Challenges and Opportunities for Technology-Supported Activity Reporting in the Workplace

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ABSTRACT

Effective communication of activities and progress in the workplace is crucial for the success of many modern organizations. In this paper, we extend current research on workplace communication and uncover opportunities for technology to support effective work activity reporting. We report on three studies: With a survey of 68 knowledge workers followed by 14 in-depth interviews, we investigated the perceived benefits of different types of progress reports and an array of challenges at three stages: Collection, Composition, and Delivery. We show an important interplay between written and face-to-face reporting, and highlight the importance of tailoring a report to its audience. We then present results from an analysis of 722 reports composed by 361 U.S.-based knowledge workers, looking at the influence of the audience on a report's language. We conclude by discussing opportunities for future technologies to assist both employees and managers in collecting, interpreting, and reporting progress in the workplace.

Author Keywords

Activity reporting; Awareness; Collaboration; Workplace

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION

In today's large, interdependent, often distributed organizations, activity reports are commonly used to formally communicate work progress. However, they differ from other forms of workplace communication (such as everyday coordination of work tasks) in several ways. Activity reports often are targeted at managers or executives and may involve summarizing or translating the same activities for different audiences, using various channels, over different time frames and for different purposes (e.g. both team and individual employee evaluation).

Prior research has to some extent looked at how software and tools help individuals keep track of individual or team member activities, but several questions about their use remain: To what extent do knowledge workers use additional tools to support them in keeping track of their activities? In what ways are they helpful for translating activities to external audiences? What strategies do workers use to compose their reports?

In this work, we explore the practices of activity reporting in the modern knowledge enterprise. We conducted a mixed-method study to understand the process and challenges of compiling activities, translating activities into reports, and crafting these reports for different audiences and for different purposes. First, we conducted a survey of knowledge workers to understand current practices and challenges. Second, we interviewed 14 of the survey respondents for an in-depth understanding of the process of tailoring, writing, and reading reports. We additionally collected and analyzed a corpus of weekly reports from 361 U.S.-based knowledge workers. Finally, we conclude with a discussion of opportunities for tools to help compile work activities and communicate them to others.

The contributions of this paper are: 1) an in-depth investigation of the process and challenges of activity reporting in the workplace and 2) a diverse corpus and analysis of weekly activity reports collected from 361 knowledge workers.

RELATED WORK

Communicating Activity Progress in the Workplace

While much work in the HCI and CSCW literature has focused on day-to-day coordination or team member availability awareness (e.g. [5, 17, 26, 27 29]), less attention has been paid to understanding how people formally communicate activity progress, particularly how this occurs among employee-manager pairs with their particular power dynamics, and varies across different time intervals. The means of doing so may vary depending on organizational preferences or job roles, and the channels which people use have different strengths and weaknesses. They may be synchronous: daily standup meetings are a

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* - The work was performed while the author was at FXPAL

common practice among software development teams, particularly those who follow an agile process. These are seen as useful for sharing information with a small team and for resolving problems, but can also be time-consuming and irrelevant to other team members [28]. Progress sharing may also be asynchronous: recently, an array of tools have been developed to support online, distributed versions of stand-up meetings (*c.f.,* [12, 25]).

Artifacts of Activity Reports

While not numerous, a few prior papers have focused specifically on analyzing the content of workers' activity reports. In the realm of written reports, daily or monthly reports have been mined to predict who will leave an organization [3], and collected to determine how workers perceive their progress [2]. Our work adds a focus on the processes and methods behind creating the reports and the challenges workers might face in creating them.

Other work has looked at how enterprise social media systems create traces of activity streams as a means of providing awareness about what other people are knowledgeable about and what their areas of expertise are [11, 20, 34]. However, these activity traces are not explicitly written by employees to summarize and clarify their activities; rather they are left behind in the course of performing daily low-level actions.

Activity Summarization and Visualization Systems

Finally, we are beginning to see the emergence of platforms and tools that provide greater transparency into how work gets done by a group of people. Designing social translucence into large-scale collaborative systems can help people understand others' activities and get work done [18]. For example, in the domain of software development, GitHub is one example of a setting that increases awareness of others' activities through social translucence [7]. Other prototype systems have been built to visualize individual contributions to a collaborative goal, e.g. in the case of collaborative writing or distributed problem solving and analysis [13, 31].

Other tools give individuals insight into their own activities and work behaviors, but are not necessarily intended to be shared with others. For example, one line of past research has focused on personal task management, creating to-do lists, or helping recover from interruptions, e.g. [4, 6, 33]. Taken together, the focus of these lines of research has been on developing tools to help individuals manage their own communications and enhance their personal productivity in a variety of situations, but not assist them in communicating what they have done to other people such as their managers.

Another relevant area pertaining to awareness of personal work activity centers on time-tracking. However, in this case, the focus is more on collecting information about activity for one's own personal use rather than sharing this with others. Several recent systems have been developed to show computer workers more information about how they spend their time during the workday online. These help people log things like which applications they have spent time in, and can be helpful for behavior change [1, 32] or task planning [14].

