

DAILY ROUTINE AND PERFORMANCE ANALYSIS - PARALLEL BETWEEN TELEWORK AND WORK FROM THE OFFICE

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Abstract: *In the field of teleworking research, there are still many gaps and unexplored topics, as it is no longer news that teleworking has seen significant growth in recent years. There are still many important aspects that need attention, starting from understanding how this working model will evolve in the long run to understanding what its effects will be on employees, employers, the quality of work performed and the economy as a whole. Many employees want workplace flexibility and the ability to work from home or remotely, and teleworking research can help them understand their requirements and preferences and develop appropriate policies. It is essential to understand whether teleworking affects employee productivity and performance, and this study can provide data to assess these aspects and identify factors contributing to their increase or decrease. Through this study, we aim to come up with new elements to help outline the image of the working days carried out by employees who perform their work tasks in telework, through a comparative analysis with the activity registered by a company that carries out the activity from the office.*

Keywords: teleworking, performance in teleworking, software development, employee monitoring, data analytics

1. Introduction

The beginning of 2020 did not predict the drastic change that would occur in our lives, we did not imagine that a crisis in global public health would follow, all due to a virus (COVID-19). The release of overburdened health systems, in the absence of a treatment that would work, but also the rapid spread of the disease, all this has led to unprecedented self-isolation measures in most countries of the world. Humanity has gone through significant social and economic changes, and one of the most widespread has been the change in the space in which employees perform work tasks, referred to as telework. Although teleworking has a history of almost four

decades, being proposed as a means of making work more flexible, the recent pandemic has “brought it out of anonymity”.

Teleworking emerged as a concept as early as 1973 and generated enthusiasm and experimentation, but the concept did not escalate [1]. Teleworking came as a quick alternative to the need to diminish physical proximity between employees to limit the spread of the frightening virus. Before the COVID-19 pandemic, many organizations were offering remote work in response to their employees’ demands to improve work-life balance [2].

Telecommuting has been referred to as telework, remote work, distributed work,

virtual work, flexible work, flexplace, and distance work, among other labels. These various terms, while overlapping, often embody different conceptualizations of telecommuting. Even across studies that have used the identical label of telecommuting, the actual definition offered may vary [3].

The pandemic has accelerated the adoption of teleworking globally, causing companies to adapt quickly to this work model, which makes teleworking research topical and especially necessary in the continuously evolving context of the labor market and technology. Research is needed to better understand the experience of employees and employers in this setting and to assess the long-term effects.

It is essential to understand whether teleworking affects employee productivity and performance, and this study can provide data to assess these aspects and identify factors contributing to their increase or decrease.

2. Literature Review

The notion of teleworking appeared before the pandemic context, being considered as support for work flexibility, facilitating the increase of employee independence in carrying out work [4]. Among the first to analyze the phenomenon of teleworking, Alvin Toffler & Charles Handy, concluded that it is not new, this form of work has existed since pre-industrial times when people worked from home, in the vicinity of the house or on their land. Industrial evolution has organized work in institutions, and in these times, we are witnessing the reverse phenomenon, of returning to carrying out activities at home, having as support electronic media, but also specific forms of communication with the company. Alvin Toffler and Charles Handy predicted as early as 1981 and 1984 respectively that working from home would be taken over by most employees and employers due to its profitability (flexibility of the schedule, reduction of transport costs, reduction of costs for maintenance of

the premises, reduction of absenteeism in the case of employees who have conditions that do not prevent them from working from home, etc.) [5].

The evolution of technology has led to evolution and progress in the case of highly educated employees. In European countries, teleworking has evolved differently, relative to the economic and social context, so that where the innovation process is the key factor for economic and social development, Internet connections have been rapidly activated, thus succeeding, with the support of mobile information technology, in relocating work tasks [6].

Research has shown that not everyone can telework effectively, that personal circumstances can facilitate or hinder remote work, and that there is a need to develop teleworking protocols and trusting relationships within organizations. In addition, issues of integrity and discipline, stress and fatigue are difficult to address [5].

Although Romania has significant performance in terms of Broadband connection (high-speed internet, minimum 128kb/sec) and adoption of digital technology within enterprises, it is positioned among EU countries only on 27th place, being placed well below the EU average when we talk about teleworking [7]. The paradox of autonomy in teleworking comes from the perception that although work flexibility implies a high level of freedom and independence, it implies more rigorous control and more intense work [8]. The effect of teleworking on stress is not clear. Some studies indicate that remote work can reduce stress, but there are also reasons to believe that remote work can increase stress due to the uncertainties involved. The changes brought about by COVID-19 have led to considerable uncertainty for people's work and personal lives, which has created discomfort for many of them. Those employees who switched to teleworking faced additional stress, for them, remote work was a novel situation, but not entirely new, they were doing the same work in new ways. For this reason, understanding

stress among remote workers is an important aspect of research [9].

