A Peek into the Working Day: Comparing Techniques for Recording Employee Behaviour

Tea Šinik, Iris Beerepoot(✉), and Hajo A. Reijers

Department of Information and Computing Sciences, Utrecht University, Princetonplein 5, Utrecht, The Netherlands
t.sinik@students.uu.nl, {i.m.beerepoot,h.a.reijers}@uu.nl

Abstract. Detailed recordings of employee behaviour can give organisations valuable insights into their work processes. However, recording techniques each have their advantages and disadvantages in terms of their obtrusiveness for participants, the richness of information they capture, and the risks that are involved. In an effort to systematically compare recording techniques, we conducted a multiple-case study at a multinational professional services organisation. We followed six participants for a working day, comparing the outcomes from non-participant observation, screen recording, and timesheet techniques. We generated 136:04 h of data and 849 records of activities. We identified 58 differences between the techniques. The results show that the use of only one technique will not produce a complete and accurate record of the activities that occur on the screen (online), in the hallway (offline), and in the extra hours (overtime). Therefore, it is vital to choose a technique wisely, taking into account the type of information it does not capture. Furthermore, this study identifies some open challenges with respect to accurately recording employee behaviour.

Keywords: Employee Behaviour · Work Patterns · Data Collection Techniques · Observation · Screen Recording · Timesheet

1 Introduction

"What did you do today?". This is a simple question that may be presented to an employee by co-workers, management, or even the employee themselves. The behaviour of employees in the workplace is directly related to the success and operations of an organisation [9]. There is an assumption that there might be a discrepancy between what employees said they have done and what is actually observed throughout the working day [22]. Mills et al. [17] argue that employees tend to omit records that reflect negatively on their behaviour or only record the records that they deem to be important. Therefore, recording employee behaviour whilst carrying out business-related activities has become indispensable [1]. Nowadays, business processes are increasingly supported by information systems [14]

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which record detailed trails of the execution of tasks in databases, system logs, or records [2]. Within Business Process Management (BPM), process mining has gained a lot of interest, both in research and in practice [5]. This family of techniques provides organisations with an opportunity to reveal exactly how processes are executed, in addition to how they should be executed [7].

The main input for the process mining techniques is event data [15]. The assumption is that these records are a truthful representation of the actual employee behaviour to discover work patterns [16]. However, Baier et al. [3] suggest that tasks are not recorded (properly) by the employee or occur outside of the information systems altogether. Thus, it is not always evident to what extent event logs or employee recordings reflect the actual behaviour of the employees. There is a sizeable gap in the literature on recording employee behaviour within an organisational context by using multiple data collection techniques [16]. The issue related to this knowledge gap is that previous studies have almost exclusively focused on one stand-alone data collection technique. This is of particular concern because each data collection technique yields unique results but also has its shortcomings which may impact the accuracy or completeness of the results [13]. Therefore, we aim to answer the following research question with this study: *"How do different data collection techniques compare in discovering work patterns of employees within an organisation?"*. We contribute to the existing body of knowledge by comparing three data collection techniques with varying characteristics to record employee behaviour and discover work patterns within an organisational context: non-participant observation, screen recording, and the timesheet. We present the (dis)advantages, commonalities and differences between the data collection techniques to examine the level of confidence that should be placed in the analysis of this type of data. In addition, we sketch new lines of research that are required to arrive at better recording techniques.

The structure of this paper is as follows. In Sect. 2, we define work patterns and examine the characteristics of the techniques used to record the work patterns. In Sect. 3, we describe the set-up of our multiple case study. The results of the case study are reported in Sect. 4. In Sect. 5 we discuss the limitations of our study as well as the research opportunities it has revealed. Finally, we conclude this paper with Sect. 6.