When talking about writing for and sharing reports with others, the content and nature of what people choose to include and share may vary depending on the audience and intended purpose of the report. Research on social media platforms shows people behave differently based on their imagined audience, which has been noted in social media contexts [15, 19, 35], and a similar dynamic may occur in the workplace [10].

Our work adds to the existing CHI and CSCW literature by focusing on understanding formal methods of work-progress reporting among knowledge workers, including the role of channel, frequency, and level of detail based on differing audiences. We also gain direct understanding of how the composition of reports varies for different audiences, and suggest areas in which technological interventions can assist with this process and in particular the challenges of adapting reports for different audiences and time frames.

ACTIVITY REPORTING PRACTICE: SURVEY AND INTERVIEWS

To obtain an initial understanding of challenges and opportunities in current practices of activity-reporting, we conducted a survey and follow-up interviews with knowledge workers employed in a variety of roles. We included workers who report to others and managers who both receive and compose their own reports. We investigated the types of reports required and the tools and communication channels used. We also captured a range of challenges and difficulties respondents encounter during their activity-reporting process. Then, we conducted follow-up interviews with survey respondents who provided their contact information for a deeper understanding of perceived benefits, challenges and strategies for progress reporting. While the survey preceded and guided the interviews, for thematic coherence, findings from the survey and interviews are presented together.

Methods (Survey)

An online survey was disseminated to individuals working for companies in various roles in the information technology industry to get a broad sample of activity-reporting experiences. We began with known contacts and used snowball sampling, enlisting our contacts to both refer others and post the survey to external mailing lists. We targeted respondents in IT companies as they are representative of knowledge workers (whose typical work is to transfer knowledge into technical solutions), and most of their work requires team collaboration where communicating progress is essential for individual, team-wide and company-wide success.

In the survey, we first asked respondents to identify their job titles and the size of their organization, as well as their organizational roles (e.g. if they were a manager or not). For respondents who identified themselves as serving in a managerial role (referred to henceforth as "managers"), we first asked them to answer a set of questions about their experiences with receiving activity reports from their team members, including the frequency, channel and purpose of the reports. We also asked them to rate on a 5-point Likert scale how useful these reports were. For respondents who claimed that they have someone as a manager or team lead they need to report to, (referred to henceforth as "employees"), we provided a set of questions regarding when, how, and why they provided reports to others (such as teammates and managers), and again to mention how useful these reports were. Finally, we asked respondents to describe challenges associated with the creation of each report type.

Method (Interviews)
Follow-up interviews were conducted over video conferencing or in person and lasted between 45 minutes and one hour. Participants received a $25 gift card as compensation. The interviews followed a semi-structured format in which we followed up in more detail about responses they gave to our survey. All interviews were transcribed and coded following an open coding scheme.

Survey Respondents
68 respondents from 28 cities from the United States (80%), Asia (15%) and Europe (5%) completed the survey. Our sample contained a range of organization sizes: 57% were large (1000+ employees), 21% were medium-size (50 to 200 employees), and the remaining 22% were small companies with fewer than 50 people.

The most prevalent job titles of the respondents included engineer (44%), researcher (17%), designer (12%) and analyst (9%). Other job duties included management, human resources and technical sales. 23 out of the 68 respondents (34%) identified themselves as managers.

Interviewees
14 survey respondents (9 male, 5 female) agreed to be interviewed. Eight interviewees were employees who deliver reports to others, and six were managers or team leads who both report to higher management and have activities reported to them. We refer to the mangers as M1-M6 and the employees as E7-E15.

RESULTS
Frequency and Communication Channel
As Figure 1 indicates, weekly reports were the most frequently mentioned type of report mentioned by 44 respondents, followed by daily reports mentioned by 24 respondents. The observed prevalence of short-term activity reporting may correspond to the recent trend of Agile software development, which promotes effective inter-personal communication and quick turnaround to drive the process of product development [23].
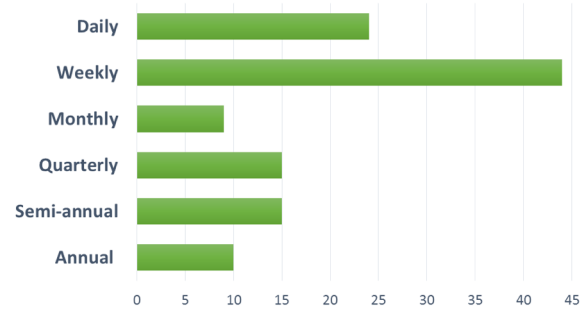

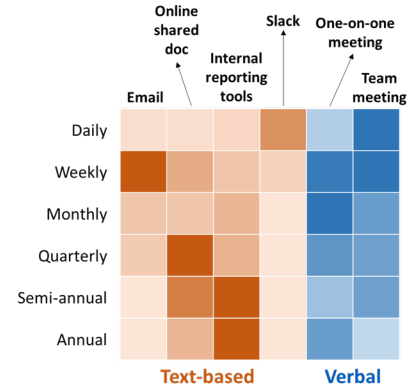Figure 1. Prevalence of types of activity reports.