3. Structure, Purpose of Research, and Research Question

The starting point in this research is to complement the existing scientific activity in a field where there would certainly be more research to be done, namely teleworking.

In essence, the aim of studies on teleworking is to help organizations and society as a whole to better understand this constantly evolving way of working, develop better practices and adapt to ongoing changes. These studies provide data and information to make more informed decisions regarding teleworking and human resource management.

The purpose of the study is to come up with new elements to help shape the image of the working days carried out by employees who perform their work tasks in telework, through a comparative analysis with the activity registered by a company operating from the office.

In order to achieve the proposed purpose, the following research question (RQ) was formulated:

RQ: Are work routines different between the 2 companies in which the study was conducted?

4. Proposed Research Model

The set of stages of the study is transposed into a conceptual model that highlights the route of study data, starting from recording the daily activity of employees with keyloggers (computer application that records any user interaction with the computer) to the final stage of the study, namely outlining conclusions and establishing limitations. Thus, Figure 1 represents the two companies in which employees record their activity on the computer, the recorded information is saved in a NoSQL database, then the data is exported in JSON format (JavaScript Object Notation) and imported for processing, in a MySQL database, with the help of an application developed in Java. Extensible Markup Language (XML) files necessary for data analysis and interpretation are exported from the data processing application.

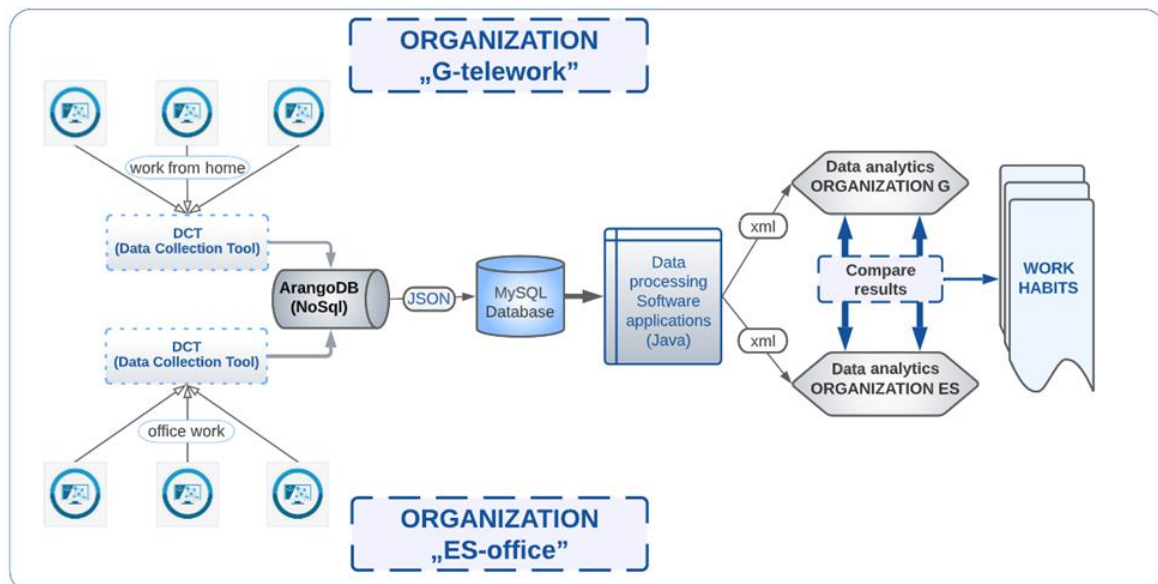


Figure 1: Proposed model -both organizations (Source: Authors of research)

5. Sample Determination

The present study is a natural continuation of the research whose results were

disseminated in the article “Workforce Analytics in Teleworking” [10] published in the journal IEEE Access. The created

framework, as well as the promising results, led to the continuation of the research, adding as novelty elements the extension of the employee monitoring period and also as novelty, registered data and employees from a company designing electrical installations and networks, which carry out the activity from the office. The purpose of also monitoring some subjects who work from the office is to discover specific characteristics of teleworking compared to traditional work. Although the type of activity of the two companies in which the study was conducted is not similar, the research could be carried out due to some elements of similarity, namely: the same geographical classification / time zone, high degree of interaction with the computer, level of studies of the research participants, internal policies regarding flexibility and fit into the time schedule.

