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Authors: Francisco Nunes (FhP), Walter Baccinelli (ABACUS), Jorge Ribeiro (FhP), Ana Pereira (FhP), Enrico Cozzoni (GZE), Carlota González (BCB)

¹ L = Legal agreement, O = Other, P = Plan, PR = Prototype, R = Report, U = User scenario

² PU = Public, PP = Restricted to other programme participants (including the Commission Services), RE = Restricted to a group specified by the consortium (including the Commission Services), CO = Confidential, only for members of the consortium (including the Commission Services)

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Glossary

TAM Technology Acceptance Model

SUS System Usability Scale

List of figures

Figure 1 Clockwork kit includes Smartphone App, Smart Lamp, Smart Badge, and Clockwork Box.	11
Figure 2 Overall study design of Clockwork’s field trials.	13

List of tables

Table 1 Distribution of participants for each test site and for each phase	13
Table 2 Outcome measures of this study and their assessments.	14
Table 3 Health Locus of Control Scale Items. I= internally worded and E = externally worded. The scale is scored in the external direction, with each item scored from 1 (strongly disagree) to 6 (strongly agree) for the externally worded items and reversed score for the internally worded items.	38

Table of contents

1. Introduction.....	8
2. Objectives, participants, and equipment	9
2.1. Objectives	9
2.2. Participants	9
2.2.1. Recruitment.....	9
2.2.2. Inclusion and exclusion criteria	10
2.3. Equipment.....	10
2.3.1. Technical support	12
3. Methodology	13
3.1. Study design	13
3.2. Outcomes.....	14
3.3. Risks mitigation measures	16
4. Privacy	18
3.4.1 Impact of the GDPR on the CLOCKWORK Project.....	18
5. Ethical considerations.....	20
5.1. Legislation and Ethics Authority.....	20
5.2. Study information and Informed Consent	20
6. Appendices	21
6.1. Characterisation questionnaire.....	21
6.2. Morningness-eveningness questionnaire	23
6.3. Munich Chronotype Questionnaire for Shift-Workers (MCTQShift).....	29
6.4. Global Depression Scale.....	32
6.5. System Usability Scale.....	33
6.6. Technology Acceptance Model questionnaire.....	34
6.7. Shiftwork Locus of Control	37
6.8. Health Locus of Control	38
Bibliography.....	39

1. Introduction

The main goal of the Clockwork project is to promote a healthy and comfortable environment for middle-aged to older shift workers by providing support in improving their circadian rhythms. This objective will be achieved by promoting self-awareness of the workers' habits, and light interventions for increasing alertness or motivating sleep. In order to fully test the developed system on end-users, a field trial involving shift-workers has been planned. To maximally exploit the outcome of the tests, the field trial has been split into two phases. During the first phase, we will evaluate the initial feasibility of the system and collect inputs from the users in a formative fashion. Such inputs will be used to refine the system and provide an advanced prototype to be fully tested in the second phase of the trials.

The two testing phases will provide meaningful information on the perceived impact of the Clockwork approach on the shift-workers circadian rhythms, and on the overall usability and acceptability of the system.

In this deliverable the definition of the methodology and the metrics applied to the two field trials is described.

2. Objectives, participants, and equipment

2.1. Objectives

The trials of Clockwork have two three main objectives:

1. **Assess system feasibility and conduct testing on-field, towards system validation** - the interest of this objective is devoted to testing – with users - the Clockwork system in a ‘real life’ setting. The field trial settings will be designed to be as close as possible to the actual usage, this means close to the ways in which shift workers will use the system in their everyday work and life. During the field trials, the main goal will be to test Lab assumptions and understand if the design of the system fits the activities and context of shift workers. We will also be able to understand how useful and usable the system is to our end-users;
2. **Assess the impact of the system on the wellbeing conditions of shift workers** – the aim of this objective is in understanding the impact the system can have in the wellbeing conditions of the shift workers. While we do not expect the system to deeply influence their health status, we will investigate the impact it can have in their health, most especially the impact in their health locus of control;
3. **Test the commercialisation strategy** – our final objective is to test the business model developed during the project. In particular, we will investigate if the assumptions about potential customers, interested stakeholders, and potential distributors, these latter selected according with the distribution strategy developed, make sense in light of the trial results.

2.2. Participants

The trials will involve middle-aged to older shift workers engaging in work activities in a healthcare institution. We chose to pilot the system with healthcare workers because they represent 40% of the total amount of shift workers, and we did our user research work with these users.

In total, we will have **16 participants** in the trial, divided between two study phases, and three healthcare institutions in different countries. Dividing the pilot into two phases will enable us to perform adjustments to the system, to better adapt to the practices of shift workers. Moreover, piloting the system in different institutions will enable us to access participants with different work functions and engagements.

Our goal is to gather people from different professional groups, including nurses, nurse assistants, and security personnel, to understand the experience of workers doing different types of shifts. Consequently, our recruitment will be adapted to finding people with different work profiles.

2.2.1. Recruitment

Participants will be recruited from Portugal, Italy, and Hungary. In Portugal, participants will be recruited from the list of shift workers of CUF; thus, all Portuguese participants will be CUF employees. The participants from Italy and Hungary will be recruited from healthcare institutions by the local partner.