Figure 2. A heat map representing the popularity of communication channels for activity reporting by reporting frequency. A darker color represents greater popularity.

For each type of report that a respondent selected, they also identified all communication channels in which the report was delivered or received. Our respondents indicated that they utilized more than one channel for each report type (1.78 different channels on average). Figure 2 visualizes how often each communication channel was selected for different reporting frequencies. Verbal channels, including face-to-face and video/audio conferencing one-on-one and team meetings, were commonly used across reporting frequencies. However, in-person reporting was more prevalent when communicating progress within a relative short period of time such as on a daily, weekly or monthly basis. In contrast, long-term (quarterly, semi-annual or annual) reports were more likely to be reported through text-based communication channels, via systems (such as JIRA) and online shared documents (e.g. Google Docs). Our interview results further revealed the decision-making mechanism in channel selections, the pros and cons of text-based communication and verbal channels, as well as the complementary functions of different channels in activity reporting.

Table 1 summarizes the main reasons our participants claimed for choosing the two channels. The most prominent perceived advantage of communicating progress through text-based channels like emails or internal reporting tools is the ease of tracking back in the future about what has been reported.

Text-based reports	Verbal reports
• Easy to track back as a documentation • Easy for synthesis and incorporation • Records of mutual agreements	• Quick feedback • Efficient for problem solving, especially for complicated issues • Conveying a sense of mentorship

Table 1. Benefits of text-based and verbal reporting channels

For instance, M3 stated why he prefers to ask team members to send written reports through email:

Everything is on record. We can trace back the progress and the problems very well. [M3]

E8 and E10 also recognized the value of having written reports as documentation of past work.

Written reports can help to keep track of the problems we have seen in the past, and in the future, we may also see similar problems. So whenever we see similar problems we can go back to find the solutions. [E8]

Similarly, written reports help keep a record of decision making to avoid misunderstanding or misremembering:

Things happened in oral communication can be para-phrased or misunderstood. When it's written, like a statement there that helps everyone understand and remember the work correctly. [E10]

Written reports are easier to be synthesized, or incorporated by other stakeholders after being delivered. For example, M5 stated that the most important elements he looks for from his team-members' reports are "*items I can easily synthesize and report to upper management*".

On the other hand, reporting progress orally through face-to-face communications also has distinct advantages. Most importantly, it allows employees to receive quick feedback from audience and support efficient problem solving focusing on specific roadblocks.

If you don't meet face to face, there could be unresolved issues that may take a longer process to deal with it. Asynchronous communication is not very effective in problem solving. In-person meetings resolve the key issues really quickly. [M3]

In person meeting is more beneficial because I can get feedback directly, right away, and for email it's just like one way, it's not like communication, it's just like deliver something. [E11]

In addition, the richness of context in verbal communications support more social interactions than text-based communications [30]. Thus, talking about progress face-to-face allows managers to convey the sense of mentorship and nurturing:

F2F context can be an important part of "mentorship" and relationship. It gives me a channel to convey the "mentorship", the nurturing side of things, rather than purely instructional, informational aspects. [M1]

Complementary function of multiple channels
In the survey, an interrelated nature of text-based and verbal communication patterns in activity reporting emerged. For instance, 38 out of 68 respondents (58%) used both in-person meetings and text-based communication methods for a single reporting period. Half of our interviewees received or delivered reports via more than one channel for a single reporting period. The choices of communication channels are typically made by the requester of reports such as the manager or team lead. Our results suggest that managers or team leads considered the different channels to serve distinct but complementary functions in activity reporting. As an example, M3 requested his subordinate to write down progress in a shared Google document but also held in-person meetings. He combined the in-person meetings with prior written reports to retain the advantages of both channels; i.e. the written reports provided a way to keep a record about the progress and as source of key issues to be discussed in the meeting:

I want to have a plan for the meeting, to use the time most effectively, so I ask him to write down some bullet points about what he has done after the last meeting, what are the issues of the current project and what are the plans and goals for the next checkpoint. The Google Doc itself also documents the incremental progress of the project. [M3]

Purpose and Usefulness of Activity Reporting
The survey asked respondents about the purpose of delivering or receiving progress at different frequencies. The purposes of activity reporting varied by the frequency of reporting and the role of the respondents in the communication (employee or manager). For short-term progress reports (including daily, weekly and monthly reports), employees perceived that the main purpose is to maintain an awareness of individual's work (89%); while 78% of managers thought the main purpose of such reports is to support project management. For long-term (quarterly, semi-annual or annual) progress reports, most managers (89%) and employees (94%) stated that the main purpose of those reports is for performance evaluation.

Respondents also answered questions about their perception of how useful delivering or receiving progress at different frequencies was on a 5-point Likert scale ranging from 1=extremely not useful to 5=extremely useful. Although the annual reports were considered to be most useful from both employees' (M=4.33) and managers' (M=4.5) perspectives, there were no significant differences among the ratings of usefulness for different types of reports in terms of the frequency of reporting.