After rigorous planning in which all the details related to the participating sample were established, ethical details were discussed and established, participants were assured of the anonymity and confidentiality of personal data, technical details and rules to be observed, the day when participants start recording data, deadlines for periodic checks and other administrative details, the study was conducted within the two companies, which

we will hereinafter call symbolically, as follows:

– **Organization “G-telework”** – Its object of activity is the development and implementation of integrated software for economic and financial management. The company has a staff of approximately 40 employees. Most of the employees hold positions as software developers, the others work as software implementers, software consultants, marketing officers, accountants, and human resources officers. Although the effects of the pandemic generated by Covid 19 seem to have diminished, the company’s employees chose to continue their activity in the telework system, supported by electronic media and specific forms of communication with colleagues and superiors. For its part, management understood that returning to traditional office work is not a simple process. From “G-telework”, the sample of this study consists of six employees: four senior software developers and two software consultants; the selected participants have at least 5 years experience in the company. When choosing the participants, it was taken into account both how much they interact with the computer to perform work tasks, and especially their availability to be part of the research (Table 1).

Table 1. Data for the study - Organization „G-telework”

Employee Code	Total number of days recorded	Number of logged events	Age	Gender	Experience in the company (years)	Position in the company
E1	72	4925204	36-45	M	5	software consultant
E2	79	13439142	36-45	M	18	software developer
E3	28	1471473	36-45	M	18	software developer
E4	92	9500191	36-45	M	15	software developer
E5	51	4629241	36-45	F	15	software developer
E6	90	3996883	36-45	M	11	software consultant
Total	412	37962134				

– **Organization “ES – office”** – with the object of activity the design and execution of civil and industrial electrical installation works and has been active on the market since 2005. The human resources consist of electrical engineers, electricians, technicians, and employees in technical-

administrative, accounting and financial services. Within the company “ES – office” the sample also consists of 6 employees who have a very high degree of interaction with the computer to perform work tasks (Table 2).

Table 2. Data for the study - Organization “ES – office”

Employee Code	Total number of days recorded	Number of logged events
SE1	37	896708
SE2	152	4239206
SE3	151	2471955
SE4	146	3148983
SE5	125	2038332
SE6	61	2009774
Total	672	14804958

6. Data Collection

The starting point in research, data collection consists in the process of gathering and collecting data and information in a standardized manner, allowing the testing of the hypotheses formulated.

Lack of clarity about data collection mechanisms can confuse and mislead rights and obligations and allow errors harmful to data consistency to propagate.

6.1. Data Collection Planning

Planning how data was collected and captured was an important step in the whole process and the following aspects were taken into account:

- who will collect the necessary information – the information is recorded by the study participants;
- the place from which the data was recorded – each study participant had installed the data recording application on the work computer;
- data collection mode – recording the activity that study participants have with the work computer;
- where the collected data is saved – the data is automatically saved in a NoSQL database;
- what kind of data is needed to answer the established research questions – primary data on participants’ interaction with the

computer were collected: mouse and keyboard data along with the names of accessed windows.

6.2. Data Collection Application Validation

The data of the present study were collected using a keyloggers application (a computer program that records every user interaction with the computer), newly developed, tested and validated by making parallel recordings for a certain period with the InputLog application (<https://www.inputlog.net/publications/>). Inputlog is a keystroke logging software (KSL) that records input made by users against a timestamp, resulting in detailed XML (Extensible Markup Language) data files (called IDFX files). These files contain a linear representation of user activity on the computer in terms of events such as keystrokes, mouse movements, and focus events (e.g., websites visited, programs used, etc.) [11].

The application remembers and saves each event that occurred and information about it: pressing a key, moving and using mouse buttons, and switching between windows. For each event, time details are saved in XML files in the form of timestamp (exact time and date for each of the events). Each saved file corresponds to a working day.

The data collection took place over a period of approximately 6 months, more precisely

the start for data registration was given on 06.09.2021, and the last day on which data were recorded was 28.02.2022.

After going through a pre-processing stage in which the recorded data were verified and the inconsistencies that occurred during collection were eliminated, 29 files that did not contain coherent data were dropped, finally resulting in a number of 1084 working days registered for both companies in which the study was conducted. The participants from the “G-telework” company registered a total of 412 days, and the participants from the “ES-office” company registered a total of 672 working days.