2.2.2. Inclusion and exclusion criteria

In summary, participants fulfilling all of the following criteria are eligible to participate:

- Shift workers working in a healthcare institution;
- 45 years of age or older;
- Owners of an Android smartphone;

Participants are excluded from the study if they exhibit one of the following exclusion criteria:

- Participant does not do night shifts;
- Participant does not have basic command of English

Since participants will use their own smartphone during the field trials, there are also some technological requirements that need to be met for the participant to be eligible to participate, in particular:

- Smartphone has Android version 5.1 (21 Lollipop)³;
- Smartphone has Bluetooth functionality⁴, in particular with Bluetooth low energy;
- Smartphone has Accelerometer sensors⁵;
- Smartphone is regularly connected to the internet, at least once a day (for transmitting data to the Firebase database);
- Smartphone has 50MB of free disk space available;

2.3. Equipment

Each participant will receive a kit containing:

- 1 x Smartphone application (link to install)
- 1 x Smart Badge (and wireless charger)
- 1 x Clockwork Box
- 1 x Smart Lamp
- 1 x manual and quick guide

³ Instructions to check the Android version of the smartphone are available at: <http://www.samsung.com/uk/support/mobile-devices/how-can-i-check-what-version-of-android-i-have-on-my-device/>

⁴ Bluetooth availability is identified if an option named Bluetooth appears in the smartphone's Settings.

⁵ If the screen rotates when the smartphone rotates from portrait to landscape mode, then the smartphone has an accelerometer. This can be tested, for example, in the web browser, by rotating the screen to the right/left.

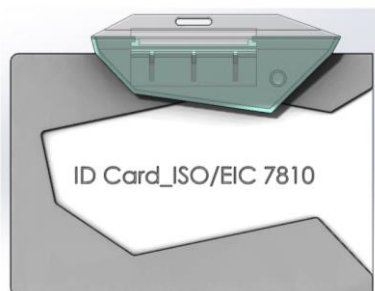
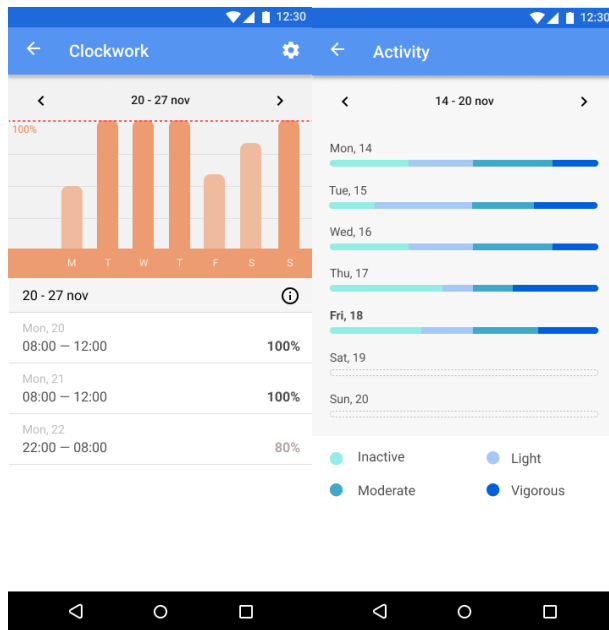


Figure 1 Clockwork kit includes Smartphone App, Smart Lamp, Smart Badge, and Clockwork Box.

Participants will receive a very short training session to understand how to use the system. The training will be provided *in loco* and will be aimed at:

- giving detailed information on the procedures to follow for switching on, connecting and using the equipment;
- checking the correct functioning of the system components;
- reporting technical issues using the devoted channels.

The technical personnel will setup the system before starting of the trial. The setup will include:

- installation of the smartphone application on the users' smartphones;
- running the setup on the smartphone and configuring the system for the user;

- positioning and boot up of the Clockwork box in the most suitable place in the work environment or at home according to the user preference;
- connection of system components (i.e. application with smart badge, smart lamp and Firebase; Clockwork box with Firebase) and functioning tests.

Participants will be asked to wear the Smart Badge while working, to monitor their sleep, activity, and light exposure. They may use the Smartphone application while at work or at home. Users will receive recommendations to use the Smart Lamp during the first hour of their night shifts, so that they can sleep better on the next day. Moreover, the Clockwork Box will be stationary, but users will be able to choose if they want to use it at work or at home.

2.3.1. Technical support

In order to offer technical support in the native language of each participant, each country will have a contact point that should be responsible for interacting with participants in the field trial. The contact person does not need to be from a technical background but should be able to assist participants with simple problems. Technical problems beyond the knowledge of the contact point should be forwarded to the appropriate technical partner. Overall, the contact point should be the person responsible for relaying information between participants and the technical partners. The technical support will be available during the normal work hours of each partner.

Three main contact lines will be implemented during the field trials: Email, phone, and WhatsApp. All of these contact lines will be open to all participants, and they can pick the one they deem more appropriated at any time.

In addition to the remote technical support, a brief instructions manual describing the basic function of the different components of the Clockwork system will be provided to each participant. Common issues and respective fixes (e.g. restart the application) will also be provided when possible.