The interviews suggest there are distinct benefits perceived by employees who prepare the progress reports and by

managers who receive those reports. Five of six managers requested short-term reports from their team members and articulated the benefits of receiving progress reports for effectively managing ongoing projects.

I have a better understanding of what is the progress of each project. In that way, I can have a list of to-dos or urgency task. I have a clear picture of how I can allocate time on each project. [M3]

Most importantly, managers view receiving reports from others as a critical opportunity to assess the health of projects and progress of individuals; especially to diagnose underlying problems and provide help in finding solutions:

For me, the report is a good way to understand every member's activities - are they doing well or not. If there's no reports, I cannot find any issues they might have. A report is a good way to understand what each member thinks or is trying, or what they are struggling with. [M5]

Rather than supporting the activities in team and project management, employees recognized the value of reporting progress from the perspective of personal benefits and growth. In particular, we summarized three vital points in terms of why preparing and delivering progress reports was seen as useful for the senders based on comments from our participants, including (1) **Reflecting on own accomplishments**; (2) **Keeping awareness of individuals' work**; (3) **Triggering feedback and communications**.

11 out of 14 participants considered the process of preparing progress reports as an opportunity to **reflect on their own achievements** and to prevent them from losing in the trivial and repeated tasks. These benefits are mostly associated with relative long-term reports such as reports delivered once more than a month.

I think they are valuable because you actually see how much you've accomplished in the six months, you have to remind yourself you did all of this great work, you get lost in the day to day of things. I think it's annoying to do but ultimately very positive. It ultimately has a very positive outcome or impact because you see all the work you've done. [E14]

In the normal day, I don't spend much time on what I already done. I just focus on what I'm doing and what I need to do. (By preparing the semi-annual) I can know whether my work is really impactful, if I really made a good use of your time. [E12]

Consistent with our survey results, making others **aware of one's work progress** is also an obvious perceived value of delivering progress reports for employees, especially for more frequent reports such as daily and weekly reports.

In particular, E13 believed her weekly reports provide her manager a clear picture of her work including corresponding priorities of each task.

We were asked to write the weekly reports according to the priority. If you see the weekly reports, manager gets to see how I am prioritizing my work. [E13]

E12 also stated how team standups allow everyone in the team to synchronize with each other regarding their progress.

Everybody gives a short update about their progress to other team members and anything that blocks their work. It's a good time to synchronize. [E12]

For some people, delivering progress reports is an important mean of **triggering communications and feedback** from managers or other co-workers. M4 emphasized the importance of the feedback of his annual report from the manager over the content in his report.

My manager's feedback is more important than my report. From the feedback, you know what to improve. More importantly, you know the plans for the whole company. [M4]

Although communicating progress is considered as an important way to initiate discussion and gain feedback, half of our participants reported that they do not receive enough feedback as they expected, especially in the cases where they delivered written reports. For example, E9 described how the feedback he got from the manager is insufficient:

She (manager) doesn't give a lot of feedback in those mid-year reports. In F2F meetings, she just tells me "[NAME], you are doing a good job." I want to know more detail of what I can improve, not just one sentence. [E9]

The Activity Reporting Process
From the survey and interviews, a three-step process for activity reporting, followed by our participants, emerged. As shown in Figure 3, activity reporting follows a three-step process: (1) *Collect activity data*, (2) *Compose progress reports* and (3) *Deliver and discuss progress*. As we discuss next, a set of challenges impact the ease of composing a report and the effectiveness of the report itself at different stages of the process.
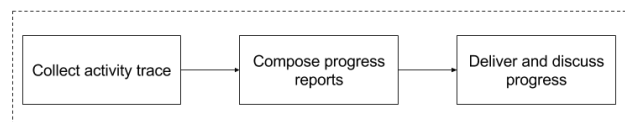
Figure 3. A three-step process of activity-reporting.

Key Challenges and Strategies in Activity Reporting
In the survey, we asked respondents an open-ended question about the specific challenges and difficulties they encountered in preparing and delivering progress reports. We analyzed 183 comments from our respondents clustered these into categories of challenges and pain points. We developed our codebook based on an open-coding approach. Two of the co-authors annotated the key

challenges expressed in each comment independently and discussed the results together. The categories of challenges in our codebook were not mutually exclusive, as a single comment may express multiple challenges.

The four categories were: **Collecting activity data** (i.e., difficulties of remembering, recalling and assessing what had been done or challenges in collecting and retrieving the traces of activities from data sources), **Composing reports** (i.e., summarizing pieces of activities into a coherent report, keeping the report concise and short, tailoring report based on perceived audience and justifying the right level of details to be included in the reports and so on), **Influence of work situations** (i.e., challenges associated with knowledge workers' availability and the realities of task execution, progress and alteration), and **Other** (i.e., social or technical issues that may influence the activity reporting practice such as logistics for in-person meeting, forgetting to deliver the required report on time).

The most pronounced challenges involved in the practice of activity-reporting related to composing reports (44%), the influence of the knowledge workers' work situation (25%) and preparing activity evidence (21%).