2 Related Work

2.1 Work Patterns

The study of recording employee behaviour to discover work patterns has gained a lot of interest, both in research and in practice [16]. There is a great amount of variation in how work patterns are recorded depending on the sector (e.g., health or education) or the scope of the research. In general, work patterns are defined as *"the (characteristics) of work activities performed by the organisational members to execute specific activities, and accomplish practices of interest related to a task"* [19], against a set of predetermined classifications. This refers to the "*everyday nature of the work activities exhibited by the organisational*

members" [6, p. 24]. The characteristics are the *where* and *when* the work activities are performed (location and time), *how* (the mediums and documents), but also by *whom* (the involved members) [10].

The classifications introduced by Mintzberg [18] are among the most commonly used for recording employee behaviour and discovering work patterns [10]. Mintzberg used a predetermined classification scheme consisting of (1) desk work, (2) scheduled meetings, (3) unscheduled meetings, (4) telephoning, and (5) tours in the organisation.

2.2 Data Collection Techniques

Lethbridge et al. [13] provide an extensive overview of data collection techniques for studying employee behaviour. They categorise the data collection techniques based on the required degree of contact between the researcher and participant:

1. Direct Technique: The researcher must have direct access to the participant.
2. Indirect Technique: The researcher must have direct access to the working environment of the participants (e.g., (home) office). In comparison to the direct technique, the indirect technique does not require the researcher to interact with the participant.
3. Independent Technique: Involves a retrospective study of work artefacts such as event logs or archival sources. The records are not created by or for (the purpose of) the study.

We examined eight data collection techniques suitable to record employee behaviour in an organisational context[1]. For this study, we selected one from each category: observation, screen recording and timesheet. Not only do they differ in terms of the categorisation, they also differ in terms of obtrusiveness, richness of information, and associated risks. We illustrate their characteristics in Table 1 and further explain them below. Additionally, the data collection took place during a peak period ("busy season") which limited the availability of the participants. We favoured the aforementioned techniques because they do not require any active participation from the participants.

Table 1. Characterisation of the Data Collection Techniques.

Characteristic	Observation	Screen Recording	Timesheet
Categorisation	Direct technique	Indirect technique	Independent technique
Obtrusiveness	Obtrusive and invasive	Less obtrusive, highly invasive	Unobtrusive, possibly invasive
Richness of information	Detailed information, but fast-paced	Highly detailed information	Less detailed information
Risks	Change in behaviour	Incomplete recording	Omitted behaviour

[1] See folder "Literature Review Results": https://doi.org/10.5281/zenodo.7535574.

Observation. This is a direct technique [13] that allows a real-time representation of the studied phenomena [21]. The data consists of subjective information which is influenced by the observer's perspective and what they deem to be important [20]. This technique requires direct contact between the researcher and the participant. The advantage is that the records contain detailed information about the online setting (on the screen) and the offline setting (physical environment). The disadvantage is its obtrusive and invasive nature which is the cause of the Hawthorne effect. This suggests that participants may change their behaviour due to their awareness of being observed [16].

Screen Recording. This is an indirect technique [13] that allows for a retrospective observation of the studied phenomena [8]. This technique is less obtrusive because it only requires access to the working environment of the participant. The advantage is that the records contain highly detailed information about the online setting because the recordings are permanent records of interactions that can be viewed repeatedly for later analysis [20]. The disadvantage is its dependency on a recording application to provide a complete recording (of the screen and sound) [12].

Timesheet. This independent technique [13] consists of existing material not created by the researcher or for the purpose of the research. The advantage of this self-reporting technique is that the participants can record their own activities (e.g., overtime). The disadvantage is that participants can omit activities that reflect negatively on their behaviour or only record the activities that they deem to be important [17]. Moreover, the records do not provide detailed information because the researcher has no control over the details of the data (e.g., the timesheet must be filled in according to the guidelines provided by the organisation) [20].

3 Research Method

We conducted a multiple-case study and compared the non-participant observation, screen recording, and timesheet technique to record employee behaviour. According to Yin [23], the multiple-case study is a suitable method since it investigates and provides a deeper understanding of a contemporary phenomenon in its own real context (e.g., the organisational context), by using multiple sources of evidence. We performed the case study from May 2022 to February 2023.

