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Deliverable Description	This deliverable reflects the outcomes of task T2.2 and T2.3. It presents integrated scenarios and use cases and it describes the functional specifications of the PEARL applications.
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Executive Summary

This Deliverable (D2.2) describes the common Vision of PEARL from the “Ideation” through the scenarios and use cases, which are completed the illustration of some selected use cases. This Deliverable specifies a set of representative use cases and scenarios associated with the deployment, configuration and use of the PEARL turn-key solutions. Therefore during the Kick-off meeting and First Transnational meeting each partner was requested to **creating a common vision** (3) for the PEARL platform in order to figure out the main components and provide written preliminary scenarios (4) per partners that was discussed within the consortium during the second and third transnational meetings. We organized the first common workshop at the Kick-off Meeting in Vienna to discuss the ideas of the various partners for creating a common understanding that we shared with local stakeholders in Romania, Netherlands and Switzerland. D2.2 illustrates some of these scenarios in storyboards (8). These scenarios will be used to drive the project in design, implementation, testing and evaluation (as part of this and other work packages of the project). This Deliverable is based on a PACT (People, Activities, Context and Technology) framework in order to specify use cases and scenarios that describe functionality on how actors interact with PEARL. This task is strongly related to T2.1 and lays the foundations for T2.3.

In Chapter 3 we explain the vision workshop with some streamlining.

In Chapter 4 we give descriptions in details of the method in writing the preliminary scenarios.

In Chapter 5, the text includes a detailed description of all the steps we followed in getting from requirements to features as well as the outcomes: (1) the feature list derived from the preliminary scenarios, (2) the feature list derived from the contextual interviews and observations and experience sampling, which includes the description of how we arrived at the final list of features.

In Chapter 6 we present detailed use cases (No 1-26) on a common standard template.

In Chapter 7 we provide information regarding the integrated functionalities of the PEARL platform based on the user requirements, where the functionalities are split in five categories, such us “Functional, Usability, Accessibility, Reliability and Security”.

In Chapter 8 four use case diagrams are illustrating exemplary the selected Scenarios.

1. About this Document

1.1. Role of the deliverable

This deliverable reflects the outcomes of task T2.2 and T2.3. It presents integrated scenarios (No 1-9) and use cases (1-26) which are clustered cases and it describes the functional specifications of the planned PEARL applications.

1.2. Relationship to other PEARL deliverables

The deliverable is related to the following PEARL deliverables:

Deliv:	*Relation*
D2.1	**Report on User and Stakeholders Requirements**: This deliverable describes the requirements engineering work that will be carried out in the scope of T2.1
D3.X	The deliverables of WP3 will describe the technical realisation and implementation of the PEARL modules which incorporate the use cases described in this document.
D4.1	**System Architecture Specification and Implementation**: Use Cases and desired functionalities are the base for the upcoming specification phase and thus have a direct influence on the definition of the system architecture.

2. PEARL Vision

2.1. Workshop for Creating a Common Vision

The main goal of PEARL is to enable the development and deployment of ICT-based ergonomic motivating age-aware and age-friendly workspaces, on the basis of a unique blending of leading edge technologies. As a first step in the project, and to kick off activities towards achieving this goal, we conducted a joint workshop that involved all partners at the Kick-off meeting in Vienna.

The goal of the workshop was to create a set of compelling posters that summarize how everybody envisions the PEARL system. As is often the case when thinking about a new project, everybody has a certain idea or picture of a desired system in mind. For some partners this picture may be rather vague, while for others it may be quite specific already. The idea behind organizing a joint workshop was therefore to foster a common understanding by exchanging and discussing initial ideas for the PEARL platform and its components, and to develop a common vision that is shared by every partner.

The workshop involved the following stages:

1. Partners were divided into pairs (6 pairs in total)
2. Each pair worked out its own vision on a poster (20 min time limit)
3. Each poster was pitched in front of all partners (2 min per poster)
4. Ideas were prioritized following a dot-voting in which each partner assigned sticky dots (or bookmarks) to the posters he/she found most interesting
5. The ideas were discussed and consolidated in a common vision.

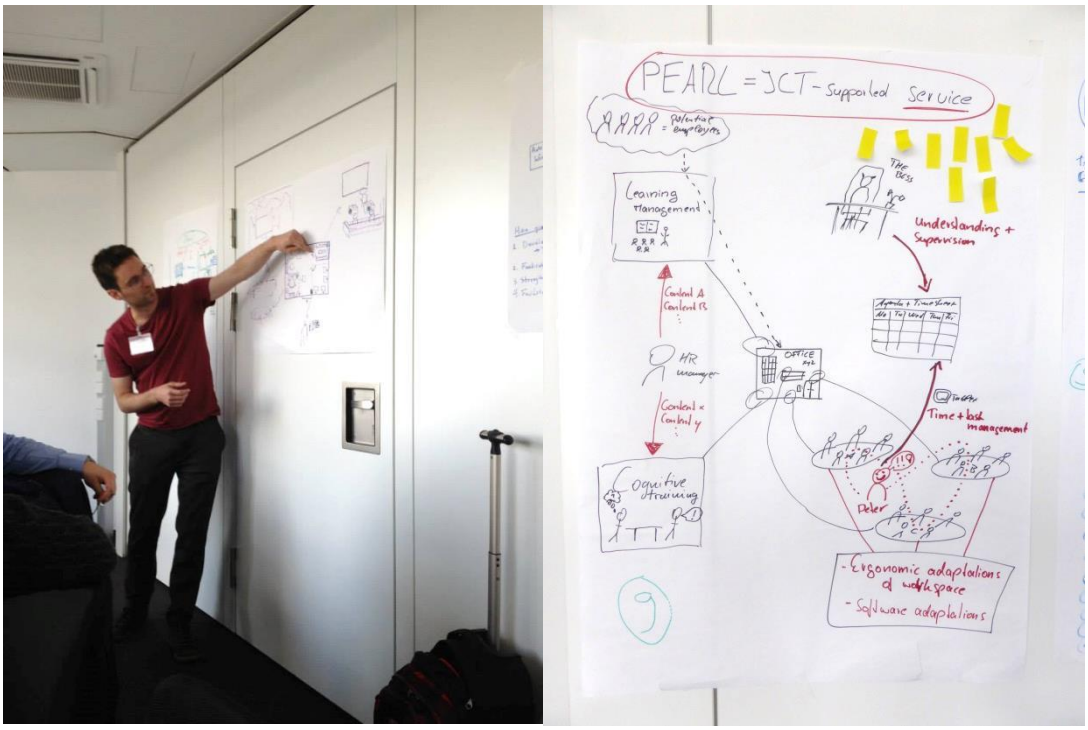


Figure 1 Stages 2-4 of the Vision Workshop

2.2. Vision: A Smart and Flexible Work and Home Environment

The main objective of the PEARL project is to support a prolonged, productive and satisfactory involvement of older employees in working life. This means fully harnessing their potential as holders of experience and knowledge, adapting to specific requirements common to this group (such as those stemming from caring responsibilities) as well as compensating for negative effects resulting from potentially reduced physical or mental capabilities. Creating an environment that can support older employees in staying active and productive longer will benefit both the older employees themselves (through increased well-being, quality of life, etc.) and their employers (through preserving essential know-how, reducing sick time, etc.).

PEARL will achieve this by developing and deploying tools for the creation of flexible, ergonomic and motivating workplaces within a smart environment for older employees.

PEARL will target different locations of working environments (home, office) as well as different working types (individual work, collaborative work).