Challenges collecting activity data: Tracking and gathering
Participants in the interview study reported two common challenges involved in collecting activity data as the first step in the reporting process: (1) remembering to keep track of one's work activities on a regular basis and (2) gathering activity traces from multiple sources.

In order to prepare work activities to be included in the progress reports, knowledge workers often relied on actively logging their work activities on a regular basis. However, in the interviews, our participants reported that actively recording all the ongoing or completed tasks required extra time and effort:

> *Sometimes, I did not keep track of the metrics when I'm done with a task. I just focus on continuing to work on the next ticket. Then I don't have such data available so I have to use really rough words to describe my achievements. [E12, semi-annual reports]*

This challenge specifically indicates the need for a mechanism to remind knowledge workers to log their work activities frequently. Interestingly, one of our participants (M1) made such an attempt on his own using an automated reminder system in Slack:

> *I keep my own Slack channel and asked Slackbot to ping me at the end of every day to write what I did at work. And to dismiss that message, I have to go to Slack anyway. So it's convenient as it prompts me and it is a time-stamped thing. [M1]*

Gathering data about work activities from a variety of data sources is also a prominent challenge for knowledge workers to prepare progress reports. As found in our survey study, knowledge workers often use multiple tools to keep track of their activities, which means the data of work activities are stored in a variety of locations. Knowledge workers thus need to gather and integrate information from multiple sources for preparing progress reports.

> *There should be better ways to help to integrate and connect resources from different channels, which can help to generate the report. For example, displaying the results of an algorithm with the discussions around it in slack together at one interface. [M3]*

Delivering reports: Mixed-channels
As shown earlier, workers often use both text-based and verbal channels to communicate their progress. However, we discovered that the lack of connections between these channels poses a challenge. Most importantly, the content discussed during the face-to-face/video meetings are often not recorded so it can be hard to be documented together with the written reports submitted through text-based channels. M3 requested his supervisee to report progress both in a shared Google document and by in-person meetings and struggled to combine the two:

> *It is not easy to document everything during the meeting, we don't have a note taker, those meetings are not recorded. While we tried to write them down in Google doc, it is hard to always do so during our discussions. [M3]*

We propose that future reporting tools should be designed to support transitions between multiple channels.

Composing reports: Summarizing and Tailoring
Finally, our content analysis of the survey data showed that summarizing the activities into short and concise reports and tailoring the content of reports based on the perceived audience were the two prominent challenges in composing progress reports. During the interviews, we asked participants about any strategies they employed to overcome these challenges.

One strategy employed by knowledge workers is to rely on previously delivered (written) reports as shortcuts for preparing their new reports. Specifically, there are two types of previous reports that have different functions in supporting the composition of new progress reports: (1) the latest report at a lower granularity helps to summarize the most recent status of work; and (2) the latest report at the same granularity gives a baseline of incremental progress.

For example, E11 used the latest weekly reports she delivered previously to summarize the most recent results of her work in the quarterly reports.

> *(When writing my quarterly report), I will see from each project what's the latest progress and what's the earliest and often the latest is more important because most recent results will be the progress. I will refer to the latest weekly report, summarize more about the latest results. [E11]*

We found that **proactively learning from the audience** was a common strategy for knowledge workers to ensure their progress reports met the needs of the specific audience. The information included in the managers' reports to higher management often provide implicit guidance for knowledge workers to learn what topics attracted attention and interest. For example, M5 and E11 described how they often read their managers' reports to higher management which helps them to consider what items to be included in their future reports based on their understanding of the audience's expectations.

Every time he (manager) summarizes the report into one page, for each of us we get only two lines or three lines, so I can see from my report which part is the most important part for him to summarize. [E11]

In other cases, we also found our participants attempted to learn the expectations of their manager through direct communications:

A few times he (manager) told me that he is very interested in the results, he doesn't like to scroll through a lot of pages. I come from an academic background and am used to writing a lot. He wants to highlight what we can do with this right now, so results are important. [E10]

Moreover, our participants reported that they tailor the level of details in their reports based on the audience's knowledge about the context and technical information of their work.

For the daily report, since he (team lead) knows the context of the applications. I report roughly but he can understand what the program is. [E7]

M4 also mentioned omitting details for his manager:

If I feel the stuff is too difficult for my manager to understand, I will omit it. She doesn't need to see the details. She wants to know the current progress, what task we can finish in time, what tasks might be delayed. [M4]

Our findings raise questions about the process of translating work into a report, and in particular, how a specific purpose and/or audience influences the content and style of a report. We tackle these questions in the next section.

COLLECTING AND ANALYZING EXAMPLES OF ACTIVITY REPORTS

Our survey and interviews revealed that composing a clear report to fit the expectations of its audience is a core aspect of activity reporting, with interviewees, for example, describing strategies for tailoring their reports. In this next part of our work, we set out to explore how report composition may be influenced by a target audience by assembling and analyzing a large and diverse corpus of examples.

We collected a corpus of 722 weekly activity reports from 361 U.S.-based knowledge workers, gathered using Amazon Mechanical Turk. We chose to collect samples of weekly reports because weekly reports were the most frequently-cited kind of activity reporting in our survey. As described below, each worker provided two versions of each report, for a manager and for personal future use, composed separately. We present themes that emerged from an analysis of structure and language use, and take a detailed look at the differences between reports composed for different purposes.