3. Methodology

The field trial of the complete Clockwork system will be performed on a sample of 16 participants from 3 different centres in Portugal, Hungary, and Italy. The trial will be composed by two phases, 8-weeks long each: the first one will run from March 2018 to May 2018 involving 8 subjects (5 in Portugal and 3 in Hungary); the second one will run from September 2018 to November 2018 involving 8 subjects (5 in Portugal and 3 in Italy).

The first phase will aim at fine tuning and testing the system in real life conditions. During this phase, on one side the self-assessment tools as well as the quantitative data gather by the system itself all along the trial duration will be exploited to clearly define a detailed target profile of the user; on the other side, all the technical issues and inputs from the users will feed the refinement process of the system. During the second phase the refined system will be assessed.

Table 1 Distribution of participants for each test site and for each phase

Phase of the trial	Portugal	Hungary	Italy
First phase	5	3	0
Second phase	5	0	3

3.1. Study design

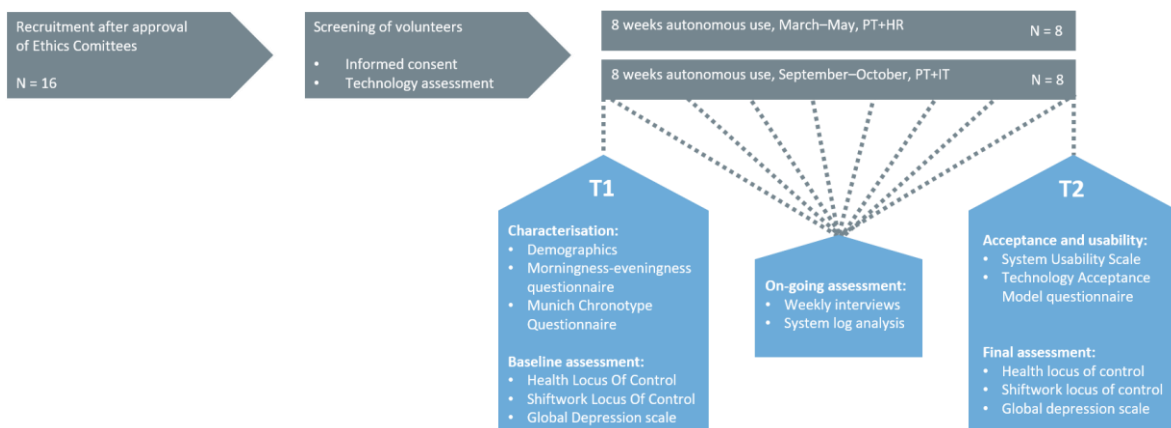


Figure 2 Overall study design of Clockwork’s field trials.

T1 assessment

At the beginning of the trial (T1), the participants will be characterized in terms of general health and sleep profile through the characterization questionnaire (section 5.1), the Morning-eveningness questionnaire (section 5.2) and the Munich Chronotype questionnaire (section 5.3). The last two

questionnaires are validated scales for investigating the sleep profile of the shift worker, and thus enable comparisons with other studies.

Besides characterising participants, at T1 we will also make a baseline assessment for measuring changes triggered by the use of the Clockwork system. We chose the Shiftwork Locus Of Control (section 5.7) and the Health Locus Of Control scale (section 5.8), because shift workers may feel more supported to deal with their work, rest, and physical effort, when using the Clockwork system. Moreover, we chose the Global Depression Scale (section 5.4), for capturing changes in the life satisfaction of shift workers.

On-going assessment

Participants of the trial will be interviewed regularly, for understanding their experience with the system and evaluating different impacts of the system on their habits and work. The interviews will often be conducted remotely, either by telephone, Whatsapp, or email. The analysis of the interviews will be qualitative and rely on Grounded Theory methods (Charmaz, 2006).

We will be also collecting usage data from the server logs, in particular:

- *Sleep Records*: The number of hours the user slept or took a nap, by day.
- *Activity records*: Level of activity during each shift.
- *Light treatments*. Number of times the user used the Smart Lamp.
- *Light records*: Average light exposure during each work shift.
- *Environmental records*: Environmental data about the light exposure, noise levels, and temperature.

T2 assessment

At the end of the 8-weeks trials (T2) the outcomes used in the baseline will be reassessed. Beside these elements, the usability of the acceptability of the system will be assessed using the System Usability Scale and the Technology Acceptance Model. These two scales were selected because they are the standard models for analysing self-reported usability and technology acceptance.

3.2.Outcomes

Table 2 describes the primary outcome measures of this study, including the methods for assessing them. It is important to note that we will be using both quantitative as well as qualitative methods, for understanding the experiences of participants with the Clockwork system. Following the table is a short description of each of the scales used in this study.

Table 2 Outcome measures of this study and their assessments.