7. Data Processing

For data processing, a Java application was used, developed to ensure import, and organization of raw data recorded by employees. Information was processed, saved and stored in a traditional SQL database. Based on the processed and saved information, situations and reports are generated that are subsequently used in the data analysis stage. The operations performed with the help of the application, starting from experimental data to generating information in the format required for the data analysis environment are as follows:

- the data recorded at the workday level was imported individually for each study participant. Each record of a working day contains events such as: mouse press, mouse movement, focus change, details (keystroke, mouse coordinates, window title in focus), timestamp - the exact time and date for each event (Unix time or Unix timestamp, is the number of seconds that have elapsed since January 1, 1970 (midnight UTC/GMT)) start and end timestamp;

- also, at the time of import, for focus events, the length of time that the window was active is calculated and saved as the difference between the timestamp of the next focus event and the timestamp of the current event;

- with the help of the developed application, the focus events for each day are associated with a type of activity: work, documentation, recreation. The allocation is based on keywords uploaded to the database for each type of activity. Based on the events in the registration, the operator can identify and add other keywords until the desired degree of identification is reached. They will be stored in the database and will be used for further processing. Thus, the application “learned” to allocate focus events on the 3 types of activities and after a relatively small number of imported files, the proportion in which events are identified, without operator intervention, exceeded 60%-70%; The identification of keywords for employee records was done with the VOSviewer map creation software tool [12].

- another important step was the identification and marking of breaks. It has been established that any duration of time of at least 5 minutes between two consecutive events of any type (focus, mouse, keyboard) is considered a break and the duration of that focus event has been identified, marked and subtracted;

- next, based on the duration of focus events, the application provides a series of information related to daily working time, divided by types of activities and time intervals. Similarly, keyboard or mouse events are counted by time slots, providing an image of the distribution of work activity during the day.

From the recorded raw data, an accurate picture of the working days can be outlined

- the number of breaks and interruptions, in what periods of the day they were made, their duration, how much time the study participants spent documenting, how much time they allocated for recreation and how much time they actually worked, what work tools are used the most and what is the number of context changes in certain defined intervals (day / hours).

8. Data Analysis

For the graphical representation of data in order to be analyzed and interpreted, Microsoft Excel from the Microsoft Office suite of programs was used.

The data analysis had as a starting point the research question formulated as follows:

RQ: Are work routines different between the 2 companies in which the study was conducted?

To complete the imagined framework, that of analyzing the habits of employees who work remotely, a comparison with the activity carried out from the office is necessary. Thus, in parallel with the study participants from the company “G-telework”, the daily work activity was recorded by the study participants who carry out the activity from the office, from the company “ES – office”, a company with a design profile of electrical installations and networks.

The identification and association of the types of activities (actual work, documentation and recreation) were made based on a set of keywords chosen according to the field of activity of the two categories of study participants, software and design of electrical installations.

The graphical representation (Figure 2) of the collected and processed data highlights interesting aspects to analyze. Starting from the average duration of the recorded time, the difference is obvious, namely if for the company “G-telework” the duration is 9.24 hours / day, for the company “ES – office”, which works from the office, the recorded time is lower, of 6.99 hours/day. The shorter duration of recorded time for

participants working from the office compared to those working remotely is also confirmed by the paper [13] where the authors reported as average recording time: 8.4 hours / day, a fact also reported by other authors who say that in many cases, working from home means more than 8 hours per day [14]. Thus, it can be said that teleworking employees prefer to divide their work tasks over a longer period of the day. Significant differences were also registered in the actual working time, those in teleworking spend 3.97 hours of the working day with activities specific to the field, compared to office employees who recorded an average of 2.26 hours of the day actually working.

In the same trend, employees in teleworking spend more time on documentation and computer recreation than employees who carry out traditional work activities, namely the average duration of 1.02 hours for documentation and the average duration of 0.50 hours for recreation compared to 0.63 hours for documentation and 0.08 hours for recreation.

Analyzing inactive time (short breaks >5 minutes and long breaks >15 minutes), the dynamics change and those who register longer inactive times are office employees, with an average of 9.78 short breaks (> 5 minutes) / day and an average duration of short breaks of 4.51 hours, compared to the average 8.10 short breaks and an average duration of short breaks of 3.55 hours recorded by participants in telework.