Method: Data Collection

Responses were restricted to U.S.-based respondents over the age of 18, who had a task acceptance rate of at least 95% and had completed at least 500 tasks. Respondents were further pre-screened with the qualification of being employed full-time. The task description stated, *"We are looking to understand progress-reporting for knowledge workers by collecting a large dataset of 1,000 sample reports. In this task, you will be asked to compose a report of your work activities."* The first question filtered for respondents who self-identified as knowledge workers, showing the Wikipedia definition of a "Knowledge Worker[1]" and having them choose whether they believe this definition applies to them. Respondents then entered the field or industry in which they were employed, followed by their job title/profession.

Each respondent was then asked to compose a weekly report to either a manager/higher up, or asked to *"Imagine that, in a month from now, you will be asked to recall what you were working on during this past week (Monday-Friday). Now, please compose a report about your work activities and progress during this past week, which will help you to remember what you were working on."* Respondents were advised to *"not include any details that should not be shared outside your organization".* They were then asked to rate, on a 7-point Likert scale, how difficult writing the report was as well as how detailed and how clear the report was. Then, on a separate page, each respondent was asked to prepare a second weekly report, this time for the second audience, and rate that report. The order of report and audience was randomized. Finally, respondents were asked to describe whether and how the two reports differed. Respondents received $1.00 each.

Corpus Overview

We manually examined every response submitted by the 457 participants to ensure the writing was of high quality and fulfilled the criteria of the task. We excluded reports where the participant either did not fit the job criteria (e.g. hairdresser), whose reports contained only meaningless

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[1] The Wikipedia definition of "Knowledge Worker": *Knowledge workers are workers whose main capital is knowledge. Typical examples may include software engineers, doctors, architects, engineers, scientists, public accountants, lawyers, and academics, whose job is to 'think for a living.'*

Job Role	To	Report	Words	1st person	3rd person	past tense	pres. tense
Paralegal	Manager	*During the past week I have assisted the organization in organizing discovery for seven cases. On Monday I completed two batches of discovery. On Tuesday, i completed two cases and drafted letters to licensing agencies to see the status of the defendant's medical providers. On Wednesday of this week I was in charge of contacting local courts in my firm's area to check on the status of several of our cases. In addition to calling the courts I also used the federal PACER system to check on the status of our federal cases. Thursday, I drafted several court documents to submit in court on a few of our active cases. On Friday, I reviewed more discovery and wrote inquiry letters to be sent to medical providers for open cases. I also drafted one court document.*	135	8.89	0	5.19	2.96
	Self	*Monday-Discovery for cases\<removed\> Tuesday-Discovery for Cases \<removed\> Wednesday-Discovery for case \<removed\> Thursday-Ran Discovery for Cases \<removed\> Friday- Worked on drafting provider letters for cases \<removed\>*	30	0	0	6.67	0
Quality Control Supervisor	Manager	*Activities completed this week: -finished draft project initiation document for improved inventory management process -created presentations for onboarding training -interviewed and hired technician for the open position*	27	0	0	14.81	3.7
	Self	*Completed during week of 8/7 to 8/11 - Completed project initiation document for inventory management. Had document reviewed by communications to ensure grammatical accuracy. Had document reviewed by a Quality Control director to ensure the project outline adheres to larger company goals and processes. - Completed onboarding training presentations regarding good manufacturing practices, good laboratory practices, allergens, and facility-specific procedures. - Hired new employee as the temporary intern's assignment has ended. Employee has proper education and background to meet position requirements.*	81	0	0	8.64	6.17

Table 2. Two sample pairs of weekly reports and counts from our dataset for illustration purposes. Each participant composed two reports for the same week – one to a manager and one for personal future reference.

input (e.g. "*it was a decent week*"), or provided a description of how they would write a report but did not actually describe their work activities (e.g. "*I would pull my plan/notes from this week to help me recall what I worked on this week*"). We also excluded 47 responses that were determined not to be weekly reports (e.g., "*Sit back and chill while I tell people to do stuff*"). The final dataset includes 722 reports from 361 U.S.-based knowledge workers covering a wide spectrum of knowledge work, including engineering, accounting, legal, medical and education.

61% of the respondents (N=222) indicated that they are required to prepare a weekly report as part of their current job, which is in accordance with the findings from our survey responses in terms of the prevalence of communicating progress on a weekly basis. Moreover, 73% of the respondents indicated that they keep track of their personal work activities daily or almost daily, 22% stated that they log their work activities only occasionally, and 5% said they never or only rarely keep track of their work. Thus, while reports were composed specifically for the study, we expect them to be representative of what our respondents "normally" produce for their employers. Participants spent a median of 8 minutes and 23 seconds completing the task, with a median of 2 minutes and 5 seconds to compose each report. Table 2 contains two examples from the dataset, for illustration purposes.