We followed the case study method by Yin [23]. Our research method consists of five phases: case study selection, technical pilot, participant selection, data collection, and data analysis.

3.1 Phase 1: Case Study Selection

The organisation investigated in this study is a multinational professional services firm located in the Netherlands. The context of this study was set within a team of data consultants, which is part of the Assurance service line. The team is divided into four self-managing "squads". Each squad is composed of members and one squad lead who is assigned to the planning activities.

3.2 Phase 2: Technical Pilot

We were required to use software that was approved by the organisation. Therefore, we used *Snagit*, which is a screen capture and recording application created by TechSmit[2]. We conducted a pilot test to confirm that the application can record multiple screens. In addition, we created a set of guidelines because the collected data consisted of sensitive information such as client-specific data.

3.3 Phase 3: Participant Selection

To create a diversified group of research participants with varying profiles, we selected an employee from each squad. The profiles of our six participants are shown in Table 2.

Table 2. Overview of Research Participants.

ID	Squad	Squad Lead	Rank	Work experience	Employment
P1	C	No	Staff	1,5 years	Part-time
P2	B	No	Staff	2,5 years	Full-time
P3	C	No	Staff	2,5 years	Full-time
P4	B	Yes	Senior	2,5 years	Full-time
P5	D	Yes	Senior	4 years	Full-time
P6	A	No	Staff	2 years	Full-time

3.4 Phase 4: Data Collection

We used a standardised form [18] for all data collection techniques per research participant to preserve uniformity, and allow the comparison and analysis of the findings across the techniques [10]. The standardised form used to record employee behaviour consisted of the following classifications:

- **Time:** The time the activity was recorded.
- **Category:** The overall category of activity, e.g., Desk Work (i.e., all work-related activities), or Personal (i.e., use of the personal mobile phone).
- **Activity:** The specific activity that the employee spent time on, e.g., Organisational Work (i.e., extraction, transformation, and validation of a dataset).
- **Sub-Activity:** The sub-activity within the main activity (e.g., incoming and outgoing calls, messages, and emails).
- **Medium:** The medium used to perform the activities (e.g., Microsoft Teams or Alteryx).
- **Participants:** The individual with whom the employees interacted throughout the working day (e.g., Audit Team).

[2] Website TechSmith: https://www.techsmith.com/snagit-features.html.

Time	Category	Activity	Sub-Activity	Medium	Participants	Initiated	Duration	Field Notes	Client	Participant
09:39:00	Desk Work	Scheduling & Administration	Planning	Microsoft Outlook	Independent	Employee	00:01:00	The employee opened their calender and planned hours for client 6A. It seems that they use their calender for the planning of hours (sort of a diary).	6A	P6
09:40:00	Desk Work	Scheduling & Administration	Planning	In-House Medium 5	Independent	Employee	00:01:00	The employee opened In-House Medium 5. They changed the ticket status of client 6A.	6A	P6
09:41:00	Desk Work	Scheduling & Administration	Planning	In-House Medium 5	Independent	Employee	00:03:00	The employee opened In-House Medium 5. They search on client 6D, they are assigning hours to themselves. They changed the ticket status of client 6A.	6A	P6
09:42:00										
09:43:00										
09:44:00	Desk Work	Scheduling & Administration	Mail Incoming	Microsoft Outlook	Data Team - One	Other party	00:04:00	Received an email from a Data Team participant regarding the planning of client 6D.	6D	P6
09:45:00										
09:46:00										
09:47:00										
09:48:00	Desk Work	Technical Problem Solving	Technical Issues	In-House Medium 7	Independent	Employee	00:07:00	The employee opened In-House Medium 7, with the intention to process the data from a client, however, they decided to first update the Datawasher version.	Non-Client	P6

Fig. 1. Snippet of an Observation Record.

