047	(0.089)
Identifying Objects, Actions, and Events	0.102	(0.174)
Inspecting Equipment, Structures, or Materials	0.003	(0.069)
Estimating the Quantifiable Characteristics	-0.016	(0.099)
Judging the Qualities	-0.006	(0.179)
Processing Information	0.049	(0.062)
Evaluating Information to Determine Compliance	0.272 *	(0.114)
Analyzing Data or Information	-0.1	(0.084)
Making Decisions and Solving Problems	0.076	(0.061)
Thinking Creatively	0.441 **	(0.142)
Updating and Using Relevant Knowledge	0.106	(0.145)
Developing Objectives and Strategies	0.063	(0.095)
Scheduling Work and Activities	-0.166 *	(0.068)
Organizing, Planning, and Prioritizing Work	-0.032	(0.141)
Performing General Physical Activities	-0.07	(0.052)
Handling and Moving Objects	0.019	(0.119)
Controlling Machines and Processes	0.116	(0.138)
Operating Vehicles, Devices, or Equipment	-0.069	(0.118)
Interacting with Computers	-0.182	(0.098)
Repairing and Maintaining Mech. Equipment	0.004	(0.303)
Documenting/Recording Information	0.062	(0.055)
Interpreting the Meaning of Information	0.063	(0.055)
Communicating Internally	**-0.133 ***	**(0.058)**
Communicating Externally	-0.052	(0.058)
Establishing and Maintaining Relationships	0.001	(0.194)
Assisting and Caring for Others	**-0.114 ***	**(0.051)**
Selling or Influencing Others	-0.014	(0.067)
Resolving Conflicts and Negotiating with Others	-0.103	(0.068)
Performing for or Working Directly with the Public	-0.130 *	(0.060)
Training and Teaching Others	**0.157**	**(0.126)**
Guiding, Directing, and Motivating Subordinates	-0.027	(0.096)
Coaching and Developing Others	**-0.054**	**(0.124)**
Providing Consultation and Advice to Others	0.002	(0.065)
Performing Administrative Activities	0.005	(0.050)
Staffing Organizational Units	-0.081	(0.173)
Monitoring and Controlling Resources	-0.108	(0.055)
Observations	1,000	

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses.
Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

Table 9

Software Developers, telework regression results, GWA

	Telework	
Getting Information	0.047	(0.123)
Monitoring Processes, Materials, or Surroundings	0.019	(0.210)
Identifying Objects, Actions, and Events	0.314	(0.271)
Inspecting Equipment, Structures, or Materials	-0.021	(0.109)
Estimating the Quantifiable Characteristics	-0.381	(0.250)
Judging the Qualities	-0.224	(0.252)
Processing Information	0.156	(0.176)
Evaluating Information to Determine Compliance		
Analyzing Data or Information	0.123	(0.091)
Making Decisions and Solving Problems	-0.168	(0.207)
Thinking Creatively	0.014	(0.137)
Updating and Using Relevant Knowledge	-0.002	(0.324)
Developing Objectives and Strategies	-0.165	(0.110)
Scheduling Work and Activities	0.255 *	(0.122)
Organizing, Planning, and Prioritizing Work		
Performing General Physical Activities	-0.328	(0.319)
Handling and Moving Objects	0.668 *	(0.273)
Controlling Machines and Processes	0.602 **	(0.217)
Operating Vehicles, Devices, or Equipment	0.851 **	(0.283)
Interacting with Computers	-0.07	(0.090)
Repairing and Maintaining Mech. Equipment	0.418 *	(0.205)
Documenting/Recording Information	0.112	(0.116)
Interpreting the Meaning of Information	-0.303	(0.369)
Communicating Internally	**-0.215 ***	**(0.094)**
Communicating Externally	0.332	(0.194)
Establishing and Maintaining Relationships	-0.248	(0.296)
Assisting and Caring for Others		
Selling or Influencing Others	0.76	(0.429)
Resolving Conflicts and Negotiating with Others	-0.126	(0.280)
Performing for or Working Directly with the Public	0.413	(0.404)
Training and Teaching Others	**-0.364 ***	**(0.170)**
Guiding, Directing, and Motivating Subordinates	0.087	(0.105)
Coaching and Developing Others	**0.088**	**(0.250)**
Providing Consultation and Advice to Others	-0.008	(0.106)
Performing Administrative Activities	-0.075	(0.250)
Staffing Organizational Units	-0.486	(0.375)
Monitoring and Controlling Resources	0.292	(0.379)
Observations		500