Outcome	Assessed by
Sleep time	Average of sleep a day from logs

Locus of control	Shiftwork Locus Of Control (T1 vs T2) Health Locus Of Control scale (T1 vs T2) Insights from the regular interviews
Life satisfaction	Global Depression Scale (T1 vs T2) Insights from the regular interviews
Usability	System Usability Scale Insights from the regular interviews
Technology acceptance	System Usability Scale Technology acceptance Insights from the regular interviews

Shiftwork Locus of Control (SHLOC)

The SHLOC refers to generalised control beliefs about the degree to which an individual believes experienced outcomes are contingent upon personal behaviour and attributes (internally) rather than being under the control of external forces (externally). It is associated with levels of personal control which people perceive in relation to four major functional domains (sleep, social, health and work) commonly associated with shiftwork-related disruption. Developed by Smith (Smith, Spelten, & Norman, Shiftwork locus of control: Scale development, 1995), it is a twenty-item scale where each item is scored on a 6-point Likert-type scale with two extreme anchors, which were 1 = “strongly disagree” and 6 = “strongly agree”. SHLOC was used in other studies (Smith, et al., 2005; Smith & Mason, Shiftwork locus of control effects in police officers, 2001; Smith, Norman, & Folkard, Predicting shiftwork-related outcomes: Shiftworklocus of control and circadian type, 2001) where individuals with high internals shiftwork-specific locus of control appeared to show greater tolerance to shiftwork in terms of health. Compared to low internals, they were found to self-report fewer shiftwork-related sleep problems, better psychological well-being, better physical health and less work-related stress

Health Locus of Control (HLC)

Health Locus of Control relates to the extent to which individuals attribute their health to their own actions or to environmental circumstances and powerful external agents. An internal locus of control suggests that positive health results from one’s own doing, willpower or sustained efforts. In contrast, an external locus of control is marked by belief in the influence of fate, powerful others, or supernatural occurrences upon one’s health. Developed by Wallston (Wallston, Wallston, Kaplan, & Maides, 1976), it is eleven-item scale where each item is scored on a 6-point Likert-type scale with two extreme anchors, which were 1 = “strongly disagree” and 6 = “strongly agree”. HLC was scored so that high scores indicated agreement with externally worded beliefs. Individuals with scores above the median were labelled “health-externals”, presuming that they had generalized expectancies that the factors that determine their health are ones over which they have little control. On the other hand, Individuals that scored below

the median were labelled “health-internal”, who believe that the locus of control for health is internal and that one stays or becomes healthy or sick as a result of his own behaviour.

Global Depression Scale (GDS)

Global Depression Scale is a self-report measure of depression. Developed by Chan⁶, it is a 15-item scale in a “Yes/No” format answer. Of the 15 items, 10 indicate the presence of depression when answered positively while the other 5 are indicative of depression when answered negatively. Scores of 0-4 are considered normal, depending on age, education, and complaints; 5-8 indicate mild depression; 9-11 indicate moderate depression; and 12-15 indicate severe depression. The GDS was found to have a 92% sensitivity and a 89% specificity when evaluated against diagnostic criteria (Greenberg, 2012). The validity and reliability of the tool have been supported through both clinical practice and research.

Technology Acceptance Model (TAM)

The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably: the Perceived usefulness (PU), the degree to which a person believes that using a particular system would enhance his or her job performance, and the Perceived ease-of-use (PEOU), the degree to which a person believes that using a particular system would be free from effort. In addition, subjective norm, voluntariness and Job relevance, as proposed in TAM2 version will be investigated.

System Usability Scale (SUS)

An often used scale for evaluation of software products is the SUS which was developed by Brooke (Brooke, 1996). It provides a global view of subjective assessments of usability. The SUS consists of ten items performed on a 5-point Likert scale on which 1 corresponds to “strongly disagree” and 5 to “strongly agree”. The evaluation results in an easy-to-interpret score from 1 to 100, similar to a percentage score. SUS is a scientifically validated and reliable scale with easy application (Brooke, 1996; Albert & Tullis, 2013). The selected statements cover a variety of aspects of system usability such as the need for support, training and complexity but SUS focus more on pragmatic quality than hedonic aspects. Based on the verbal categorization/adjective rating of Bangor (Bangor, Kortum, & Miller, 2009), we expect a SUS score of at least 70 to have an “acceptable” solution (52= ok, 73 = good, 85 = excellent, 100 = best imaginable).

3.3.Risks mitigation measures

The risks associated to the running have been identified, and a mitigation plan has been developed for each risk. This will allow a smooth running of the field trial.

⁶ <http://oscarcanada.org/oscar-users/emr-resource/templates/GDS>

Risk	Mitigation measure
Failure of a system component.	Spare parts will be available at the testing site premises for replacement in case of failure. The available technical assistance will guide the replacement procedure.
Drop out of a subject.	In case of drop out of a subject, a new participant will be selected in the group of subjects found eligible for the study during the recruitment phase.
Non-functioning of the system not identified by the user.	In case a failure of the system occurs, but it is not recognizable by the user (e.g. motion data not transmitted, environmental data not available), the constant analysis of the logged data will allow the technical team to spot the issue and correct it.

4. Privacy

CLOCKWORK consortium is committed to ensure that activities in CLOCKWORK project are compliant with:

- On the one hand, the necessary ethics requirements specified in the description of Action and subscribed in the Grant Agreement and,
- On the other hand, the European Union legal framework (e.g. inter alia Directive 95/46/EC Personal data, General Protection Regulation and H2020 guidelines).