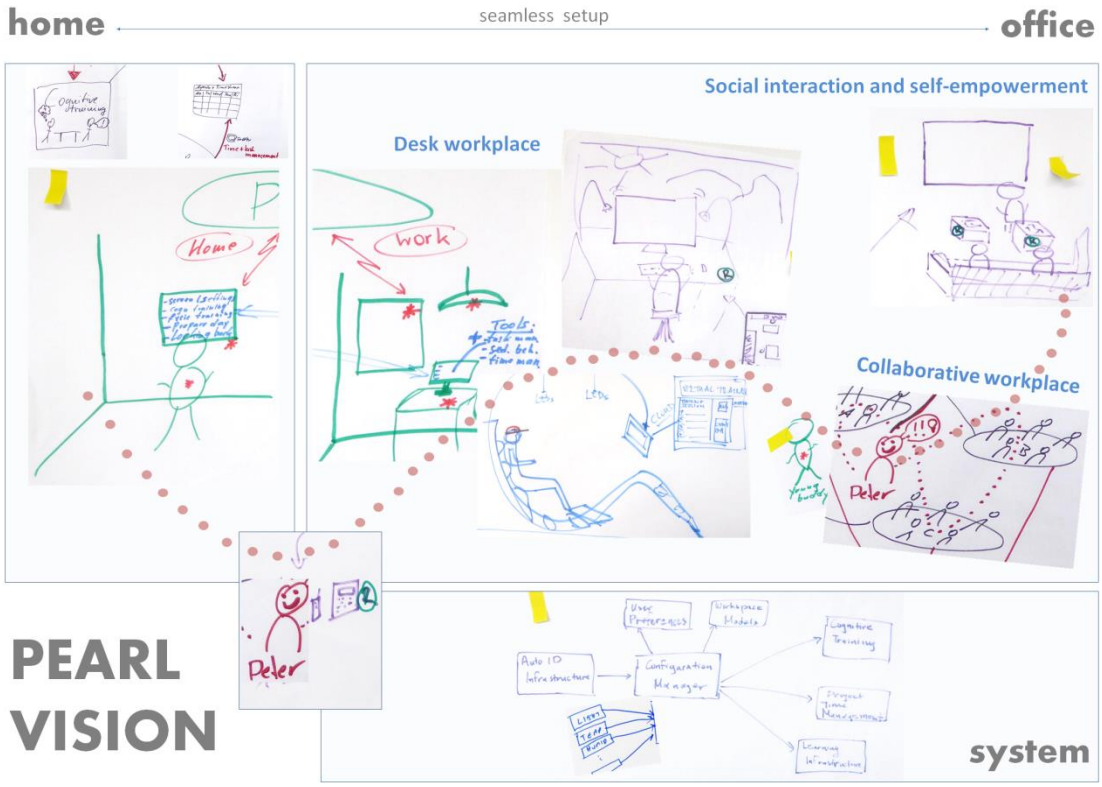


Figure 2 Consolidated common vision depicting different working locations (home, office) and working types (individual work, collaborative work)

Our vision of the PEARLplatform is depicted in **Figure 2**above. It foresees a seamless setup and integration of the home and the working environment, allowing older employees to alternate freely between both. PEARL will encompass support for task and work flow management, for ergonomic adaptations of different types of workplaces, for collaborative and individual work as well as for skills training and cognitive gaming.

Employees will have high discretion over how they will use PEARL in day-to-day life, in keeping with their own needs but also respecting requirements of their employer. To facilitate this, PEARL will be highly configurable not only at first setup but throughout its operation. At no point will PEARL prescribe specific working practice, but rather offer highly customizable support to increase employee satisfaction and productivity.

PEARL envisions a working environment that allows older employees to alternate freely between various kinds of workplaces – according to personal preferences and the nature and requirements of the work tasks. In the next paragraphs, we present the envisioned working environments at different locations (office & home), while considering the different working types (individual & collaborative) that are usually performed at each location.

Office Environment

The office shall contain spaces for privacy and silence when high concentration is needed, spaces for exchange and collaboration between colleagues to encourage teamwork, and in addition leave room for training and self-empowerment activities.

More specifically, PEARL envisions three kinds of workplaces within the office: the private desk workplace, the collaborative workplace, and the social workplace. The private desk is

the most individual of the three workplaces. Using AutoID recognition, it automatically adapts its ergonomic parameters, based on previously set personal preferences. It can be used when an employee needs a quiet place in the office to focus on a task. At the same time the actual desk can rotate freely through the available office space, e.g. from one workday to the next. The collaborative workplace facilitates both classical team work and specialized use cases such as the older employee acting as a mentor or advisor to various teams within the company. It offers easy means of sharing content from private devices to a public screen, collaborative work on digital assets, and joint task and workflow management. The social workplace is envisioned for interactions between colleagues (for team building and intergenerational exchange), for cognitive games, skills training but also for leisure activities in work breaks.

Home Environment

The integration with the home environment will allow older employees to carry over work tasks into a more familiar, quiet and potentially productive setting, as well as to respond flexibly to unforeseen circumstances, e.g. caused by caring responsibilities. A key requirement for PEARL services for the home environment will be to safe-guard the home against unwanted intrusion of work matters as well as to ensure adherence to health and safety regulations. Thus, employee preference and health and safety regulations will be the main criterion to define which work tasks they will do in the home. The employee will be able to select from a number of use cases or work tasks to be supported, including cognitive games, skills training, non-collaborative work on digital assets, as well as task management and agenda planning.

Summary box: PEARL common vision

The common vision of PEARL partners is to support a productive, prolonged and satisfactory involvement of older employees in working life by:

- Harnessing their potential as holders of experience and knowledge
- Compensating negative effects of potentially reduced physical or mental capabilities
- Adapting to specific requirements in terms of caring responsibilities
- Integrating home and working environment seamlessly

PEARL partners will create a working environment that allows older employees to alternate freely between various kinds of workplaces -- according to personal preferences and the nature of the work tasks:

Home environment

- ✓ Responding flexibly to unforeseen circumstances
- ✓ Carrying over tasks into a more familiar and potentially productive setting
- ✓ Safe-guarding the home against unwanted intrusion of work matters

Office environment

- ✓ Private and silent places when high concentration is needed (Private desk workplace)
- ✓ Spaces for exchange and collaboration between colleagues (Collaborative workplace)
- ✓ Rooms for training and self-empowerment

3. Preliminary Scenarios

In this project we used scenarios as a tool to stimulate debate about the future of PEARL platform. The idea behind this step was to bring to life the shared vision that originated from the common workshop at the kick-off by taking the perspective of the user. For that purpose, each partner was asked to think about and write down his/her own vision of the PEARL platform. Together with the selected features derived from the contextual interviews and observations (see chapter 5), these written scenarios served as a basis for specifying the use cases (see chapter 6).

For writing the scenarios all partners received the following instructions (based on Rosson& Carroll, 2002):

The scenarios are intended as a first *sketch of use* that describes *how* the user interacts with the PEARL system.

- ✓ Try to put yourself in the shoes of an imaginary user who tries to accomplish several work tasks or activities.
- ✓ Focus on the user and his/her experience with the system rather than technical details of how the system provides that experience.
- ✓ Use concrete examples that allow people who read your scenarios to quickly empathize with the user.
- ✓ Consider his/her motivations/goals, knowledge, capabilities, and describe the setting in which everything takes place.
- ✓ If you feel limited by the technical constraints or the current state-of-the-art, it might help you to think of a PEARL platform of the future, 20 or 30 years from now.
- ✓ Feel free to take a look at the PEARL vision document for inspiration or for checking alignment with the common vision

In short: the basic idea of the scenarios is to take the **perspective of the user**, describe **his/her experience** both *concretely* and *vividly* but *without worrying* about the technical details (they will become relevant later on in the use cases).