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses.
Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

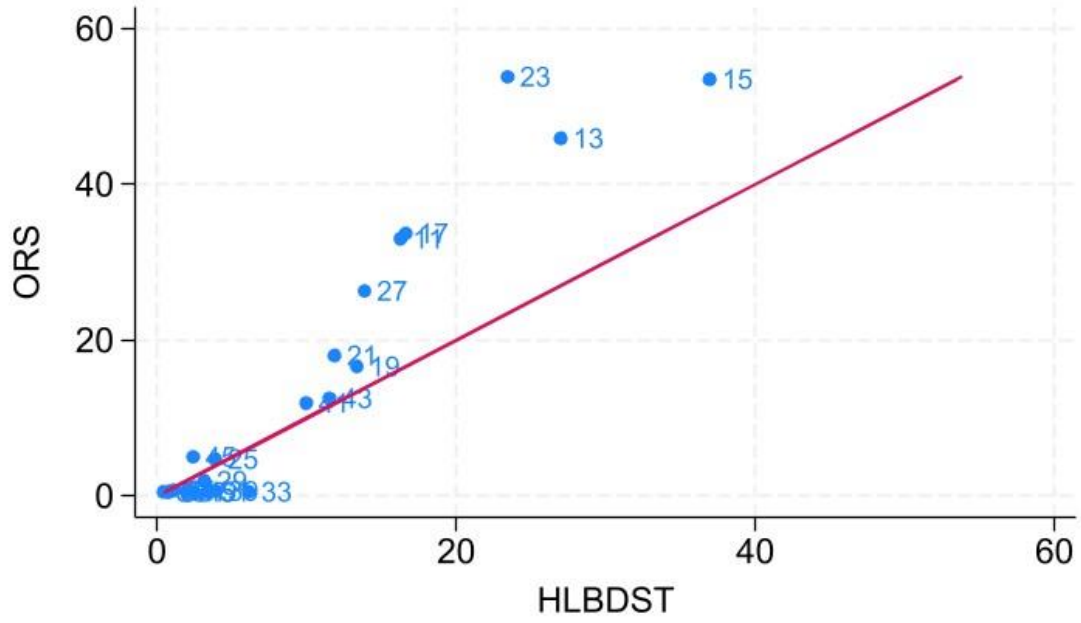
Table 10

Telework regression results, GWA

	All		All(within)	
Getting Information	0.025 **	(0.007)	0.005	(0.006)
Monitoring Processes, Materials, or Surroundings	-0.050 **	(0.005)	-0.004	(0.004)
Identifying Objects, Actions, and Events	0.027	(0.019)	0.025	(0.017)
Inspecting Equipment, Structures, or Materials	-0.038 **	(0.005)	-0.007	(0.004)
Estimating the Quantifiable Characteristics	-0.001	(0.011)	-0.007	(0.009)
Judging the Qualities	-0.022	(0.009)	0.002	(0.008)
Processing Information	0.007	(0.007)	0.002	(0.006)
Evaluating Information to Determine Compliance	0.058 **	(0.018)	-0.01	(0.016)
Analyzing Data or Information	0.087 **	(0.011)	-0.005	(0.010)
Making Decisions and Solving Problems	0.008	(0.008)	0.002	(0.007)
Thinking Creatively	0.051 **	(0.009)	0.009	(0.007)
Updating and Using Relevant Knowledge	0.023	(0.014)	-0.01	(0.013)
Developing Objectives and Strategies	0.070 **	(0.014)	-0.003	(0.012)
Scheduling Work and Activities	-0.030 **	(0.009)	-0.008	(0.009)
Organizing, Planning, and Prioritizing Work	-0.003	(0.016)	-0.003	(0.012)
Performing General Physical Activities	-0.072 **	(0.004)	-0.004	(0.003)
Handling and Moving Objects	-0.063 **	(0.003)	-0.004	(0.003)
Controlling Machines and Processes	-0.030 **	(0.006)	0.004	(0.005)