For this reason, a new procedure has been designed to ensure that all the legal requirements derived from the new GDPR are met: each partner will circulate the documents and deliverables generated among their own Ethics Committees and own Legal Departments responsible for regulation aspects.

Ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country in which the research is carried out.

CLOCKWORK consortium is aware of the new regulation affecting Data Protection and takes into consideration the new General Data Protection Regulation GDPR approved recently by the European Parliament.

3.4.1 Impact of the GDPR on the CLOCKWORK Project

Most relevant to the CLOCKWORK Project is the explicit addition of online identifiers in the definition of personal data. The recitals indicate that online identifiers may include IP addresses, and other identifiers found in devices, applications, tools, and protocols.

While these online identifiers are not necessarily personal data by themselves, when combined with other unique identifiers and other information which can be used to create profiles, the likelihood that such identifiers are personal data greatly increases.

Potentially most impactful is that if an entity is not able to use data to identify an individual but a third party can use that same data to identify an individual, then such data is personal data under a strict reading of the GDPR. For example, if an entity receives encrypted personal data but does not have the means to decrypt that data that data may still be considered regulated personal data when processed by that entity⁷. To the extent that the CLOCKWORK Project processes information that it cannot use to identify an individual, but which can be used by any other person to identify the individual, there is a greater likelihood that such data will now be personal data, notwithstanding the technical impossibility of the CLOCKWORK Project identifying the individual from such data.

⁷ This position mirrors what has previously been proposed by the Article 29 Working Party in its Opinion Paper 216 on Anonymisation techniques which describes encryption, hashing, and tokenization as pseudonymisation techniques (and not as anonymization techniques), available at http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2014/wp216_en.pdf

While the GDPR provides exemptions to specific obligations within the GDPR that require the controller to know the identity of the data subject (e.g., the exercise of data subject rights), other obligations such as obligations to provide notice, to have a legal ground for processing and to implement appropriate technical and organizational security measures continue to persist.

5. Ethical considerations

All ethical aspects relevant for the Clockwork trials were discussed in detail in an earlier Deliverable (Deliverable D2.1). Here we provide a short summary of the main aspects. For further details, please refer to the Deliverable D2.1.

5.1. Legislation and Ethics Authority

The trials of the Clockwork project will comply with the current legislation and regulations of the countries in which the research is carried out. Moreover, the project will comply with all relevant European Union (EU) legislation, especially the legislation below:

4. The European Charter of Fundamental Rights
5. Declaration of Helsinki of the World Medical Association (WMA)
6. EU-ICH-Guideline for Good Clinical Practice E6(R1)
7. Directive 2001/20/EC
8. International Ethical Guidelines for Biomedical Research Involving Human Subjects
9. Convention of the Council of Europe on Human Rights and Biomedicine
10. Directive 95/46/EC

Furthermore, in each country, there are different ethics authorities which have to approve all the research activities of the Clockwork project. Each partner is responsible to stay in contact with the respective ethics authority and get the ethical approval for the trials if needed.

5.2. Study information and Informed Consent

Following the national and European law, all participants will get a detailed study information in the respective language and they will have to sign an informed consent before starting the trial.

Participants have to be informed about research goals and methods/procedures. This information will be handed out in writing (study information) and orally. Potential participants will be notified in their own language and in a comprehensible way. The researchers will make future participants aware that their participation is completely voluntary, that they have the right to refuse to participate and that if they agree to participate they can still terminate their participation at any time and without providing a reason for their decision. The researchers will inform participants on a number of important factors which could influence their decision to participate (like risks/benefits, potential inconveniences or adverse consequences, restrictions to confidentiality etc.). Participants should get ample opportunity to read through the information, to ask the researcher any question and to consider their potential participation.

Informed consent is meant to guarantee the voluntary participation in research and is probably the most important procedure regarding integrity and privacy issues.

Informed consent consists of three important components: adequate information, voluntariness and competence. This implies that, prior to consenting the participation, participants should be clearly informed about research goals and procedures, potential risks and the possibility to refuse participation or withdraw from research at any time and without consequences.

6. Appendices

6.1. Characterisation questionnaire

The characterisation questionnaire has been developed to collect demographic information, health status and sleep quality of the subject.

General data

Age: _____

Sex: _____

Weight: _____

Height: _____

Number of meals in one day: _____

Meals time (for each meal): _____

In your family there are cases of: diabetes hypertension obesity
 myocardial infarctio stroke tumor
 depression none

Progress pathologies: diabetes hypertension obesity
 myocardial infarction stroke tumor
 depression gastric ulcer duodenal ulcer
 none

Current pathologies: diabetes hypertension obesity
 myocardial infarction stroke tumor
 depression gastric ulcer duodenal ulcer
 none

Are you assuming drugs with continuous use? If yes, list them _____

Work environment assessment

Job: _____

How long have you been working as night shifter (years)? _____

Number of night shifts per week (mean): _____

Night shifts duration (hours): _____

Sleep assessment

During the past month,

1. When have you usually gone to bed? _____

2. How long (in minutes) has it taken you to fall asleep each night? _____

3. What time have you usually gotten up in the morning? _____

4. A. How many hours of actual sleep did you get at night? _____

B. How many hours were you in bed? _____

5. During the past month, how often have you had trouble sleeping because you:	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good	Fairly good	Fairly bad	Very bad

6.2. Morningness-eveningness questionnaire

For each question, please select the answer that best describes you by circling the point value that best indicates how you have felt in recent weeks.