- **Initiated:** The individual who initiated the activity (e.g., the employee or the other party).
- **Field Notes:** The purpose of notes is to aid in recalling the (context of the) activities during the transcription and coding.
- **Client:** Each client was given a unique identifier to be able to record the time spent on (non-)client-related work.
- **Participant:** The research participants were given a unique identifier (e.g., P1 or P2).

Each participant was subjected to three data collection techniques: observation, screen recording and timesheet on one working day of their choosing. Only one researcher conducted the data collection and data analysis. The case study time frame was set between 09.00 and 17.00. During the observation, we used two screens. On the screen turned towards the participant, we opened an application unrelated to our study e.g., Microsoft Outlook. We opened the standardised form (see Fig. 1 for an example snippet) on the screen turned away from the participant. The aim was to minimise the Hawthorne effect by pretending that we are not actively observing the participant. While the observation took place, the participant recorded their screens including (system) audio. Moreover, each participant recorded their behaviour in a timesheet using an in-house timesheet system. The timesheet consists of an engagement ID, activity ID, and a short description. The result of the data collection was the following: six full-day screen records, timesheets and observation records.

3.5 Phase 5: Data Analysis

To minimise the risk of being influenced by using the data gathered from one technique to another technique, we rearranged the data analysis through two steps.

1. Predefined the data analysis order of the data collection techniques. First, we analysed the data collected from the observation. We recorded our observations in the standardised form, meaning that we had already transcribed (a part of the data). Second, we analysed the data collected from the timesheets that provided a broader picture of the studied phenomena [4] from the perspective of the research participant [16]. Lastly, we analysed the data from the screen recording that presented rich empirical data regarding the behaviour and work patterns of the employees [11]. This technique allowed us to (re-)watch the recordings until the entire working day was transcribed and coded.

2. Randomised the data analysis order of the research participants per data collection technique. To minimise the risk of creating connections between the data of a research participant across the data collection techniques, we randomised the analysis order of the collected data of the research participants per data collection technique (archival analysis and screen recording). For the observation, we used the order taken during the data collection. We used a random number generator tool to generate a unique and randomised order for the archival analysis and screen recording. Table 3 illustrates the predefined analysis order of the data collection techniques (see column "Order") and the randomised order of the research participants per data collection technique (see column "Participant order").

Table 3. Order of Analysis.

Order	Data Collection Technique	Participant order
1	Observation	1 2 3 4 5 6
2	Archival Analysis (timesheet)	2 5 1 3 6 4
3	Screen Recording	4 1 2 6 3 5

To reduce errors and improve the reliability of the data analysis, we used two tools. First, we used Alteryx[3] to decrease the number of manual actions (e.g., merging files by copy-pasting). Second, to summarise the large amounts of data, we generated pivot tables in Microsoft Excel.

4 Results

After following six participants over the course of six working days, we collected 136:04 h of data during the non-participant observation technique (43:49 h), screen recording technique (43:25 h), and the timesheet technique (48:50 h). In total, the techniques recorded 849 activities[4].

We compared the records of all classifications in the standardised form. For the observation, screen recording, and timesheet technique we recorded the duration and the count (i.e., the total number of times the classification is observed).

[3] Website Alteryx: https://www.alteryx.com/.

[4] See folder "Results Multiple Case Study": https://doi.org/10.5281/zenodo.7535574.

Table 4 contains the durations and counts of the categories and Table 5 those of the activities. By analysing the records, we found 58 differences related to *timestamps, online versus offline activities, brief activities, overtime activities, and uncategorised activities*. We will discuss each of these differences in the following sections.