All partners were further given the following example scenario about a *collaborative virtual environment* that enables university students to interact with their friends at the science fiction club:

> After three years at Virginia Tech, Sharon has learned to take advantage of her free time in-between classes. In her hour between her morning classes, she stops by the computer lab to visit the science fiction club. She has been meaning to do this for a few days because she knows she'll miss the next meeting later this week. When she tries to start up the online collaborative environment, she finds that this computer does not have the client, so she waits for a minute or two while it is automatically downloaded and installed. After she logs in, she is taken back to her previous visit location, and sees the familiar panoramic view of her livingroom, her to-do lists and sketchpad, and the interactive map of Blacksburg. She positions and zooms in on the map until she can see downtown buildings. She enters the Eastenders Pub subspace, where the science fiction club usually meets. She sees a panoramic image of bar, faces that show Bill and Sara are here, a food and drink menu, and various standard tools. The map updates to show a floorplan of the Pub—the dining room, the darts room, the office, and the main bar. Bill and Sara are using a chat tool and a shared whiteboard to sketch an event timeline for Asimov's Robots and Empire. Joining Bill and Sara in the chat tool, she types "Based on the Zeroth Law, I'm afraid I must drink some of your beer".
>
> — (see Rosson& Carrol, 2002, Table 1)

3.1. Scenario 1

Manfred

Background

Motor Design S.A. has installed PEARL platform at its premises to facilitate the work of the elderly workers. Manfred is a 58 year old engineer with vision loss problems, employed currently by Motor Design S.A. Manfred has noticed difficulties in attention and memory during the last years. Apart from these difficulties, Manfred finds it difficult (compared to his younger colleagues) to catch up with the latest technologies, e.g., find and access online tutorials relevant to his work, get familiar with new time management and collaborative tools. For all these reasons, Manfred has started to think about retirement. However, his recent experience with the PEARL platform has significantly improved his work performance and overall quality of life.

Scenario

Manfred uses his RFID card when entering his office to get identified by the PEARL platform. PEARL platform identifies Manfred and configures the workspace according to his needs. The font size in his PC monitor is set at the preferable size, while written instructions are accompanied with voice instructions, whenever possible. The light in the room is configured to facilitate his vision and the temperature is kept in his preferred level.

Manfred is able to easily keep track of his running projects and upcoming tasks through the use of the dedicated PEARL task & time management tool and the PEARL Master calendar where all different calendars that until now he utilised, are merged. The platform's project and time management tool uses a simple interface with large fonts allowing to track the progress of his running projects and organize his work in a more efficient way. In addition to those, Manfred also easily keeps up with daily chores using the digital noteboard through which he also shares events and tasks with his colleagues.

During the day, Manfred has scheduled several meetings. When he is out of office, he prefers to switch off the lights in his office and set his computer in sleeping mode. Using the Preference Editor, Manfred needs only to switch his task on “Meeting” mode, and PEARL platform will automatically adjusts his workspace, while also prepare the meeting room for him (Switch on the lights and turn on the beamer)

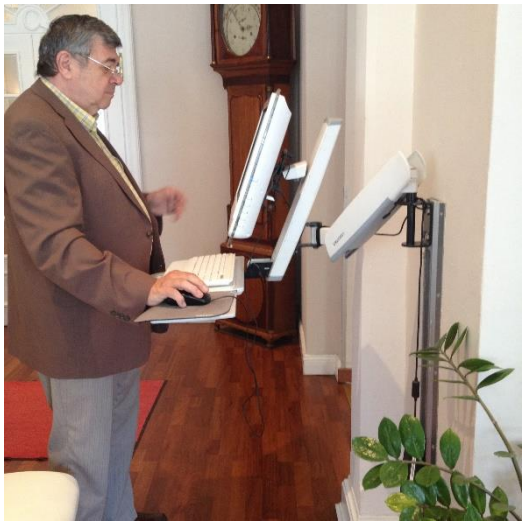
Today has been a very busy day, and Manfred has been sitting at his chair for many hours. PEARL has been configured to notify Manfred when it understands that he should take a break and prompt him to be physically and mentally active. Thus, PEARL notifies

Manfred that he should take a short break from work, possibly to go out and have a short walk alone or his friends at the park that is opposite to the company building.

After Manfred returns from his short walk, he decides that it is time for a crash-course on how to organise his e-mails. Manfred went through a very busy period where he did not have the time to get engaged with e-mail management, thus he decides to follow this e-learning session provided to him through the PEARL platform. Through PEARL he also has access to numerous tutorials and training material that can keep him up-to-date on his work. Manfred's access to the learning material is adapted to his personal needs, while the tutorials are accompanied with video and/or voice wherever possible, and the text is displayed in large fonts so as to compensate for his poor vision.

It is nearly the end of his business day. Manfred decides that before going back home he should get engaged with a couple of cognitive training games, targeting the exercise of memory and attention. Thus Manfred interacts with the PEARL platform and plays a couple of serious games provided through the platform.

3.2. Scenario 2



Tibor

Background

Tibor who is 69 years old, economist, with his passion of Information Technology, he lives alone in his home in Hochdorf, but he is still working actively. He spending 2-3 days per week in his company office, but he works from home more and more as remote worker, where he has 3 different workstations(Microsoft, Mac and LINUX).He has been working as an IT teacher at High school before, and now as a treuhand for many years now. This a highly-demanding job in terms of knowledge but also in terms of skills, concentration and memory. Nevertheless, he always enjoyed it and is now well known for the quality of his work in his area. During the last year, he started to experience some difficulties when performing his tasks. He indeed felt his movements were a bit less precise than before, his back was more and more hurting when staying in the same chairs. Additionally his hearing and visual acuity are deteriorated also a lot. As he was worried to see his working difficulties, he convinced his company to provide him with new tools and devices to help him carry out his daily tasks.

Scenario

His company bought 2 new chairs to him, one for his company workplace and another one for his home workplace and he was supported during the installations by a Swiss Service Team. They proposed him how to adjust chair to a suitable height, what is the best tilt seat for lumbar support which allow adequate knee clearance under the desk and a strong advice: “do not sit in the same position for long periods”. Now he works on his connected PEARL ergonomic workstations in both places, equipped with different features. To address his visual acuity difficulties, he now uses a high quality camera and he ordered a hearing aids. He went also to the eyes control and few weeks ago he has changed his reading glasses. He was looking for some tools, like collocated and collaborated features and tools on PEARL which encourage him and his clients to keep the close cooperation. Since Tibor`s home job requires the working hours registration, he make a work-time register which is a feature on PEARL.

In his private life Tibor also use the same workspace and he really enjoy some functions, tools (serious games) and e-learning short courses in his free time, which can be used online and offline as well. He start to work almost every day, after his early wake-up at 5 a.m. to play with memory games on his iPhone just for few minutes.