1. *Approximately* what time would you get up if you were entirely free to plan your day?

[5] 5:00 AM–6:30 AM

[4] 6:30 AM–7:45 AM

[3] 7:45 AM–9:45 AM

[2] 9:45 AM–11:00 AM

[1] 11:00 AM–12 noon

2. *Approximately* what time would you go to bed if you were entirely free to plan your evening?

[5] 8:00 PM–9:00 PM

[4] 9:00 PM–10:15 PM

[3] 10:15 PM–12:30 AM

[2] 12:30 AM–1:45 AM

[1] 1:45 AM–3:00 AM

3. If you usually have to get up at a specific time in the morning, how much do you depend on an alarm clock?

[4] Not at all

[3] Slightly

[2] Somewhat

[1] Very much

4. How easy do you find it to get up in the morning (when you are not awakened unexpectedly)?

[1] Very difficult

[2] Somewhat difficult

[3] Fairly easy

[4] Very easy

5. How alert do you feel during the first half hour after you wake up in the morning?

[1] Not at all alert

[2] Slightly alert

[3] Fairly alert

[4] Very alert

6. How hungry do you feel during the first half hour after you wake up?

[1] Not at all hungry

[2] Slightly hungry

[3] Fairly hungry

[4] Very hungry

7. During the first half hour after you wake up in the morning, how do you feel?

[1] Not at all tired

[2] Slightly tired

[3] Fairly tired

[4] Very tired

8. If you had no commitments the next day, what time would you go to bed compared to your usual bedtime?

[4] Seldom or never later

[3] Less than 1 hour later

[2] 1-2 hours later

[1] More than 2 hours later

9. You have decided to do physical exercise. A friend suggests that you do this for one hour twice a week, and the best time for him is between 7-8 AM. Bearing in mind nothing but your own internal "clock," how do you think you would perform?

[4] Would be in good form

[3] Would be in reasonable form

[2] Would find it difficult

[1] Would find it very difficult

10. At *approximately* what time in the evening do you feel tired, and, as a result, in need of sleep?

[5] 8:00 PM–9:00 PM

[4] 9:00 PM–10:15 PM

[3] 10:15 PM–12:45 AM

[2] 12:45 AM–2:00 AM

[1] 2:00 AM–3:00 AM

11. You want to be at your peak performance for a test that you know is going to be mentally exhausting and will last two hours. You are entirely free to plan your day. Considering only your "internal clock," which one of the four testing times would you choose?

[6] 8 AM–10 AM

[4] 11 AM–1 PM

[2] 3 PM–5 PM

[0] 7 PM–9 PM

12. If you got into bed at 11 PM, how tired would you be?

[0] Not at all tired

[2] Slightly tired

[3] Fairly tired

[5] Very tired

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which one of the following are you most likely to do?

[4] Will wake up at usual time, but will not fall back asleep

[3] Will wake up at usual time and will doze thereafter

[2] Will wake up at usual time, but will fall asleep again

[1] Will not wake up until later than usual

14. One night you have to remain awake between 4-6 AM in order to carry out a night watch. You have no time commitments the next day. Which one of the alternatives would suit you best?

[1] Would not go to bed until the watch is over

[2] Would take a nap before and sleep after

[3] Would take a good sleep before and nap after

[4] Would sleep only before the watch

15. You have two hours of hard physical work. You are entirely free to plan your day. Considering only your internal “clock,” which of the following times would you choose?

[4] 8 AM–10 AM

[3] 11 AM–1 PM

[2] 3 PM–5 PM

[1] 7 PM–9 PM

16. You have decided to do physical exercise. A friend suggests that you do this for one hour twice a week. The best time for her is between 10-11 PM. Bearing in mind only your internal “clock,” how well do you think you would perform?

[1] Would be in good form

[2] Would be in reasonable form

[3] Would find it difficult

[4] Would find it very difficult

17. Suppose you can choose your own work hours. Assume that you work a five-hour day (including breaks), your job is interesting, and you are paid based on your performance. At *approximately* what time would you choose to begin?

[5] 5 hours starting between 4–8 AM

[4] 5 hours starting between 8–9 AM

[3] 5 hours starting between 9 AM–2 PM

[2] 5 hours starting between 2–5 PM

[1] 5 hours starting between 5 PM–4 AM

18. At *approximately* what time of day do you usually feel your best?

[5] 5–8 AM

[4] 8–10 AM

[3] 10 AM–5 PM

[2] 5–10 PM

[1] 10 PM–5 AM

19. One hears about “morning types” and “evening types.” Which one of these types do you consider yourself to be?

[6] Definitely a morning type

[4] Rather more a morning type than an evening type

[2] Rather more an evening type than a morning type

[1] Definitely an evening type

6.3. Munich Chronotype Questionnaire for Shift-Workers (MCTQShift)

Munich Chronotype Questionnaire for Shift-Workers (MCTQ^{Shift})

The following questions concern your sleep- and wake behavior on work days and free days. Please answer them with regard to your current shift schedule, i.e. not all combinations have to be filled out! Also, please reply with regards to the current season (i.e., the last 6 weeks). Please try to answer ALL questions, even when an answer seems difficult! Spontaneous answers are often the best. Please help us in the evaluation of your data by providing unambiguous time references (e.g. 23:00 rather than 11:00 PM).