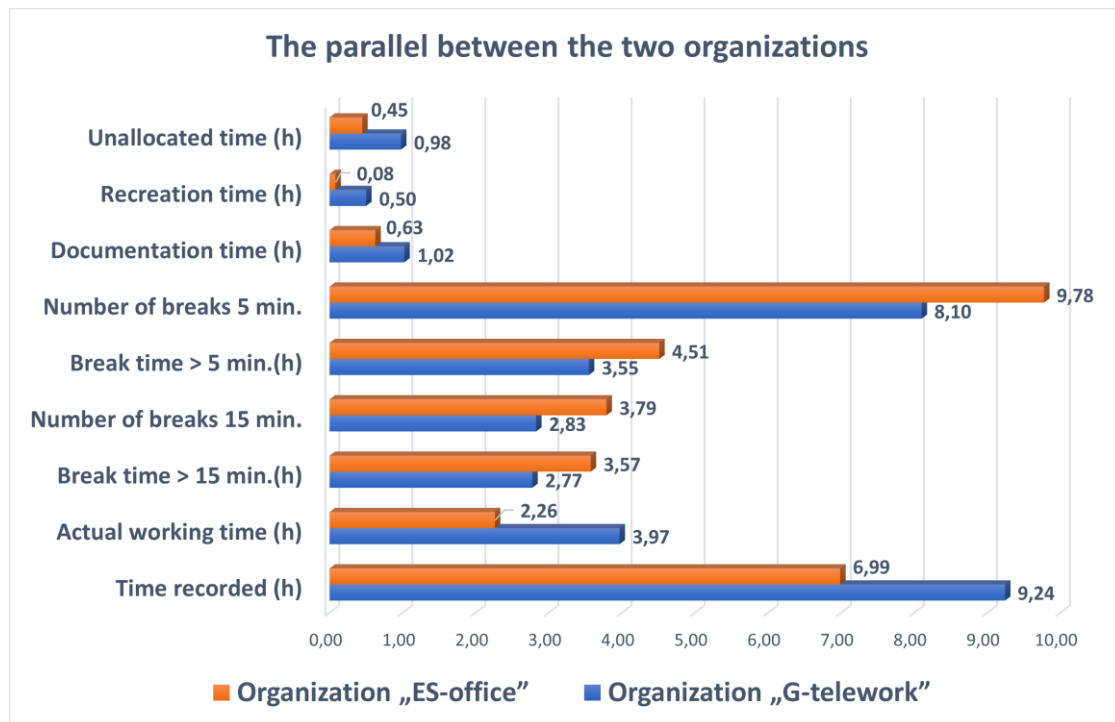


Figure 2: Parallel company “G-telework” - the company “ES – office” - durations (Source: Authors of research)

At the level of mouse-keyboard use and open windows, the differences between the study participants in the two companies are very large, which is easy to see from (Figure 3). For employees in telework, the number of mouse, keyboard or focus events is also almost six times higher, as is the case with the number of keyboard events, with an average of 17808 keys pressed / day by an employee in telework compared to 3185 keys pressed by employees who carry out work activities from the office. A

smaller difference was registered at the level of open windows (number of focus events) by the two categories of subjects, with an average of 516 open windows / day by office employees compared to the average of 1658 open windows / day by employees in telework. It can be concluded that employees in the office work less dynamically in terms of interaction with the computer than employees who work from home.

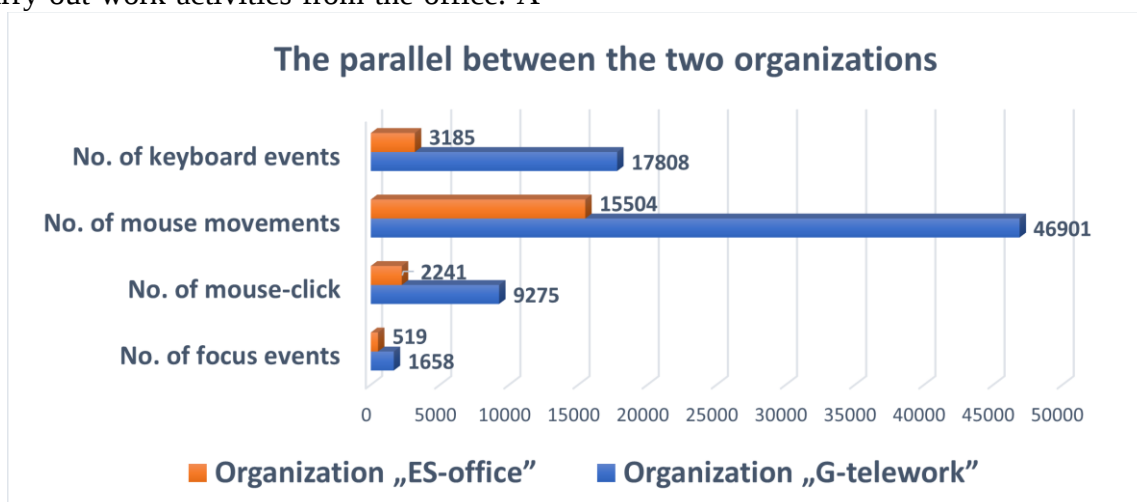


Figure 3: Parallel “G-telework” – “ES – office” - events (Source: Authors of research)