Tibor has a friend in Austria since 30 years, in Burgenland, his name is Gyorgy, who is historian (85 years old), who has similar interests. Tibor and Gyorgy both enjoy to talk freely about all kind of new learning contents and brain games like memory and cognitive games. Both confirm their interest during their regular skype chats and they are enjoying that their actual computer adds them tips daily on the new learning boxes and games for seniors to their personal buddy lists. Based on their free times, they are enjoying several times a week to find and play with some memory games available on the PEARL workspace. Thanks to PEARL, Tibor and Gyorgy share more and more time and activities online and offline together to keep their old friendship.

3.3. Scenario 3

Suzy

Background

Suzy is a 62 year old woman, widowed and working as a web designer for an IT company. As Suzy is very experienced, she is very popular and most of the time engaged in the bigger projects. Suzy loved to do this for quite some years, but the last few years she is getting more and more problems with the management of these big projects as she starts losing overview and starts forgetting things. She also struggles with vision loss, which makes it even more difficult for her to get familiar with all the new technologies.

The last few years, Suzy encounters difficulties in managing all planned activities in the various projects. Additionally, the distractions in her office environment are an increasing burden to her as she often fails to fully concentrate on her work. In her younger years, this would not have been a problem but, since a few years it became more difficult to isolate herself from the environmental stimuli in her work environment.

Suzy is also becoming more and more tired from traveling around to clients and getting physical complaints from every time changing suboptimal working places, which she faces in the current flexible desk culture her company seems to like. On the other hand Suzy is really enjoying that her younger colleagues are very eager to learn from her extensive experience, what makes that Suzy does her utmost best to stay in this current position of leading the big projects. Suzy would really like to become more physically active during her workdays and to take decent, relaxing breaks again. Additionally, she would like to become more efficient in scheduling her tasks. However, she does not know how to and who to ask.

Scenario

The introduction of PEARL: Suzy was notified by one of her colleagues on the PEARL system. He told her that PEARL could help her in managing her projects and tasks and that it also supports physical activity as it provides break suggestions based on her sedentary behaviour and/or when the system detects time gaps in her agenda. Suzy decided to give it a try, because she could really use some help in keeping an overview of the projects she is running and by planning enough breaks to stay physically healthy and focused during the workday.

The use of PEARL: *Initial settings of PEARL*

To get engaged in the PEARL system, Suzy got a personal RFID chip integrated in a smart watch and she had to fill in a questionnaire in which she is asked about:

- her physical characteristics (e.g. gender, age, length, body weight),
- her physical, social, material and emotional well-being,
- whether she experiences any physical complaints and/or wants to set long-term targets regarding her physical activity,
- personal development and activity (e.g. working hours, leisure time, the level of motivation and challenge in her job),
- her preferences about her working schedule and working conditions (e.g. light, background, sound, environment),

- about what and how she would like to be reminded and enabled to get optimally prepared for the different tasks and
- additional characteristics of her working environment while collaborating with colleagues.

This enabled PEARL to create a first personalized setting of Suzy's working environment and other work related preferences. PEARL includes for example a support service that advices to take a break and to execute physical exercises and a program that could support Suzy in scheduling her tasks throughout the day. It could also assist her in setting up a mutual learning project with a younger colleague.

Daily routine starting up PEARL

It is Monday morning; Suzy wakes up, showers, starts the PEARL system at home and attaches her accelerometer to her belt. The PEARL system welcomes her, notifies her about the weather and advices her when to leave the home, because PEARL knows based on the questionnaire, that Suzy likes to go to work by bicycle. It also provides her some news items of her interest to have a friendly start-up of the week. PEARL shows Suzy her agenda and reminds her on the tasks that have a due date for today so Suzy does not forget. When arriving at the office, Suzy is being recognized by her RFID chip as she swipes the card in front of the reader and gets directed to one of the flex spot that is being automatically configured to her pre-set preferences. The lights in the room and the sound levels of her laptop are muted. The availability indicator on her desk switches on and lights up in red, orange or green based on her first planned task and the digital picture frame on her desk starts rotating family photos.

Task Management – preparing a meeting

At 11 o'clock Suzy has an appointment with one of her clients and PEARL suggests her to prepare the meeting by showing her pointers to all necessary reports and presenting the agenda for the meeting. Suzy made these suggestions herself when she scheduled this call, as PEARL asked her to attach pointers of the related documents. When Suzy opened one of the attached documents she caught herself staring at the small figures in the document with which she has difficulty reading. She opens the ZoomIt tool from her PEARL taskbar to enlarge the figures and to easily toggle between zooming and normal view.

Intergenerational knowledge transfer

When she starts preparing, she is notified by the PEARL system that her younger colleague Leon has being indicated as her younger fellow for this specific job and PEARL suggests to notify him that she started with the preparation. Leon shows up after being notified and they start working together. PEARL notices that Leon has arrived and adapts the working environment to support the collaboration. The shared screen option starts on both Suzy's and Leon's laptop, in this way they can still use their own devices. They also use a shared drive on which they can easily exchange knowledge and information. As Leon is much more familiar with the project management program: KIMAI, with which their office is working, Suzy has more knowledge regarding the strategic issues that are important for this specific job and client, so both can learn from each other.

Exercise Prompter

After the morning meeting the PEARL system notifies Suzy that she has been quite sedentary the whole morning, so it would be good idea for her to go for a short walk during lunch. During her lunch walk PEARL suppresses all notifications, but does make a trade off in degree of urgency (e.g. an e-mail in which she got invited to a meeting does not require immediate action). When Suzy arrives back at the office she is notified by PEARL that Leon already implemented the actions that came out the meeting this morning, making it able for Suzy to close this job for today and look at other issues that need to be done.

Task Management – an overload of tasks

When she arrives back from her lunch walk, a few colleagues came into her office with some urgent questions. She also received a lot of new emails and planned all kinds of work tasks. Usually, she would have tried to manage all these things in parallel. Therefore she presses the 'emergency button' on the digital noteboard to indicate that she wants to take care of the urgent questions of her colleagues first, to which PEARL immediately reacts by rescheduling all other planned activities based on priority and advises her when to execute each activity in the afternoon. After she instructed her colleagues what to do, she started sorting her email with the help of PEARL. While she was answering her email the availability indicator on her desk turned orange, because she needs to focus on this task, but is still available for urgent questions.

Time Management

At 4 pm, PEARL suggests her to go home by bicycle one hour early, based on the weather forecast – as this will prevent Suzy from bicycling through a shower – and suggests scheduling an hour in the evening at home to do the rest of the email. Suzy agrees to go home and PEARL provides her the overview of the day: things that were finished in time, but also things that she did not manage during the day. PEARL asks Suzy whether to reschedule these tasks in the next days, but also advises her for which tasks she probably could ask her younger fellow in the context of their mutual learning project. Suzy notifies that there were indeed some tasks that are nice for Leon to learn from and assigned some of these to him. PEARL notifies via the location detection of her smartphone that Suzy left and restores the environment in the neutral position.

Cognitive training

When arriving at home Suzy made dinner, after which she did her email and then decided to relax a bit. Suzy has indicated to PEARL that she likes gaming to help her relax. PEARL knows from Suzy's calendar that Suzy's workday has been finished and advises her some nice "SOCIABLE" brain games. In this manner, PEARL will not only support Suzy during working hours but also helps her to relax while training her cognitive function.

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3.4. Scenario 4

Christian

Background

Christian aged 58 is works as a design for CreativeDesign S.A., a creative marketing company. CreativeDesign S.A. designs marketing campaigns for food products, including relevant marketing materials (e.g., leaflets, video clips). The company promotes a results-oriented approach, which provides flexibility to employees to work both within the company premises and from their homes. For older employees, this is supported by an age friendly workspace and empowered by PEARL technology («PEARL System»).