How to fill out the Munich ChronoType Questionnaire:

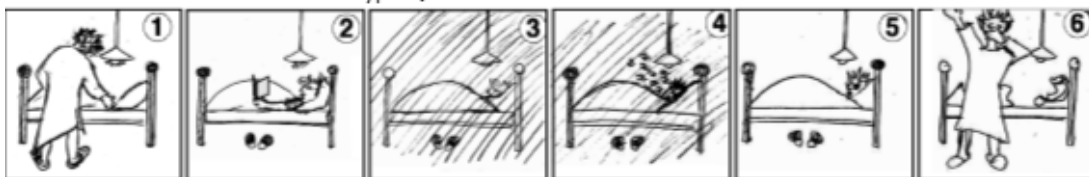


Image 1: The time when you went to bed.

Image 2: Note that some people stay awake for some time when in bed!

Image 3: The time when you “decided” to sleep, i.e. closed your eyes or turned off the lights.

Image 4: Minutes you usually spent of average on falling asleep.

Image 5: Time when you woke up.

Image 6: Minutes to get up.

Alarm: Indicate whether you used an alarm or not (NO, if you woke up before the alarm signal went off).

Between two shifts: Please indicate your sleep times between two shifts.

Between two free days after a given shift: Please indicate your sleep times between two free days after a given shift block (i.e., 2 free days after 4 days of morning shift in a row).

Between two Morning Shifts

I go to bed at _____ o'clock. (Image 1)

Note that some people stay awake for some time when in bed! (Image 2)

I actually get ready to fall asleep at _____ o'clock. (Image 3)

I need _____ minutes to fall asleep. (Image 4)

I wake up at _____ o'clock. (Image 5)

with alarm without alarm

I get up after _____ minutes. (Image 6)

I usually take a nap: Yes No

If “Yes”: I take a nap from _____ o'clock to _____ o'clock.

There are particular reasons why I **cannot** freely choose my sleep times on morning shifts:

Yes No

If "Yes": Child(ren)/pet(s) Hobbies Others, for example:

Between two days after Morning Shifts

I go to bed at _____ o'clock. (Image 1)

Note that some people stay awake for some time when in bed! (Image 2)

I actually get ready to fall asleep at _____ o'clock. (Image 3)

I need _____ minutes to fall asleep. (Image 4)

I wake up at _____ o'clock. (Image 5)

with alarm without alarm

I get up after _____ minutes. (Image 6)

I usually take a nap: Yes No

If "Yes": I take a nap from _____ o'clock to _____ o'clock.

There are particular reasons why I **cannot** freely choose my sleep times on morning shifts:

Yes No

If "Yes": Child(ren)/pet(s) Hobbies Others, for example:

Between two days after Evening Shifts

I go to bed at _____ o'clock. (Image 1)

Note that some people stay awake for some time when in bed! (Image 2)

I actually get ready to fall asleep at _____ o'clock. (Image 3)

I need _____ minutes to fall asleep. (Image 4)

I wake up at _____ o'clock. (Image 5)

with alarm without alarm

I get up after _____ minutes.

(Image 6)

I usually take a nap: Yes No

If "Yes": I take a nap from _____ o'clock to _____ o'clock.

There are particular reasons why I **cannot** freely choose my sleep times on morning shifts: Yes NoIf "Yes": Child(ren)/pet(s) Hobbies Others, for example:

Between two days after Night Shifts

I go to bed at _____ o'clock.

(Image 1)

Note that some people stay awake for some time when in bed!

(Image 2)

I actually get ready to fall asleep at _____ o'clock.

(Image 3)

I need _____ minutes to fall asleep.

(Image 4)

I wake up at _____ o'clock.

(Image 5)

 with alarm without alarm

I get up after _____ minutes.

(Image 6)

I usually take a nap: Yes No

If "Yes": I take a nap from _____ o'clock to _____ o'clock.

There are particular reasons why I **cannot** freely choose my sleep times on morning shifts: Yes NoIf "Yes": Child(ren)/pets) Hobbies Others, for example:

6.4. Global Depression Scale

	YES	NO
1. Are you basically satisfied with your life?		
2. Have you dropped many of your activities and interests?		
3. Do you feel that your life is empty?		
4. Do you often get bored?		
5. Are you in good spirits most of the time?		
6. Are you afraid that something bad is going to happen to you?		
7. Do you feel happy most of the time?		
8. Do you often feel helpless?		
9. Do you prefer to stay at home, rather than going out and doing new things?		
10. Do you feel you have more problems with memory than most?		
11. Do you think it is wonderful to be alive now		
12. Do you feel pretty worthless the way you are now		
13. Do you feel full of energy?		
14. Do you feel that your situation is hopeless?		
15. Do you think that most people are better off than you are?		