The analysis of the work program for the two categories of participants studied also reveals differences both at the start of the work program and at its completion. Teleworkers start working around 8:54 a.m., nearly an hour later than office workers, who start work around 8:02 a.m. on average. According to the average duration of the recorded time, the

completion of the program differs greatly between the two companies, if those from the company “ES – office” finish the activity, on average, around 15:45, for the employees of the company “G-telework” the end of the work schedule approaches 19:00 (Figure 4).

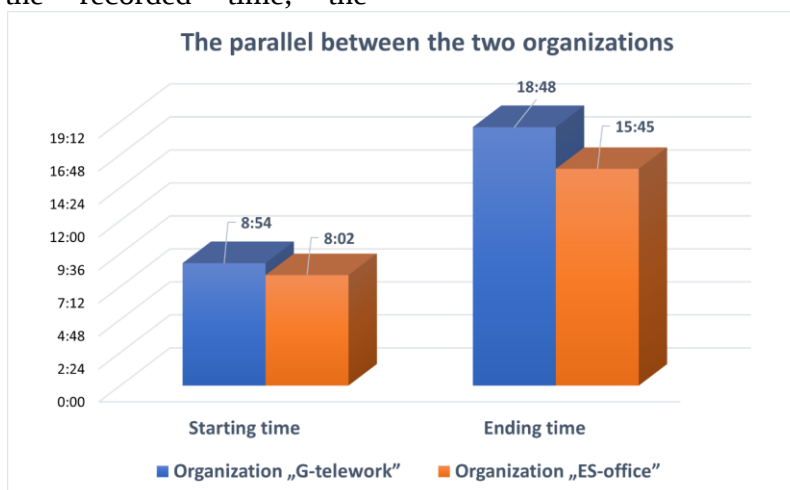


Figure 4: Parallel “G-telework” – “ES – office”-working hours (Source: Authors of research)

To further determine what a working day looks like in the two companies, we divided it into two-hour intervals.

(Figure 5) gives the picture of working days in teleworking. In the first part of the working day, the first two intervals record low activity, then the next 3 intervals, between 10.00 and 16.00 prove to be the most productive, with a peak of 0.99 hours of actual work and 0.16 hours of

documentation between 12.00 and 14.00. After 6 p.m., teleworkers seem to complete certain work tasks, recording an average of 0.79 hours of actual work and an average of 0.17 hours to document. In the last part of the day, you can also notice a significant increase in the duration of idle time, but also a slight increase in recreational time interacting with the computer.

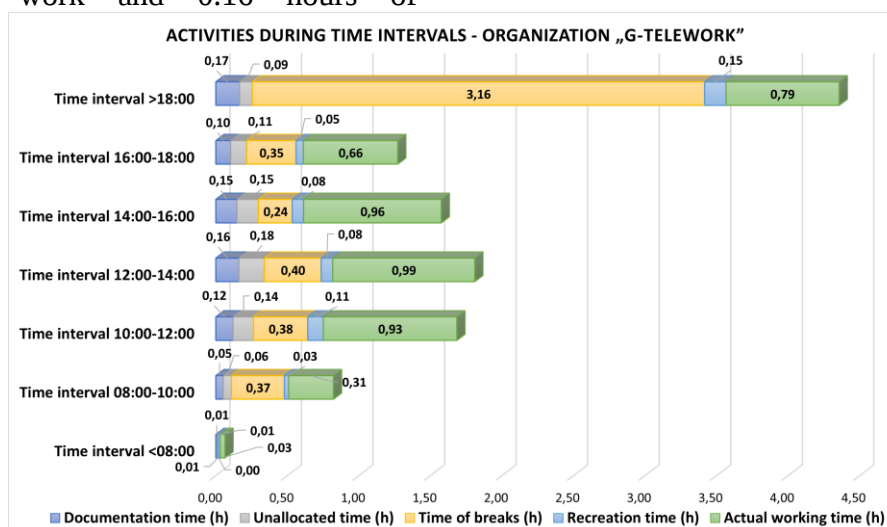


Figure 5: Interval activity company “G-telework” - durations (Source: Authors of research)

Instead, analyzing (Figure 6) it can be seen that for office employees the activities are relatively evenly distributed at the level of the working day, the interval in which the actual work is most intense, with an average of 0.69 hours, is between 08:00-10:00. After 12.00 there is an increase in the duration of breaks, the most intense

interval as activity is 14.00-16.00, and after 16.00, the activity ends abruptly. For office employees, the duration of time allocated to computer recreation registers very low values, with the highest value recorded, 0.03 hours, between 08.00-10.00 and 14.00-16.00.