Scenario

Towards using «PEARL» Christian has been given an employee-AutoID card («PEARL card») which uniquely identifies and authorizes himself to use his computer applications. These applications include design/CAD programme and a wide range of auxiliary programmes/utility such as a calendar, a tutorial/training platform and a project management tool. The card is read/activated at appropriate readpoints (readers), within Christian's office and his home. Upon attaching the card at his workstation (either at home or at office), Christian can access a personalized version of his environment in terms of: (a) User interface and ergonomics of the applications (e.g., (typically large) fonts at his preferred size, (typically high) volume, preferred screen solution); (b) Personalized status of the various applications (e.g., personalized calendar, project management environment filled-in with the tasks pertaining to Christian, status/context of the design tools). The status of the above-listed applications is continually save in the PEARL system and therefore Christina can (through the «PEARL» card) gain flexible access to his personalized elderly friendly environment.

PEARL is aware of Christians general preferences (e.g., in terms of colour, layout, volume etc.), but also of the tasks he is carrying out. The latter include creative design tasks, but also web programming tasks. PEARL customizes automatically the environment according to Christian's preferences per task. Hence, he can listen to his favourite and inspiring classic music when designing, while enjoying silence during his web programming tasks. PEARL is also able to suggest relevant training resources (e.g., tutorials, eBooks, forum) as Christian is working on specific design or programing tasks. Furthermore, PEARL helps him to keep in touch (via chat and skype) with other use of the PEARL system, who are working on similar tasks towards sharing knowledge and experiences.

PEARL facilitate Christian to take mental exercises (games) based on his cognitive training module. The system schedules and proposes to Christian cognitive training sessions within specific dates/times, using Christian's calendar applications. The training sessions are structured into complete programmes (e.g., based on a frequency of 2-3 hourly sessions per week). Christian can either accept the schedule proposed by PEARL or suggest an alternative schedule. Cognitive training sessions have during the last couple of years helped Christian to keep his memory and orientation in good shape – he is not experiencing any signals of cognitive decline so far, which makes his work and life easier.

For all these reasons, Christian has one very important thing in mind: Not to forget his PEARL Card!

3.5. Scenario 5

Ole

Background

Ole is a 62-year-old employee in ABOVE Ltd., a digital advertising agency. Ole was for years the creative director of ABOVE, at the time that advertising was mainly focusing on above and below-the-line campaigns. In the digital era, Ole found himself in a difficult position, when ABOVE decided to focus on Internet campaigns, which also resulted in a mild depression to him. He therefore proposed to his CEO to become a consultant and leave the position of creative art director to a younger colleague. At the same time the CEO of ABOVE understood that the talent and experience of Ole was difficult to be exploited, while his ethics didn't allow him to think of substituting Ole. On the contrary he decided to equip the office with the PEARL system, a platform for ergonomic and motivating, ICT-based age-friendly workplaces. The system was not only focusing on Ole's needs, but to a number of his colleagues too. The deployment of PEARL in the main office space of ABOVE included purchasing new furniture, installing a public digital noteboard to keep the team members up to date with important announcements and pending tasks and setting up personalisable workspace areas for a few employees like Ole.

The personalisable workspace areas were ergonomic with larger computer screens, while the software they were running was tailor-made to meet the needs of a senior employee who was highly skilled but he was not very familiar with technology. Each desk was equipped with a private digital noteboard, connected to a digital paper calendar interface, which allows Ole not only to get a reminder about the pending tasks and appointments, but also to add, edit or remove entries with ease. The RFID infrastructure that was also

implemented allowed the older employees to switch easily workplaces as their preferred setup was deployed automatically after they swipe their access card at the desk reader.

Scenario

In the morning, while sitting at home and drinking his morning coffee, Ole launches the PEARL platform on his smart phone. Instantly he can see an overview of his daily tasks and upcoming meetings, which allows him to start planning his daily activities. A friendly reminder pops up to suggest him play his favourite cognitive training game that he really enjoys. The game is carefully selected based on his profile in order to boost his creativity and keep him mentally alert.

At Ole's office there are a few personalisable workspace areas that are equipped with PEARL and are specifically designed to meet the needs of elderly employees. Each workspace is equipped with an ergonomic chair, a desk with adjustable height, on which there are two large PC screen and desk RFID reader. For every workspace the PEARL platform offers a set of different configuration plans that are based on the currently performed task and are tailored to meet the preferences of each employee. Ole's personal profile, for example, is configured to distinguish between electronic communication tasks, design tasks, eLearning tasks and cognitive gaming. When he goes to his workspace in the morning he swipes his RFID card at the desk reader and logs in the PEARL system. His personal profile is automatically loaded, the light at his desk is switched on, the desk height is adjusted and the screen font and contrast are configured to meet his preferences, set for performing electronic communication tasks. As soon as he sits down he sees on the second PC screen, which is dedicated to the needs of PEARL platform, an interactive digital noteboard with scheduled appointments and tasks that he needs to carry out. The tasks are arranged by priority and include short title, deadline date, progress status and relevant project. Ole can easily view task details by clicking on the task entry or add a new task by pressing the add button. Ole has been using his paper calendar for many years and although he was recently forced to try Microsoft Outlook scheduler, he could never abandon the paper version he knew so well. As a result many of his meetings were recorded only on paper and when he lost his notebook several months ago he spent a huge amount of effort to recover the missing information. PEARL finally offered him an innovative solution that he could easily get used to – a simple scheduler coupled with a digital paper interface that resembled a lot the paper calendar he cherished so much. So when a client called him to ask for an urgent meeting tomorrow afternoon, Ole knew he was available just by a glance at the private digital noteboard on his screen and instantly wrote down the meeting with the dedicated smart pen on the digital paper calendar. The information was automatically synchronized with his Outlook agenda and displayed on his noteboard.

Ole is not a computer expert and he is not very familiar with the earned media (i.e. social media, online rating sites, etc.) and the newest technological trends. The use of PEARL platform, however, gave him an access to a set short of tutorials on various technological topics that were adapted to needs of people with limited IT knowledge. In the afternoon today, when his schedule was clear, the PEARL platform encouraged Ole to complete an eLearning tutorial with a pop-up reminder, he finally decided to set up a Facebook account. He launched the PEARL eLearning module, by clicking on the button in the pop-up dialog window. The platform asked him if he wants to switch to eLearning task mode and his workspace was automatically adjusted, based on his profile preferences. He quickly found the relevant short tutorial, which guided him through the process and presented the major features that everybody uses.

ABOVE Ltd. has made the right choice. The company managed to maintain the senior staff of people that were the 'kings' of advertising and thus they differentiate from the competition that is only utilizing young advertisers. Productivity is significantly increased and Ole is feeling again an important contributor to the company.

3.6. Scenario 6

Walter

Background

Walter, aged 65, has been working for more than 30 years as an engineer for a small civil engineering office that specializes in designing hydropower plants. Walter is very active. He likes to go ski touring during the winter and hiking during the rest of the year. He also enjoys his work very much. In fact, if he wanted he could retire already but he prefers to keep working. Walter is mentally acute but has recently been diagnosed with osteoporosis. He now takes pills to fight the dwindling bone mass. In addition, he follows a special diet and a daily exercise routine to strengthen specific muscle groups, improve his balance, and to keep him agile.