Table 4. Results per Category (Obs = Observation, SR = Screen recording, TS = Timesheet, NOB = not observed)

	Duration (in Hours)			Category (Count)		
Category (Total)	Obs	SR	TS	Obs	SR	TS
Desk Work	23:17	22:34	39:55	322	324	37
Personal	01:24	01:44	NOB	18	15	NOB
Telephone	09:50	09:47	08:25	32	33	13
Tours	08:23	07:42	NOB	26	21	NOB
Meeting	00:55	NOB	00:30	3	NOB	1
Unable to categorise	NOB	01:38	NOB	NOB	4	NOB
Grand Total	**43:49**	**43:25**	**48:50**	**401**	**397**	**51**

Table 5. Results per Activity (Obs = Observation, SR = Screen recording, TS = Timesheet)

	Duration (in Hours)			Activity (Count)		
Activity (Total)	Obs	SR	TS	Obs	SR	TS
Breaks	07:17	07:25	NOB	19	19	NOB
Giving Information	01:44	00:49	00:30	24	21	1
Organisational Work	14:59	14:31	26:00	145	144	16
Personal	01:11	00:37	NOB	12	6	NOB
Receiving Information	00:57	57:00	01:15	14	14	2
Requests & Solicitations	00:48	00:42	NOB	22	22	NOB
Scheduling & Administration	12:27	12:10	16:50	124	124	30
Set-up time	00:24	NOB	NOB	1	NOB	NOB
Socialising	01:22	01:56	NOB	13	14	NOB
Technical Problem Solving	02:40	02:40	04:15	27	29	2
Unable to categorise	NOB	01:38	NOB	NOB	4	NOB
Grand Total	**43:49**	**43:25**	**48:50**	**401**	**397**	**51**

4.1 Timestamp

The timesheet aggregates the duration of the activities, therefore the records do not contain a timestamp. This restricts the ability to use these records for

additional time analyses. The records of the observation and screen recording technique both contain timestamps. However, the observation technique is less accurate than the screen recording technique. We observed 15 differences in the timestamps between the observation records and the screen recording (Table 6). The observation technique relies on the researcher capturing the exact time the activity is executed. As opposed to the screen capturing technique, the observation technique does not allow going back in time to check the exact starting time, and as such, the timestamp may be inaccurate. In our study, we observed *time lags* in 13 instances, i.e., where the timestamp of the activity was set at a time later than in the screen recording. We consider the screen recording the ground truth, as we can check exactly when the activity started or ended. *Overlapping (parallel) activities* are especially difficult to deal with when using the observation technique. For example, participant 1 joined a weekly squad call via Microsoft Teams from 16.05 until 16.30, but at the same time started working on a second task on a different screen. The screen recording technique showed that the second task started at 16.07. Using the observation technique, we only observed the switch in tasks at 16.10.

Table 6. Difference in Timestamps between Observation and Screen Recording.

Description	Count
Observation recorded the activity 1 min before screen recording	2
Observation recorded the activity 1 min later than screen recording	9
Observation recorded the activity 2 min later than screen recording	2
Observation recorded the activity 3 min later than screen recording	2

4.2 Online Versus Offline Activities

Offline activities, i.e., activities that did not occur on the screen, were only recorded with the observation technique. Here, we distinguish three categories: Meeting, Personal, and Tours.

Meeting: The category Meeting was adopted from Mintzberg's categorisation and refers to *offline* meetings, as opposed to the category of Telephoning for *online* meetings. Table 7 shows the results of recorded offline meetings for each of the techniques. The observation technique allows for complete recording of offline meetings. It recorded three meetings with a total duration of 55 min. The opposite is true for the screen capturing technique: no offline meetings could be recorded, as by definition, the technique does not capture activities taking place outside of the screen. The timesheet technique partially includes offline meetings, i.e., only when employees choose to include them in their time registration. It recorded one meeting with a total duration of 30 min. This means that this technique failed to record two meetings with a total duration of 25 min (55%).

Table 7. Offline Meetings Recorded per Technique.

	Observation	Screen Recording	Timesheet
Duration recorded (in hours)	00:55	00:00	00:30
Number of meetings recorded	3	0	1
Percentage recorded	100%	0%	55%

Note: We used the 55 min recorded by observation as the ground truth, i.e., the time that should have been recorded by the techniques.