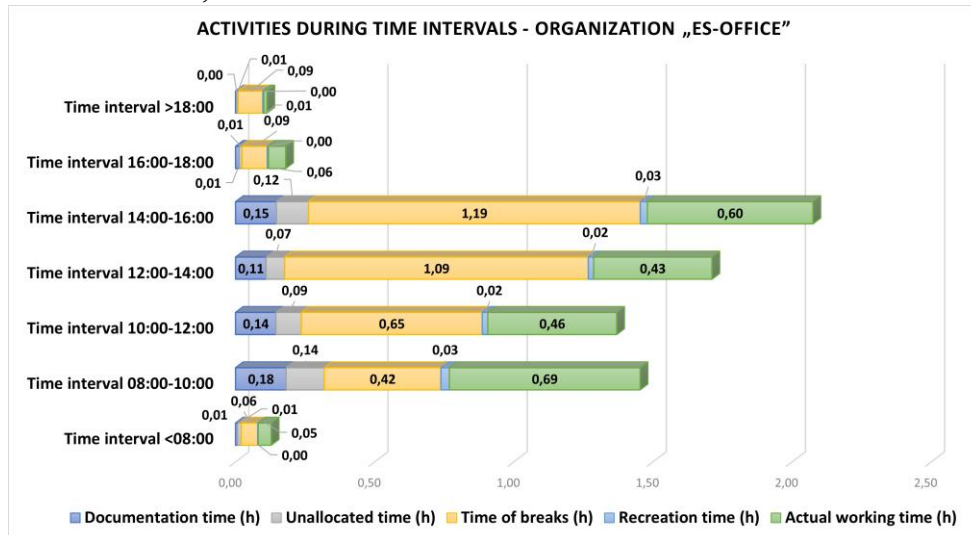


Figure 6: Activity on intervals company “ES-office” - durations (Source: Authors of research)

Considerable differences between the habits of employees in teleworking and those of employees working from the office are also highlighted by comparing the two graphical representations (Figure 7 and Figure 8) that render on intervals the values recorded for focus, mouse and keyboard events. Thus, if the employees of the company “G-

telework” register the most events between 12.00-14.00, namely 3853 keyboard events and 12153 mouse movements, the employees of the company “ES – office” are more active in the first part of the day, between 08.00-10.00, with 912 keystrokes and 4845 mouse movements.

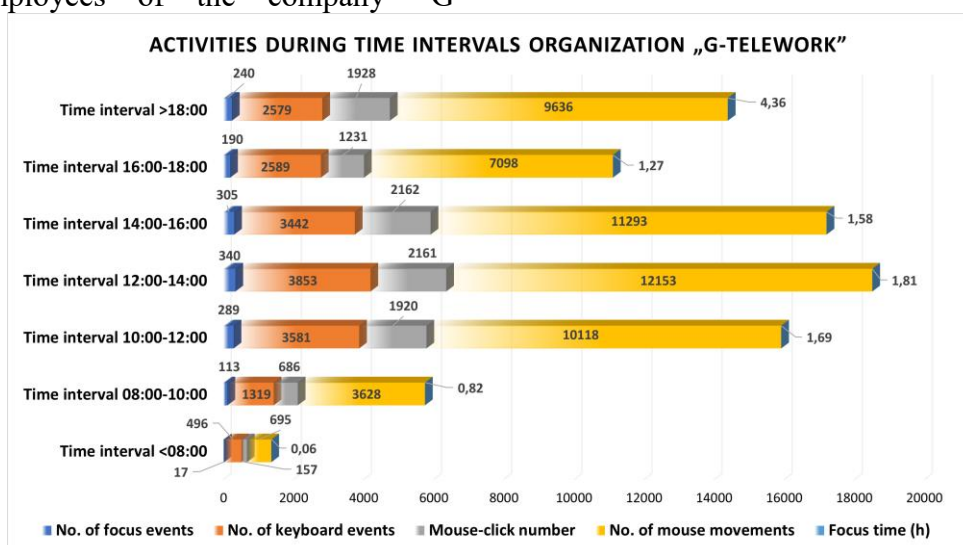


Figure 7: Activity on intervals company “G-telework” – events (Source: Authors of research)