Scenario

The company Walter works for has taken an active approach in recent years to support older employees in their changing needs, which has led to the reorganization of the work environment by means of a new adaptive system called PEARL. An essential benefit of the PEARL system is that it enables a seamless work experience. Both at home and at work, the system provides Walter with everything he needs. He chooses where he wants to work, and the environment adjusts automatically to his preferences and needs.

Walter is now able to work both from home and the office. He typically starts his workday around 8:30 in the morning with checking his emails. Sometimes he does that from home and sometimes from the office. At both locations he uses a special setup that allows him to check his emails while doing some mild physical exercises on a stationary bicycle. There is no need to carry a computer with him as the setup includes one already. The setup between the bicycle at home and at the office is seamless. The system recognizes Walter based on an I.D. chip card that he carries with him and adjusts the bicycle and the computer accordingly. It sets the height of the saddle and the handle bar to match his physique, and automatically logs him in to his virtual network workspace. It also provides him with information about his daily exercise targets and his progress towards meeting them. Walter uses the bicycle mostly for lighter work (e.g., checking his emails, his

calendar...), for the more demanding work (e.g., drawings, calculations…) he prefers a desk workplace.

At the office Walter can choose between several desk workplaces. Just as with the stationary bicycle(s), the system recognizes him and makes all the adjustments for him. It sets the height of the chair and desk, and logs him into his network account. Another office space that Walter uses on a daily basis is dedicated to fostering cognitive and motor skills through exer-games. The setup involves a computer connected to a large TV and several motion sensing input devices (e.g., camera, balance board…). Walter uses it mostly for physical exercises that are part of his daily exercise routine. Many of the exer-games he plays have been designed specifically to strengthen muscle groups that are affected by osteoporosis.

Both Walter and the civil engineering company are very satisfied with the result of the reorganization brought about by the PEARL system. It has helped Walter to continue in his job, which he loves, and still be able to fight the disease; and it has helped the company to retain key know-how and thus to stay competitive in times when finding qualified engineers has become increasingly difficult.

3.7. Scenario 7

Caroline

Scenario

Caroline arrives at work, and checks in at the front desk using her RFID chip. She now has 456 points gathered, which is the same amount of days that she has not been sick in a row. She feels motivated every morning, checking in, knowing that she is now only 144 points away from the “Fit and Healthy” prize.

Today Caroline is sharing an open office with Alex and Jack. These are not the co-workers she usually works with, but this week she has signed up for one of the open assignments that the office offers. This means that she will be working on a special assignment, where co-workers from different parts of the company work together on a short project for a week or two. She is excited for this new project that she has gotten the opportunity to work on, and finds it interesting to work with colleagues she doesn’t usually talk to.

She logs in to the computer using her RFID chip. Her passwords are saved on the RFID chip, and therefore she only needs to scan this to log in. Caroline is very fond of this feature, as she usually forgets the complicated passwords she needs to have. Also, she doesn’t need to use her reading glasses for this task, as she only has to scan the chip,

which makes this task less complicated for her. When she registers with the chip, the desk that she will be using automatically sets to the personal settings that she has configured.

After lunch, Caroline has 10 minutes to check the incoming suggestions from the Idea Box. She knows that it is important to vote for the best suggestions, as the management at the end of the month will revise them. She chooses a suggestion for a new purchasing management system, which saves time and 3 paper copies for every new purchase. She uses her RFID chip to sign in to the voting system.

An hour later she receives a text message from her mid-level manager. It is a short progress report, saying how the company has been doing this month. She likes these short updates, as it makes her feel involved in the company, and how it is progressing.

Caroline thinks that after the RFID time registration management has been introduced, which also allows the employees to see the projects progess, she feels much more informed about what is going on in the company.

At 2 o'clock Caroline leaves for the day. She is part of the flexi-job agreement, and have the opportunity to work on flexi time 10 hours a week. She checks out, using her RFID chip, at the front desk. At home, in the evening, Caroline checks in using her RFID chip at her home desk. As a part of the flexi job agreement, she has a small RFID reader placed next to her home PC. When she checks in using her RFID chip, the PC opens with the right settings, ready for work.

3.8. Scenario 8

Alma

Alma is a 63 years old employee at One74, a communication and design agency. She has been working for the company for more than 20 years now and has recently been harbouring some doubts whether she will be able to keep up with the required pace and flexibility as she is getting older. Usually, she feels quite fit and active, but sometimes her body (and mind also) seem to not want to operate in the way she wants them to. This is normally no problem, but given the pressure in the working world, new technologies being invented quicker than she could ever imagine, she had always thought that she would retire early as she really had some doubts whether she could keep up with the pace. These concerns had grown a few years ago when her mother was diagnosed with dementia and soon needed more support from her and other family members. Her mother's dementia is luckily not progressing quickly, but Alma's caring responsibilities increased steadily during the last few years with the consequence that she has to flexibly

handle work and private life. This is of course sometimes easier, sometimes harder, depending on her mother's health status and the tasks and deadlines at work.

Alma loves her work and feels as a useful and productive part of the company, in particular as she has a lot of experience and expertise to share with younger colleagues, as well as long-standing connections with the company's key clients. This was also realized by her boss John who about one year ago appointed her as a kind of mentor for younger employees. She was proud to take on this responsibility and loves to support younger colleagues and team members and to "show them the ropes".

However, all these various work and life responsibilities come along with advantages and disadvantages, as Alma often says, but above all were increasingly difficult to handle as she becomes older with some little pains and aches appearing here and there. She was thus quite curious when John decided to use the newly available PEARL system in his company. A system that supports the employees, and in particular older employees, with different work tasks & settings and also provides training tools to help them staying physically and mentally fit. PEARL was installed at the company's offices and in her home, and she has been using it for a couple of weeks to good effect, as the following two examples show.

a) One morning, Alma was woken up ahead of time by her mobile phone ringing. It was her mother telling her that she was feeling dizzy and a bit sick, so that she thinks she would have to see a doctor. Luckily, Alma had only an internal appointment and two smaller tasks scheduled for this morning, that she would now have to shift. While eating a hasty breakfast, she logs into her computer using an RFID chip. All the necessary data and her preferences are stored on the chip so that every device she is using automatically adjusts its settings. She always worried about passwords in the past so she now thinks that the RFID chip is really useful. Furthermore, because of her work, she uses several devices (mobile, desktop) and really likes the feature that the devices, which are also being used by other colleagues, can be adjusted to her preferences. This has become more and more important during the last 2 or 3 years, as her eyes and also her tactile capabilities have gone down, as she has to admit. After logging in she accesses her work schedule at One74. She moves the internal appointment to the afternoon and sets new deadlines for the two tasks, assuming she will be able to do one of them in the waiting room of the doctor's practice. She also sets her presence status to absent / reachable over mobile. The updated schedule and her status are instantly available to all colleagues that she works with. Alma gets into her car and drives to her mother's home to pick her up and go to the doctor together. As she had hoped, she finds some time during the examination to do one of the work tasks in the waiting room, using her tablet. As the doctor comes out of the interrogation room with Alma's mother it becomes however clear that her morning's schedule will change even further. The doctor tells her that her mother should have an X-ray taken at a nearby radiology practice. He has made arrangements for an immediate appointment if that would suit. Since Alma knows that the rest of her week will be even more packed, she accepts this immediate appointment. While going down to the car with her mother, she accesses her work schedule via her mobile, reshuffling another appointment. The radiology appointment goes reasonably quick and she is back in the office at 11am, after having dropped her mother off at her home. While the morning leaves her rather stressed-out, she is also happy that the flexible tools of PEARL allowed her this comparatively easy re-planning.

b) On another morning, Alma wakes up and does not feel 100% well. She does not think that she is ill but simply feels as not being her usual self. Apparently, taking care of her mother who has dementia is on some days more exhausting than expected and she

seems to have some problems with her circulation as a result from time to time. She knows that she has scheduled a range of team building and training workshops with her younger colleagues today. However, she does not recall the exact time of the meeting and is also aware that she needs one hour more or so in order to get fit for work.