Over the course of six working days, the six participants spent 2,09% of their time (55 min of 43:49 h) on meetings. Although this percentage (2,09%) may seem insignificant, offline meetings used to be a substantial part of the daily activities. The case study was conducted while COVID-19 restrictions were still in effect. As a result, the employees switched from *offline meetings* to online *telephoning* via Microsoft Teams. Once the employees return to their five-day workweeks in the office (or client sites), the meetings are expected to again become a larger component of the daily activities (24,53%), as shown in Table 8. Therefore, the inability of the screen recording and timesheet techniques to (completely) record the meetings could have a significant impact.

Table 8. Potential Significance of the Meetings.

	Meeting	Telephoning	Combined total
Duration recorded (in hours)	00:55	09:50	10:45
Activities recorded	3	32	35
Total (%)	2,09%	22,44%	24,53%

Personal: The activities that fall under the Personal category are *the use of a personal mobile phone, socialising, and the use of the internet browser (not work-related).* As shown in Table 9, we observed differences in the ability of the techniques to record these activities. With the observation technique, we were able to record all (online and offline) activities. The screen recording technique, however, failed to record three activities (15/18). Although screen recording provides an accurate recording of *online* activities, *offline* activities such as the use of a personal mobile phone or socialising cannot be recorded. The timesheet technique did not record any activities related to the category Personal. As it is a self-reporting technique, employees can omit records that reflect negatively on their behaviour, or can choose to only record the activities they deem important. Taking the observation records as the ground truth, we note that participant 3 spent 58 min on activities related to using the internet browser, their personal mobile phone, and socialising. However, based on the timesheet records, we know that the employee *chose* not to include this in their timesheet.

Table 9. Personal Activities Recorded per Technique.

	Observation	Screen Recording	Timesheet
Duration recorded (in hours)	01:24	01:44	00:00
Activities recorded	18	15	0

Tours: The activities that fall under the category of Tours are *set-up time and breaks (e.g., restroom, coffee, and lunch breaks)*. As they are offline activities, the observation technique is the only one that can record all activities within this category. For example, the observation technique recorded that participant 5 started their working day with a 24-minute fire drill at 10.25. The screen recording and timesheet technique failed to record this activity. Due to the sound recording, the screen recording technique was able to *partially* record activities related to Tours. For example, the technique was able to record that participant 1 asked their colleague to go on a (smoke) break. As shown in Table 10, for all six participants over the course of their working days, the observation technique recorded 08:23 h of activities related to Tours. The timesheet technique does record any information about Tours and thus omits a significant part of employee behaviour.

Table 10. Tours Recorded per Technique.

	Observation	Screen Recording	Timesheet
Duration recorded (in hours)	08:23	07:42	00:00
Activities recorded	26	21	0

4.3 Brief Activities

One type of activity that was only recorded by the screen recording technique was short activities with a duration of only 1 or 2 min. Based on the records of the screen recording technique, we observed that there were 133 activities with a duration of 1 min and 55 activities with a duration of 2 min. In total, 47,36% of the activities had a duration of 1 or 2 min. This means that it is vital for a data collection technique to be able to record these brief activities. The screen recording technique produces permanent records of the activities (the screen recording and sound) that can be viewed repeatedly [20]. This aids in the recording of brief activities such as the use of the internet browser to resolve technical issues or incoming and outgoing emails, (chat) messages, and calls. Using the observation technique, the researcher might miss the activity because they are busy categorising and/or creating field notes of the previous activity.

The timesheet technique was particularly incomplete in terms of recording brief activities. The shortest activity recorded in the timesheet had a duration of 10 min. Employees might feel that recording each brief activity takes too much

time. However, choosing not to record them might affect the number of hours that can be billed to the client. Table 11 shows the clients that were recorded for each of the techniques.

Table 11. Clients Recorded per Technique.