6.5. System Usability Scale

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5

6.6. Technology Acceptance Model questionnaire

The questions are evaluated using a Likert scale from 1 to 7 with the following meaning.

7. Strongly disagree
8. Moderately disagree
9. Somewhat disagree
10. Neutral (neither disagree nor agree)
11. Somewhat agree
12. Moderately agree
13. Strongly agree

PERCEIVED USEFULNESS

11. I find Clockwork to be useful in helping me facing the night shifts

1	2	3	4	5	6	7
---	---	---	---	---	---	---

12. Using Clockwork improves the quality of my sleep

1	2	3	4	5	6	7
---	---	---	---	---	---	---

13. Using Clockwork improves the recovery from the night shift

1	2	3	4	5	6	7
---	---	---	---	---	---	---

PERCEIVED EASY OF USE

14. It is easy to get Clockwork to do what it is intended to do

1	2	3	4	5	6	7
---	---	---	---	---	---	---

15. Clockwork is easy to use

1	2	3	4	5	6	7
---	---	---	---	---	---	---

16. Interacting with Clockwork does not require a lot of mental effort

1	2	3	4	5	6	7
---	---	---	---	---	---	---

17. The interaction with Clockwork is clear and understandable

1	2	3	4	5	6	7
---	---	---	---	---	---	---

SUBJECTIVE NORM

18. People who influence my behaviour think that I should use Clockwork

1	2	3	4	5	6	7
---	---	---	---	---	---	---

19. People who are important for me think that I should use Clockwork

1	2	3	4	5	6	7
---	---	---	---	---	---	---

20. In general the hospital has supported the use of Clockwork

1	2	3	4	5	6	7
---	---	---	---	---	---	---

VOLUNTARINESS

21. My use of Clockwork is voluntary

1	2	3	4	5	6	7
---	---	---	---	---	---	---

22. My supervisor does not ask me to use the system

1	2	3	4	5	6	7
---	---	---	---	---	---	---

23. Although it might be helpful, using Clockwork is certainly not compulsory

1	2	3	4	5	6	7
---	---	---	---	---	---	---

JOB RELEVANCE

24. The use of Clockwork is pertinent to various tasks

1	2	3	4	5	6	7
---	---	---	---	---	---	---

25. Usage of Clockwork is relevant

1	2	3	4	5	6	7
---	---	---	---	---	---	---

26. Usage of Clockwork is important

1	2	3	4	5	6	7
---	---	---	---	---	---	---

6.7. Shiftwork Locus of Control

SHLOC is divided into 4 scale items: sleep, social, health and work.

1. Sleep
 - 1.1. I am responsible for how well I sleep when on shiftwork.
 - 1.2. The kind of sleep I get when working shifts depends most on my own behaviour.
 - 1.3. My own actions determine whether or not my sleep is disrupted when I work shifts.
 - 1.4. It is my own fault if my sleep suffers when I am working shifts.
 - 1.5. When I work shifts I have control over the quality of sleep I get.
2. Social
 - 2.1. It is my own behaviour which influences the extent to which my social life is interfered with when one shifts.
 - 2.2. When working shifts I determine whether or not I have a proper social life.
 - 2.3. If my social life is disrupted when working shifts, I am to blame.
 - 2.4. When I work shifts it is my own fault if my social life suffers.
 - 2.5. I am responsible for the quality of my social life when I work shifts.
3. Health
 - 3.1. When working shifts my well-being depends on my own actions.
 - 3.2. I control whether or not my health is harmed when I work shifts.
 - 3.3. My physical well-being depends on how well I take care of myself when I work shifts.
 - 3.4. If I become ill when on shifts, I have the power to make myself well again.
 - 3.5. If I feel ill when I am working shifts it is because I have not been taking care of myself properly.
4. Work
 - 4.1. When working shifts, the effectiveness of my work performance is due to my own behaviour.
 - 4.2. When on shifts I can influence my job performance.
 - 4.3. It is my own behaviour which determines my job performance when I work shifts.
 - 4.4. When on shifts I determine whether or not I get good results at work.
 - 4.5. When on shifts I am responsible for the quality of my work performance.

6.8. Health Locus of Control

Table 3 Health Locus of Control Scale Items. I= internally worded and E = externally worded. The scale is scored in the external direction, with each item scored from 1 (strongly disagree) to 6 (strongly agree) for the externally worded items and reversed score for the internally worded items.

Item	Direction
1. If I take care of myself, I can avoid illness.	I
2. Whenever I get sick it is because of something I have done or not done.	I
3. Good health is largely a matter of good fortune.	E
4. No matter what I do, if I am going to get sick I will get sick.	E
5. Most people do not realize the extent to which their illness are controlled by accidental happenings.	E
6. I can only do what my doctor tells me to do.	E
7. There are so many strange diseases around that you can never know how or when you might pick one up.	E
8. When I fell ill, I know it is because I have not been getting the proper exercise or eating right.	I
9. People who never get sick are just plain lucky.	E
10. People's ill health results from their own carelessness.	I
11. I am directly responsible for my health.	I

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