Thus, after preparing herself a coffee, Alma logs into the PEARL system on her tablet using her RFID chip. Once logged in, she sees her tasks and meetings of the day in the time and task management tool. Alma enters her expected arrival date in the office into the tool which automatically adjusts the day schedule for her and informs her colleagues accordingly. This normally works quite well as the PEARL system, to which the task and time management tool belongs, considers schedules of her colleagues as well when rescheduling her day. Otherwise she would not really like it as she hates it to be a burden on others, but this way she is quite fond of that feature since rescheduling and agreeing new meeting dates prior to PEARL often took a lot of time and different work steps. Apart from rescheduling calendars, PEARL also informs the secretary Monica that Alma will arrive about one hour later today.

Alma is a very responsible employee and appreciates the flexibility given by his employer. In order to get herself into a better shape this morning, she chooses one of the physical training exercises offered by PEARL. The nice and motivating side-effect is that she collects three One74 stars, a kind of competition they play at the agency. After one year, the winner can look forward to a nice award. The awards have been extremely attractive the last years, so Alma is keen to beat her colleague Ralf this year.

One hour later Alma feels fit for work and starts her journey to the office by car. She arrives at the front door and again her RFID chip registers her, boots up her computer and smartly adjusts her desk workspace according to her preferences and current settings such as lighting outside etc. These adjustments also include, and this is again a functionality Alma is very fond of, ergonomic adaptations of her desk, chair etc. This is particularly important since at One74 they have a desk rotation policy, mainly because of the various specific requirements for different work tasks they have to accomplish and because many employees are part-time teleworkers. Prior to PEARL, Alma (and other colleagues as well) was forced to more or less every day adjust her desk again which was annoying for her and meant losing some of her valuable working time for her employer.

Her day starts with an Internet research at her own desk. She wants to use some of the results of her research during the upcoming workshop together with some of her colleagues and thus uses the PEARL task management tool to provide input to her colleagues prior to the meeting.

At 1pm the workshop starts. Alma takes her laptop and meets her colleagues in the recently established team workspace. As she has her RFID card with her, her desk in the joint workspace is again being ergonomically adjusted to meet her preferences and requirements. Alma starts the workshop with her younger colleagues who can learn a lot from her experiences. In order to be able to support them also outside these regular exchange workshops, the PEARL system includes a forum for “intergenerational exchange” where her younger colleagues can pose questions to her, and, on the other hand, she can find support from younger people, particular for stuff like Twitter and other new applications she seems to have some difficulties with.

At around 5pm Alma plans to leave the office. She uses the preference manager in the PEARL system to set office and computer to the mode “business trip” as she needs to attend a workshop in Linz tomorrow. When leaving the office building, her RFID chip automatically logs her out.

3.9. Scenarios 9.1 - 9.3

Technologies

The technologies described below are involved in the following scenarios[1].

- **OrganIO**: a digitally enhanced paper calendar, offers a touch display on top, is aware of the current page and is supplemented with a smart pen
- **Smart pen**: this pen belongs to the OrganIO and digitizes the analogue input (hand-writing). If technology is capable, it also tracks position of the writing on the paper.
- **Interactive whiteboard**: an interactive whiteboard that can send content to the OrganIO and also receive and display content provided by the OrganIO
- **PrivBoard**: private touch screen situated on desk next to the main screen displaying open tasks and notifications
- **Telephone**: regular telephone placed on a desk
- **Personal computer**: dedicated workstation for an employee

3.9.1 Scenario „Reminder/Calendar“


Paul and Rachel

Background

Paul (55, Graphic Designer) and Rachel (32, Sales Agent) are working for an advertising agency specialized on healthcare. They work in the same building but are located on different floors. Recently, the company provided each employee with several devices: a PrivBoard and an OrganIO. Furthermore they installed an interactive white board in their meeting room. Paul prefers to plan his schedule on paper but the company has an online calendar available for all employees.

Scenario

Paul is coming to work on Monday and is eager to plan his activities throughout the week. A PrivBoard is placed on Paul's desk and notices his appearance when he takes a seat on his desk and greets him: "Hi Paul, here are your tasks for this week". He sees the upcoming tasks and realizes he needs to deliver some concept drafts to a client on Friday. In the previous week he already prepared some material but wants to discuss his work with his colleague Rachel, who established the client contact and had worked with them in previous projects. Paul grabs his OrganIO from his bag and opens the Monday page. The

[1] Technology names are working titles

OrganIO calendar can display the shared calendars from his colleagues. He selects Rachel's calendar and OrganIO shows Rachel's day's schedule corresponding to the open page on the display. As he flips through the pages the day's schedule on the display adapts. He flips until Thursday and sees that both are available at 10am. Usually, he would call Rachel or go directly to her and ask whether she can meet up face-to-face (but that would require him to walk two floors upstairs and he isn't even sure if she's there). Luckily, he knows that OrganIO can help: he's taking a note on the 10am line: "Update on concept drafts for BigHealth Inc. with Rachel". While he his writing with OrganIO's smart pen on the paper he can see a live-preview of his hand-writing on the display. When he finished writing, OrganIO interprets his hand-writing and suggests sending an event invitation to Rachel on Thursday 10am, which he confirms. Paul then closes his OrganIO and moves on to some other work.

Later that day Rachel responds to the invitation in her Outlook calendar and suggests to meet an hour later, since she will arrive later to work on that day. Instantly the PrivBoard displays a notification: "Rachel postponed your invitation by 1 hour (until Thursday 11am)". He remembers that there were no other events on that day so he can easily re-schedule this meeting. He grabs his OrganIO and opens the Thursday page. The display shows an option to accept this event on that day. He confirms by touching on the display and draws an arrow from the 10am line to the 11am line to indicate that this event will take place later. The event is now available online and Paul still has the convenient paper option.

3.9.2 Scenario „Tasks and To Do´s"

Sarah

Background

Sarah (60) is the marketing expert in a small company that develops assistive technology. She gets back from holiday and has received a lot of e-mails while she was away. Now she has to plan her tasks for the following week and discuss topics with her colleagues, in a brainstorming meeting.

Scenario

Sarah is back from holiday. She uses her personal computer to browse through her mails and wants to keep track of the tasks that result from the received emails. A customer has scheduled a *"PrintScreen"* project meeting for the following Friday, which needs some preparation in advance.

She opens her OrganIO and flips to the page for Friday. The OrganIO screen provides an overview of her unconfirmed appointments for that day. She takes notes on paper, writing down the tasks she has to accomplish before the meeting. To mark the notes as task she writes "todo:" in front of the list of tasks.

The list of tasks is displayed on the OrganIO screen and Sarah assigns them to the project "*PrintScreen*". She also sets reminders for the different tasks, by selecting the time she wants to be reminded on the OrganIO screen.

The tasks are also displayed automatically on the PrivBoard on her desk.

3.9.3 Scenario „Collaborative Meeting"

Renate

Background

Renate (63) is a project manager in the same company as Sarah. They meet up in a meeting room equipped with an interactive whiteboard, where they discuss the tasks for the "PrintScreen" project meeting.