Reports' Length and Structure
On average, reports contained 61.7 words (Median=46 words, SD=55.7). To investigate the structure of reports, we coded each of the 722 reports into one of four structure categories:

- **Bullets**: Using a list of bulleted items to present the activities in a structural format.
- **Narrative**: Providing a description of the activities in paragraph(s) consisting of complete sentence(s).
- **Phrases**: Using short phrases or sentence fragments to briefly present the activities.
- **Mixed structure**: Using a mix of the structures above in a single report.

Our analysis shows that 49% of the reports (355) followed a narrative structure, 38% of the reports (273) were written in a bulleted structure, 11% (85) were written as phrases, and only 1% (9) used a mixed structure.

While we observed different structures for the reports, a Chi-square test showed no consistent difference between the structure of reports written to a manager and those written to self ($X^2(3)=3.9$, *n.s.*). Interestingly, however, we found that 98 participants (27%) used different structures for their two reports. Participants' description of differences between the reports echoes this finding. For example, 35 participants who used a narrative structure for their report to the manager, used a bullet structure to themselves. Some

wrote that, *"The report for myself included no details. I only need things to "jar" my memory to be able to tell what I had been doing. This report was a very basic outline of what I did. In contrast, the report for my manager had to be more detailed and spell out exactly what I did."* In contrast, 16 participants who used a narrative for themselves used a bullet structure for the manager. They wrote, for example, *"Mine was informal (diary like) and to my manager was formal (detailed and arranged)."*

Linguistic Characteristics

To examine the language used in the reports, we used the Linguistic Inquiry and Word Count (LIWC) [21]. LIWC calculates the percentage of words in a given text that fall into various linguistic categories including grammatical, psychological, and content word categories. While LIWC can calculate as many as 81 features for each piece of text, for this analysis, we focused only on the 10 categories presented in Table 3, which are relevant to the context of activity reporting at work.

Work-related words accounted for 14% of words in the reports (SD=9.4). Reports scored high on the Analytical Thinking metric (an average score of 88 out of 100), and neutral on Emotional Tone (an average of 47 out of 100). Indeed, only 2.5% of words in the reports related to affective processes (for details on these categories, see [22].

We also explore the use of informal language (e.g., *btw, lol, OK, hm*), pronouns (1st-person and 3rd-person) and tense (past, present, future) in the reports to see how knowledge workers describe their work in the reports and whether they write differently for the managers and themselves. Overall, we found very little use of informal language (less than 1%). Also, participants used 1st-person pronouns in only 4% of words and they used 3rd-person pronouns (e.g., *she, her, him, their*) even less frequently, accounting for only 1% of all words used. Not surprisingly, participants used more past-focused terms (6%) and present-focused terms (4%) than future-focused terms (1%).

The Effect of the Intended Audience

In this section, we take a closer look at whether and how knowledge workers write differently for different intended audiences, comparing length, structure and language use.

Effect of the order of writing

We first looked for order effects – based on whether this was the first report written (Block A) or second (Block B). We performed a mixed-model analysis with ParticipantID as a random effect (to account for each pair of reports coming from a single participant) and Block as a fixed effect. Word Count (logged) and Time Spent (logged) were the dependent variables.

There was a significant effect of Block on both time and length; the first report received more time (Median 2:38) than the second report (median 1:41); F[1,359]=112.4, *p*<.0001) and was longer (Median 55 words vs. 39 words;

Category	Example	Mean	*p*
Word Count		61.7 words	**<.001**
Time Spent		3:20 minutes	**<.001**
LIWC Measures			
Work		14%	-
Analytical thinking		88 of 100	-
Emotional tone		47 of 100	-
Affective Processes	*happy, cried*	2.5%	n.s.
Informal language	*btw, umm, OK, hm*	<1%	n.s.
1st person	*I, mine, we, ours*	4%	**.002**
3rd person	*she, her, him, their*	1%	n.s.
Past focus	*ago, did, talked*	6%	**.003**
Present focus	*today, is, now*	4%	**.002**
Future focus	*may, will, soon*	1%	n.s.

Table 3 Descriptive statistics and the results of the mixed-model ANOVA comparing reports written for a manager and for respondents themselves.

F[1,359]=91.8, *p*<.0001). We thus include Block as control in all subsequent analyses.

All the analyses described below were performed as mixed-models, with ParticipantID as a random effect to control for each participant writing two reports. All dependent variables were log-transformed; however, means, medians and SDs are reported un-transformed. Table 3 summarizes the results of our analyses.

Length and word count

The analysis shows that, on average, participants wrote longer reports to a manager than to self (M=68.9 words vs M=54.5; F[1,359]=55.9, *p*<.001) and spent longer writing them (M=3:37 minutes vs. M=2:56; F[1,359]=12.4, *p*<.001). However, looking more closely at participants' open-ended description of the difference between their two reports revealed an interesting phenomenon: aside for participants who claimed that the two reports were the same, some of the participants described writing a longer report to their manager (in order to provide more details). However, many other participants described writing a *shorter* report to their manager, stating the manager required fewer details. Indeed, when we explore the (absolute) difference between each pair of reports, ignoring the direction of change, we discover a large variation in change –each pair varies by a median of 19 words. This is a large and interesting difference.