	Observation	Screen Recording	Timesheet
Total recorded (count)	43	44	24
Total unrecorded (count)	2	1	21
Total unrecorded (%)	4.44%	2.22%	46.67%

Note: The calculation is based on 45 being the total number of recorded Clients, calculated based on the 44 recorded and 1 unrecorded Client (screen recording).

It shows that the timesheet technique failed to capture a large number of these activities where employees worked for clients. According to the records of the screen recording technique, there were 60 activities related to the 21 clients that the timesheet technique failed to record. The far majority of these missing activities are brief activities of 1 or 2 min, as shown in Table 12.

Table 12. Clients-Related Activities Unrecorded by the Timesheet Technique.

	More than 10 min	5–10 min	3–4 min	1–2 min
Activities (count)	2	7	9	42
Activities (%)	3.33%	11.67%	15%	70%

Note: The calculation is based on 60 being the total number of client-related activities.

4.4 Overtime Activities

Comparing the total amount of time spent on different categories of activities, we observed a difference of more than 5 h between the observation and screen recording technique on the one hand, and the timesheet technique on the other. We classify this difference as *overtime activities* because only the timesheet technique was able to record these activities. This means that the employee performed the activities outside the study's time frame (before 09.00 or after 17.00). The observation technique is a direct technique and as such, requires direct contact between the researcher and the participant. A disadvantage of the observation technique is that it cannot record any activities performed outside of the time frame of the study because the physical presence of the researcher is required. The screen recording technique is an indirect technique. This means that it only requires direct access to the working environment (laptop). Compared to the observation technique, it is more flexible in terms of the recording

of online behaviour [8]. The participants can record all online activities, from the office or their homes, as long as the screen recording application works. However, the disadvantage is that the offline activities that occur during overtime (e.g., meetings or use of a personal mobile phone) cannot be recorded by the screen recording technique. The participants could have performed the overtime activities at the office, on the train, or at home. However, the timesheet technique can record overtime activities. As the timesheet is an independent self-reporting technique, participants can record their own activities, whether performed during or outside of work hours. As a result, this technique produces a record that includes overtime activities.

4.5 Uncategorised Activities

A final difference between the techniques that can be observed relates to the number of activities that could not be categorised, i.e., the fields indicated by *NOB* in Table 4 and Table 5. The observation technique can categorise both online and offline activities. As such, 100% of activities could be categorised. The screen recording technique was able to categorise the activities for almost all recorded hours. However, one of the participants (participant 3) experienced technical issues during the recording of their working day which caused the tool to produce a partial screen and sound recording. As a result, the technique was unable to categorise 1,01% of the activities. The percentage of the activities that the timesheet technique failed to categorise is higher. Due to a lack of information that can be extracted from the timesheet caused by the design of the timesheet, and the limited information provided in the description, many activities could not be categorised.

5 Discussion

The previous sections have illustrated how each of the techniques has strengths and weaknesses in terms of the completeness of recording. In Fig. 2, we provide an overview of our comparison of recording techniques. The screen recording technique provides accurate timestamps and is an excellent choice when brief activities are an important aspect of daily work. Observations provide valuable information when important employee behaviour takes place offline. The timesheet technique provides the least information of the three, but is readily available for analysis in many organisations that perform billable work.

From the overview, we conclude that choosing the most valuable technique heavily depends on the purpose of the analysis. Evidently, there is a trade-off involved in terms of the obtrusiveness of the technique and the richness of information that the technique can offer. Generally, techniques that provide rich information seem to be more obtrusive, typically, and a combination of techniques would result in an even more complete picture of employee behaviour. However, it would also be highly invasive to the employee to collect this information and would ask for a significant effort from the collector. Therefore, choosing

a technique or combination of techniques requires careful consideration of the recording impacts on the employee and the extent to which these are balanced by the positive outcomes for the employee. Regardless of the selection of techniques, it is crucial to take into account the shortcomings of the chosen techniques when drawing conclusions about employee behaviour.