Operating Vehicles, Devices, or Equipment	-0.042 **	(0.007)	0.005	(0.006)
Interacting with Computers	0.080 **	(0.013)	-0.003	(0.012)
Repairing and Maintaining Mech. Equipment	-0.034 **	(0.005)	-0.001	(0.005)
Documenting/Recording Information	0.021 **	(0.005)	0	(0.005)
Interpreting the Meaning of Information	0.003	(0.008)	0.001	(0.007)
Communicating Internally	**0.027 ****	**(0.006)**	**0.005**	**(0.005)**
Communicating Externally	0.017 *	(0.007)	-0.006	(0.007)
Establishing and Maintaining Relationships	0.181 **	(0.025)	0.044 *	(0.022)
Assisting and Caring for Others	**-0.068 ****	**(0.004)**	**-0.014 ****	**(0.004)**
Selling or Influencing Others	0.024 *	(0.010)	-0.017	(0.011)
Resolving Conflicts and Negotiating with Others	0.050 **	(0.016)	0.01	(0.015)
Performing for or Working Directly with the Public	-0.014	(0.008)	-0.012	(0.007)
Training and Teaching Others	**-0.060 ****	**(0.007)**	**-0.004**	**(0.006)**
Guiding, Directing, and Motivating Subordinates	0.034 **	(0.006)	-0.002	(0.005)
Coaching and Developing Others	**-0.084 ****	**(0.011)**	**-0.011**	**(0.009)**
Providing Consultation and Advice to Others	0.038 **	(0.008)	0.008	(0.008)
Performing Administrative Activities	-0.033 **	(0.005)	-0.027 **	(0.006)
Staffing Organizational Units	0.063 **	(0.018)	-0.003	(0.017)
Monitoring and Controlling Resources	-0.056 **	(0.004)	-0.017 **	(0.004)
Observations	102,000		102,000	