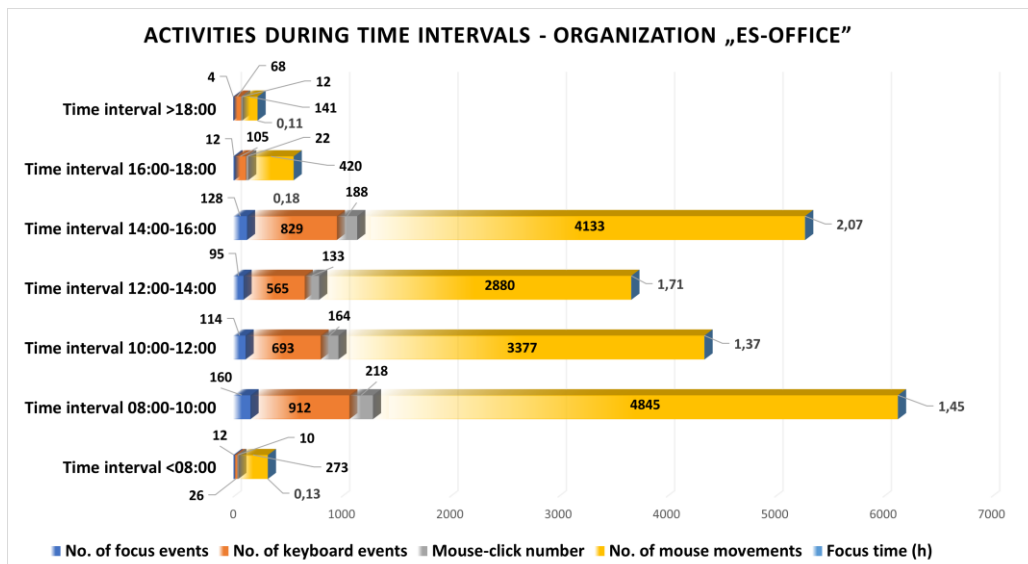


Figure 8: Activity on intervals company “ES – office” - events (Source: Authors of research)

10. Conclusions and Personal Contributions

The “dream” of any company manager is to have an instrument that offers objectively and measurably the degree of performance and productivity of each of the employees, given that human resources is a complex resource.

Therefore, the exposed framework and tools proposed in this research can be considered a solution for monitoring and evaluating the performance of remote employees. The functionality of the framework has been tested and evaluated, for significant periods, in a company that develops economic and financial software and in an electrical company, in order to highlight specific aspects of teleworking compared to office work. Study participants from the two companies were monitored using keyloggers for a total period of about six months.

The study conducted in the two companies, “G-telework” and “ES – office” revealed information worth taking into account in the treatment of the subject of teleworking. Comparing the work routines in the two companies where data were recorded, differences emerged that can be interpreted in two directions, namely: some differences can be considered only specificities of teleworking, while certain differences between the two routines can be considered

worrying. Thus, special attention should be paid to the end time of the work schedule of teleworking employees (around 19.00) because it may indicate an imbalance between free time and time intended for work, with possible negative effects in the medium and long term.

We have shown that the average duration of recorded time, but also the average duration recorded for actual work is higher in telework than the time recorded by subjects working from the office, which confirms the reports of previous research. In the same sense, subjects in teleworking spend more time documenting and recreating themselves with the help of the computer than participants who carry out work activities in the traditional system. We found that there are differences in terms of time spent on breaks, namely that office employees are the ones who recorded longer inactive times, both in duration and number. From the perspective of dynamism in computer interaction, by far telework employees are the ones who have recorded many more mouse, keyboard and focus events.

If the image of working days at the office is not unknown to managers, surely the way in which employees’ working days look in the home office is still a mystery to their superiors. By dividing the teleworking and traditional workdays into two-hour

intervals, we obtained a projection of the working days.

Organizational interventions, such as granting greater autonomy, building an environment of trust, offering flexible working hours and ensuring confidentiality, require additional attention from researchers. Adaptations of HR practices, such as changes in training, career development plans and performance appraisal systems, should also be investigated [15].

11. Limitations and validity

The most obvious limitation of the study is

related to the small number of participants, namely 12 employees from two companies. Convincing employees from the two companies to participate in the study was not an easy step, but without coherent arguments, this research would not have been conducted in this format.

However, the originality of the data collection approach, the significant number of events recorded by employees (approximately 52.5 million) as well as the number of days (1084) monitored, ensure consistency and credibility of research results.

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