Personal pronouns

We found a small significant increase in the use of 1st-person pronouns (e.g, *I, me, mine, we, ours*) when writing to a manager compared to when writing to oneself (M=5% vs. M=4%; F[1,359]=10.1, *p*=.0016). However, there was no significant difference in the use of 3rd-person pronouns.

Tense use

We were interested to see whether participants changed their descriptions of their work, putting emphasis on finished and ongoing activities. To test that, we examined

participants' use of Time Orientation (past, present and future) in their reports. The analysis showed greater *past* focus (e.g., *ago, did, talked*) in reports to the manager vs. to self (F[1,359]=8.8, *p*=.003) as well as greater *present* focus (e.g., *today, is, now*) (F[1,359]=9.8, *p*=.002). There was no difference in *future* focus (e.g., *may, will, soon*). We speculate that workers wish to provide more context when reporting to a manager, thus including ongoing activities in the report. (A less generous interpretation may be that workers wish to inflate their report.)

Use of informal language
We expected workers to use more formal language when writing to a report to a manager. However, we found no significant different between types of report on the use of informal language (F[1,359]=1.45, *n.s.*). There was a very small significant order effect, with a higher likelihood of use of informal language in the second report (F[1,359]=12.6, *p*=.0004).

Ratings of Difficulty and Clarity
Overall, participants rated the reports as easy to write (M=5.2, SD=1.5). There was a significant effect of whether participants regularly keep track of their work activities (F[2,357]=5.78; *p*<.01) – participants who regularly keep track of their work rated the report as easier to write than those who keep track of work only occasionally (M=5.4 vs. M=4.8; F[2,358]=5.5, *p*=.004). Similarly, those who regularly keep track of their work rated their reports as slightly clearer (M=5.9 vs. 5.6; F[2,357]=3.54; *p*<.05). Surprisingly, participants did not rate the second report as easier to write (F[1,359]=3.1, *n.s.*). There was also no effect of intended audience on ease of writing (F[1,359]=0.1, *n.s.*).

DISCUSSION
In the survey, interviews, and gathering of report examples, we encountered several common themes that spanned the three data collection methods. First, the survey and interviews revealed that progress reporting was not solely limited to the written format, and that gaining awareness of others' work activities came through a combination of shorter-term, in-person informal discussions and longer-term written records. While each method has pros and cons, both seem to be valuable for collaborative work. Second, across all three studies we noted that remembering activities (when not logged regularly) was often a hindrance to effectively and efficiently being able to transfer these activities to a written record, whether for oneself or a manager. Interestingly, we noted that people write differently when writing to another person in a position of power, where they may be more concerned with evaluation (this was hinted at in the interviews and later supported in the mTurk study). However, workers often lack feedback from their managers as to what is expected of them, meaning there exists a great deal of variation in terms of the level of detail or summarization provided.

While many of these issues may be shaped or influenced by organizational changes, such as providing greater scaffolding for the content of reports, we were surprised to see little technological support (outside of bug-tracking systems for software developers) to help people in other types of job roles record and assemble their work activities, particularly when the work is creative or does not follow a clear-cut path (such as research projects). Here we suggest promising opportunities for technology design that could help address some of the difficulties we observed.

Opportunities for Technology Design
Future tools can be designed to help with needs observed in our work, such as the need to easily summarize activity reported across different channels. Much work progress sharing happens in face-to-face contexts where answers can be given quickly and questions clarified, combined with written reports which can be time-saving and also offer the benefit of a written archive. Tools should support transition and sharing of information between these two contexts. For example, there may be easier ways to capture outcomes of face-to-face meetings and save them for future reference, using voice interfaces or other emerging technologies.

With the challenge of collecting activity data, another opportunity exists in helping people get more context from their past work records (emails, calendar, etc.) to make the process of going back through this information easier and more informative. It could also be useful to visually summarize some of this information to help motivate people by seeing what they have accomplished (and to serve as a sort of portfolio of activities and skills that could be referred to later on as well).

Finally, summarizing and tailoring reports could be improved with tools to help provide suggestions about how to re-write or adapt personal notes for external readers could help people who struggle with deciding how much detail to provide for an audience, suggesting ways to tailor the content (where relevant) for a manager or person in power. The suggestions could be system-generated, or provide some lightweight feedback for viewers (such as a heat-map of where their content had been read and if any of it was copy-pasted into a further summary report).

CONCLUSION
We presented results from a mixed-methods investigation of activity reporting in the workplace. Our survey and interviews highlighted challenges with recalling, composing and delivering reports, and uncovered the prevalence of communicating progress across multiple channels. Our corpus of real-world weekly reports highlighted the ways in which people tailored reports differently based on presumed audience. As activity reporting continues to be an important means of achieving workplace awareness, our work provides insight into promising areas in which technology can support the power dynamic between workers and managers. We highlight opportunities for researchers and designers to further streamline the process of recording activity for different audiences, across multiple places and channels, so that the outcomes can benefit all stakeholders.

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