Notes: ORS survey weights used. Regressions also include year fixed effects. Standard errors are in parentheses.
Significance levels: ** p<.01, * p<.05.
Source: Occupational Requirements Survey microdata, authors' calculations.

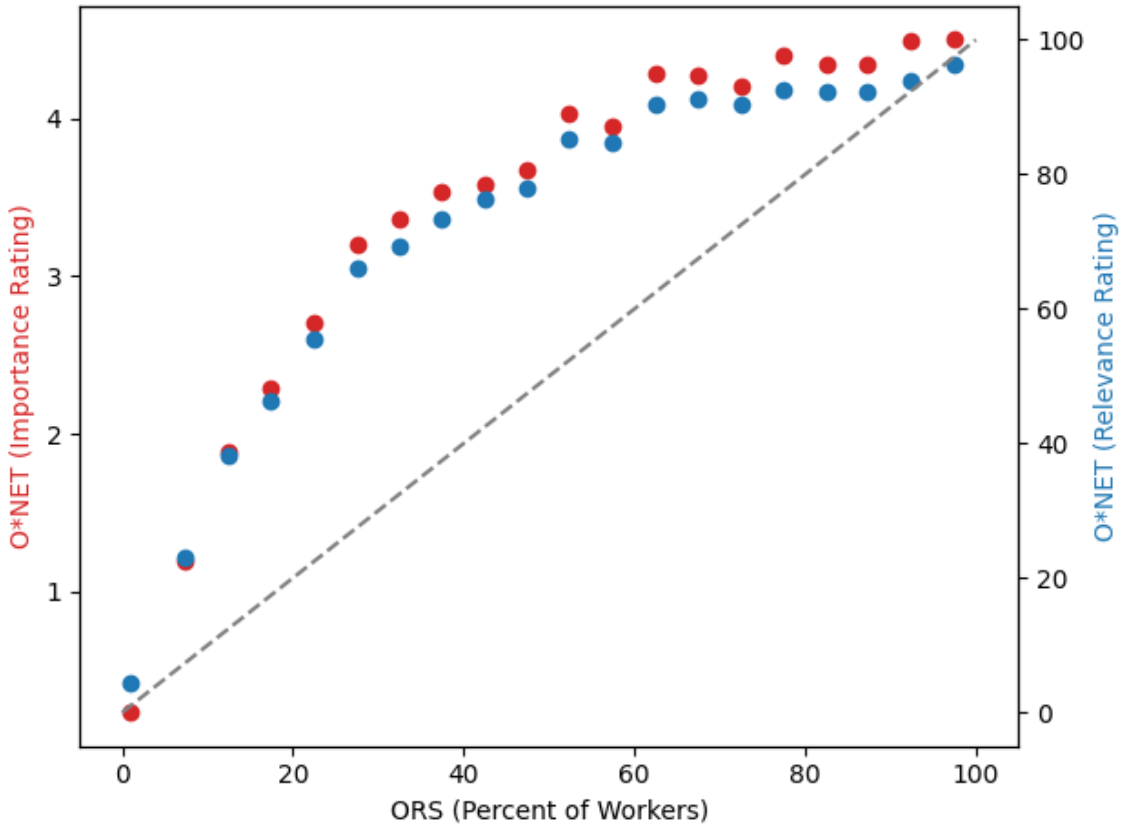
Figure 1
Telework by 2-digit SOC



Source: Occupational Requirements Survey (ORS), second wave estimates available on www.bls.gov/ors, and Hansen, Lambert, Bloom, Davis, Sadun and Taska (HLBDST) available on https://wfhmap.com.

Figure 2

Binned scatter plot of ORS GWA estimates and O*NET ratings

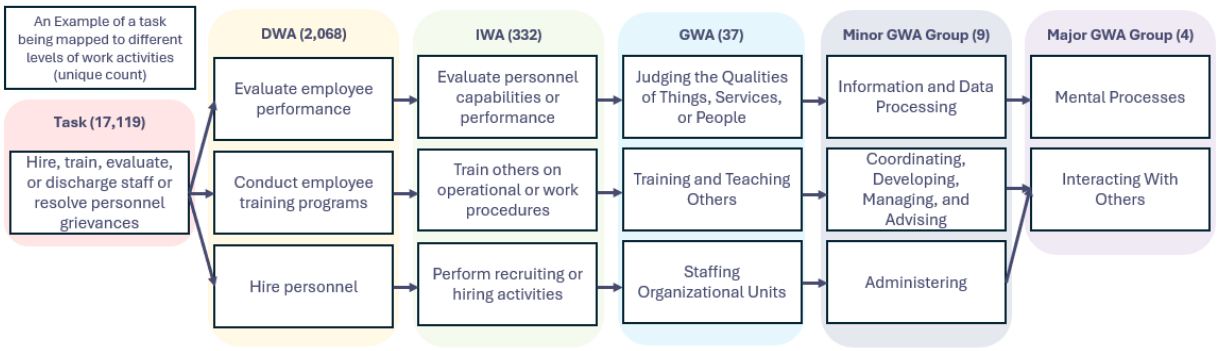


Notes: n = 17,791 SOC-GWA combinations, bins = 20. Task-level importance and relevance ratings are used, and the highest ratings are carried forward to higher aggregation (i.e., GWA).

Source: Occupational Requirements Survey and O*NET 25.2 Database available on https://www.onetcenter.org/db_releases.html, authors' calculations.

Appendix 1

An example of O*NET Content Model mapping of tasks to work activities



Source: O*NET 25.2 Database available on https://www.onetcenter.org/db_releases.html.

Appendix 2

O*NET generalized work activities (GWA)