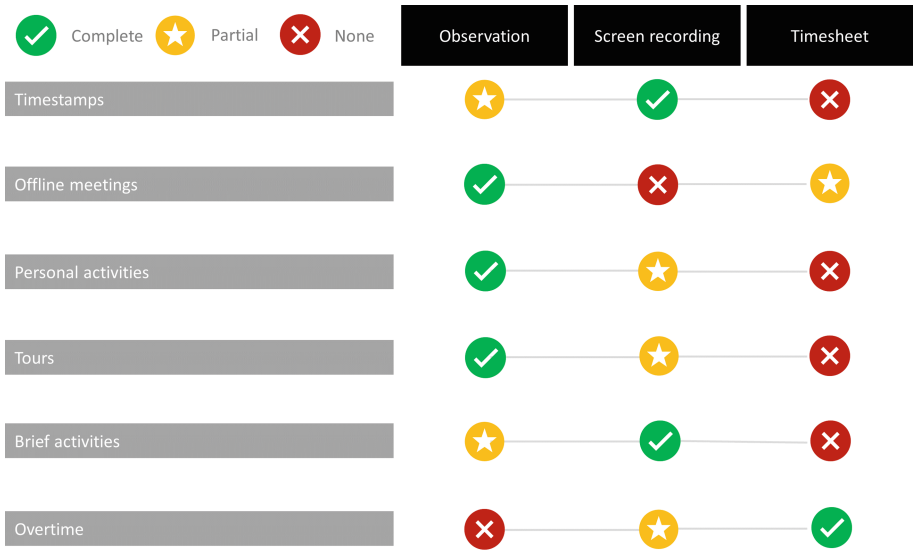

Fig. 2. Overview of Recording Techniques.

5.1 Limitations

Participant 3 faced technical issues during the use of the recording tool. We became aware of this once the working day had ended. We analysed the data and concluded that we missed 01:38 h of the screen recording. We did have sound (microphone and system audio), and thus, considered the following options. First, to accept the partial recording if we could demonstrate that the partial data was still reliable and valid for our data analysis based on the audio recording or our observation notes. Second, if the reliability of the data could not be ensured, then we would plan a new observation (either a whole or partial working day). The reason why we accepted the partial recording is that we had the sound recording, and we did not want to risk the participant exhibiting different work patterns from those noted during the initial observation.

5.2 Future Work

We see several avenues for future research in this area. First, future work might expand on the data collection techniques that were used in this study. Techniques such as the analysis of event logs or the use of work diaries would be valuable additions to the comparison. Probably, by considering additional techniques, we will become aware of how to better combine existing techniques to achieve the objectives for recording user behaviour. Second, other studies might validate the found patterns in different types of organisations and study employee behaviour for a longer period of time. It is fair to expect that by doing so, we may encounter types of activities unseen so far with their own 'fit' with the data collection techniques.

Finally, future studies might focus on the implications of choosing a particular data collection technique and the consequences of missing activities for insights that can be drawn from the analysis. This insight is arguably the most important line for future research since it may help us better understand the impact of relying on one or the other data collection technique.

In conclusion, there are major opportunities for studying employee behaviour. We trust that the present study provides a starting point for better understanding these techniques and making better decisions in selecting these techniques for actual application.

6 Conclusion

In this study, we followed six employees during their working days, recording their behaviour using three data collection techniques: non-participant observation, screen recording, and timesheet. By systematically analysing the differences in the 136:04 h of data that the techniques recorded, we show that each technique yields different results in terms of the activities that were recorded and the level of detail at which employee behaviour can be analysed. The use of one of the techniques will not produce a complete and accurate record of the activities that occur on the screen (online), in the hallway (offline), and during the extra hours (overtime). Depending on the purpose of the analysis, researchers or practitioners may select the best-fitting technique. However, it remains vital to reflect on the behaviour the chosen technique cannot capture. There are also opportunities to improve and extend existing techniques to better capture employee behaviour.

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