Name	Description
Information Input	Where and how are the information and data gained that are needed to perform this job?
Looking for and Receiving Job-Related Information	How is information obtained to perform this job?
Getting Information	Observing, receiving, and otherwise obtaining information from all relevant sources.
Monitoring Processes, Materials, or Surroundings	Monitoring and reviewing information from materials, events, or the environment, to detect or assess problems.
Identifying and Evaluating Job-Relevant Information	How is information interpreted to perform this job?
Identifying Objects, Actions, and Events	Identifying information by categorizing, estimating, recognizing differences or similarities, and detecting changes in circumstances or events.
Inspecting Equipment, Structures, or Materials	Inspecting equipment, structures, or materials to identify the cause of errors or other problems or defects.
Estimating the Quantifiable Characteristics of Products, Events, or Information	Estimating sizes, distances, and quantities; or determining time, costs, resources, or materials needed to perform a work activity.
Mental Processes	What processing, planning, problem-solving, decision-making, and innovating activities are performed with job-relevant information?
Information and Data Processing	How is information processed to perform this job?
Judging the Qualities of Objects, Services, or People	Assessing the value, importance, or quality of things or people.
Processing Information	Compiling, coding, categorizing, calculating, tabulating, auditing, or verifying information or data.
Evaluating Information to Determine Compliance with Standards	Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations, or standards.
Analyzing Data or Information	Identifying the underlying principles, reasons, or facts of information by breaking down information or data into separate parts.
Reasoning and Decision Making	What decisions are made and problems solved in performing this job?
Making Decisions and Solving Problems	Analyzing information and evaluating results to choose the best solution and solve problems.
Thinking Creatively	Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions.
Updating and Using Relevant Knowledge	Keeping up-to-date technically and applying new knowledge to your job.
Developing Objectives and Strategies	Establishing long-range objectives and specifying the strategies and actions to achieve them.
Scheduling Work and Activities	Scheduling events, programs, and activities, as well as the work of others.
Organizing, Planning, and Prioritizing Work	Developing specific goals and plans to prioritize, organize, and accomplish your work.
Work Output	What physical activities are performed, what equipment and vehicles are operated/controlled, and what complex/technical activities are accomplished as job outputs?
Performing Physical and Manual Work Activities	What activities using the body and hands are done to perform this job?
Performing General Physical Activities	Performing physical activities that require considerable use of your arms and legs and moving your whole body, such as climbing, lifting, balancing, walking, stooping, and handling materials.
Handling and Moving Objects	Using hands and arms in handling, installing, positioning, and moving materials, and manipulating things.
Controlling Machines and Processes	Using either control mechanisms or direct physical activity to operate machines or processes (not including computers or vehicles).
Operating Vehicles, Mechanized Devices, or Equipment	Running, maneuvering, navigating, or driving vehicles or mechanized equipment, such as forklifts, passenger vehicles, aircraft, or watercraft.
Performing Complex and Technical Activities	What skilled activities using coordinated movements are done to perform this job?
Interacting with Computers	Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information.
Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.
Repairing and Maintaining Mechanical Equipment	Servicing, repairing, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.
Repairing and Maintaining Electronic Equipment	Servicing, repairing, calibrating, regulating, fine-tuning, or testing machines, devices, and equipment that operate primarily on the basis of electrical or electronic (not mechanical) principles.
Documenting/Recording Information	Entering, transcribing, recording, storing, or maintaining information in written or electronic/magnetic form.
Interacting With Others	What interactions with other persons or supervisory activities occur while performing this job?
Communicating and Interacting	What interactions with other people occur while performing this job?
Interpreting the Meaning of Information for Others	Translating or explaining what information means and how it can be used.
Communicating with Supervisors, Peers, or Subordinates	Providing information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person.
Communicating with Persons Outside Organization	Communicating with people outside the organization, representing the organization to customers, the public, government, and other external sources. This information can be exchanged in person, in writing, or by telephone or e-mail.
Establishing and Maintaining Interpersonal Relationships	Developing constructive and cooperative working relationships with others, and maintaining them over time.
Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.
Selling or Influencing Others	Convincing others to buy merchandise/goods or to otherwise change their minds or actions.
Resolving Conflicts and Negotiating with Others	Handling complaints, settling disputes, and resolving grievances and conflicts, or otherwise negotiating with others.
Performing for or Working Directly with the Public	Performing for people or dealing directly with the public. This includes serving customers in restaurants and stores, and receiving clients or guests.
Coordinating, Developing, Managing, and Advising	What coordinating, managerial, or advisory activities are done while performing this job?
Coordinating the Work and Activities of Others	Getting members of a group to work together to accomplish tasks.
Developing and Building Teams	Encouraging and building mutual trust, respect, and cooperation among team members.
Training and Teaching Others	Identifying the educational needs of others, developing formal educational or training programs or classes, and teaching or instructing others.
Guiding, Directing, and Motivating Subordinates	Providing guidance and direction to subordinates, including setting performance standards and monitoring performance.
Coaching and Developing Others	Identifying the developmental needs of others and coaching, mentoring, or otherwise helping others to improve their knowledge or skills.
Providing Consultation and Advice to Others	Providing guidance and expert advice to management or other groups on technical, systems-, or process-related topics.
Administering	What administrative, staffing, monitoring, or controlling activities are done while performing this job?
Performing Administrative Activities	Performing day-to-day administrative tasks such as maintaining information files and processing paperwork.
Staffing Organizational Units	Recruiting, interviewing, selecting, hiring, and promoting employees in an organization.
Monitoring and Controlling Resources	Monitoring and controlling resources and overseeing the spending of money.

Notes: * indicates generalized work activities that are not mapped to by any task statements. Source: O*NET 25.2 Database available on https://www.onetcenter.org/db_releases.html.