Scenario

Sarah needs to discuss tasks with her colleague to see if Renate can support her and collect feedback. Thus she calls Renate and asks her if she has time for a quick meeting. She agrees, and 10 minutes later they get together in the meeting room.

Sarah wants to show Renate the list of tasks that need to be done before the meeting. Sarah opens the Friday page on her OrganIO and circles the list of tasks, with her double sided pens. On the screen a dialogue appears that asks her with whom she wants to share the list with. She selects "public whiteboard / meeting room" and the list is displayed on the whiteboard. Sarah and Renate now discuss the tasks and move them around on the whiteboard to sort them into meaningful work packages. After they reach an agreement who does what, Renate synchronizes her OrganIO with the whiteboard to get a list of her tasks. Renate gets back to work after the meeting and quickly she has completed the first tasks. She uses the OrganIO to cross out the already solved tasks so they are marked as finished. This also means that no reminder will be shown for the already done tasks

4. From Requirements to Features

This chapter ties in with the detailed description of the methods, procedure and results from the requirements analysis carried out in T2.1 (see D2.1 Report on User and Stakeholder Requirements). Building on the insights gained from the requirements analysis, this chapter focuses on the subsequent steps undertaken in refining the insights into feature ideas and in deciding which feature ideas to develop for the PEARL platform. Section 4.1 presents a first list of feature ideas derived from preliminary scenarios written by each partner that were based on the PEARL common vision. Section 4.2 presents a list of feature ideas derived from the contextual interviews, observations, and experience sampling carried out in Romania, the Netherlands, and Switzerland. Section 0 presents the features selected for development by the consortium. Detailed descriptions of the process that was followed are given in each section.

4.1. Feature Ideas Derived from Preliminary Scenarios

Within the PEARL project, a first set of feature ideas was derived based on the common vision developed at the PEARL kick-off meeting. For that purpose, each partner was asked to think about and write down his/her own vision of the PEARL platform in the form of preliminary scenarios that capture the interaction of future users with the PEARL platform (see Chapter 3).

The feature ideas presented in Table 1 below were derived from an analysis of these preliminary scenarios that involved reading through the scenarios and highlighting interesting feature ideas. Together with the feature ideas derived from the contextual interviews and observations (see 4.2), these written scenarios served as a basis for deciding which features to develop within PEARL (see chapter 5), and ultimately as a basis for specifying the use cases (see Chapter 6).

Table 1 Feature ideas derived from the preliminary scenarios. Similar ideas were consolidated before adding them to the table.

#	*Feature name*	*Feature description*
1	Fit ‘n Healthy Points	Point / star system to reward "fit and healthy" behaviour("Fit and Healthy" prize; stars are collected through performing physical training exercises; comparison with other colleagues).
2	Open Assignments	Work on short projects with colleagues from other parts within the organization.
3	Idea box	Employees can vote on ideas for improvement that management reviews once a month.
4	Newsflash	Short status/progress report about the company's performance for the last month.
5	Flexi-job agreement	10 flexible work hours per week that the employee can move around as s/he pleases.
6	Speechifier	Voice output along with written instructions (for those with impaired vision).
7	Predefined “modes”	E.g., a "meeting mode" that automatically adjusts the workspace and prepares the meeting room: lighting, projector…
8	Auto-Adjust	General awareness and automatic adjustments (of the preferences and tasks of an employee).

9	Task Pairings Optimizer	Predefined task-pairings (e.g., turning on classical music whenever an employee starts with a specific task)
10	Instant Messenger	Communication tool to stay in touch with other PEARL users (e.g., chat, Skype…)
11	Adaptive Scheduler	Adaptive scheduling (e.g., PEARL suggests cognitive training sessions based on availability in the calendar)
12	RFID smartwatch	RFID chip in smartwatch
13	Scheduling Assistant	A program that supports one in scheduling tasks throughout the day
14	Break reminder	Take a break timer/advisor
15	Welcome Screen	Interactive dashboard, e.g., with news items; weather; schedule of the day; presence/absence status updates shared automatically with colleagues
16	Mentoring program	Younger colleagues assigned to own projects
17	Prioritization Helper	Prioritisation assistance (e.g., sorting emails on topic and urgency)
18	Daily Summary Screen	Overview of things/tasks done; rescheduling of tasks not done...
19	Neutral Position Restore	Environment adjusts to a neutral position as soon as someone logs out of PEARL.
20	Ergonomics Expert Advice	Initial setup of (desk) workplace by ergonomic experts (i.e., PEARL Swiss Service Team)
21	Magnifying Tool	A camera as a visual aid that transmits live images to zoom in on a tablet (a virtual magnifier)
22	Settings Lock	Automatic daily behaviour profiles to identify and lock preferences of older workers.
23	My Cohort Friends	Friends through profile matching (e.g., suggests other older employees living in the neighbourhood as friends)
24	Bicycle Work Station	Stationary bicycle that can be used to combine easy work tasks like checking your email with mild physical exercises.
25	Exer-games	Exer-games to foster both cognitive skills and motor skills.
26	Motion Sensing Input	Motion sensing input devices (e.g., camera, balance board) used together with the exer-games.
27	Muscle Builder	Exer-games designed to strengthen specific muscle groups (e.g., ones typically affected by osteoporosis)
28	Flexible Schedule	Accounting for caring-responsibilities of older workers (when a parent gets sick, etc.).
29	RFID Key	RFID chip replacing the need for remembering passwords.
30	Auto-Rescheduling of Appointments	Automatic notification of rescheduled appointments to secretary (no need to call)
31	Pre-meeting Informer	PEARL task management tool for providing input to colleagues prior to meetings
32	Co-learning and Exchange forum	Intergenerational co-learning and exchange forum: a kind of mentoring system so that the experiences and knowledge of older employees can be passed on to younger employees.

33	Relax Room	'Relax room' equipped with a large screen, surface table computers, and smart cubicles
34	Mental Mood Equilibrator	Mental health / mood of the day measured through a smartphone game with interventions suggested based on that (e.g., going outside the office to hold a meeting...).
35	Biographic Memory Game	E.g., previous examples of work are presented and the employee is quizzed on certain attributes, like the year he/she worked on that.
36	RFID Nutritionist	RFID based nutritional advice (e.g., nutritional tips projected against a wall at the lunch place).

4.2. Feature Ideas Derived from Contextual Interviews and Observations

Building on the insights gained from requirements analysis carried out in Romania, the Netherlands, and Switzerland, this section focuses on the refinement of these insights to feature ideas. In line with the overall goal of providing feature ideas as input for the technical specification of a smart work environment for older people, we followed a multi-method approach as depicted in Figure 3 below.

The first two phases, the contextual interviews and observations and the needs and frictions analysis, were reported already in D2.1. They served the purpose of gaining bottom-up insights into the work environments of older computer workers and culminated in a total of 96 insights (see D2.1, Table 5).

Phases 3 and 4, the Ideation Workshop (see4) and the NUF-prioritization (see 4.2.2) are subsequently reported in this deliverable. The goal of the ideation workshop was to derive feature ideas, based on the 96 insights, in interactive sessions following the World Café method (Brown & Isaacs, 2005).The goal of the NUF-Prioritization Survey (Gray, Brown & Macanufo, 2010) was to prioritize these feature ideas in an online survey among experts.

Finally, in a next phase the resulting output can be used for the creation of mock-ups to gather valuable feedback from our target group.

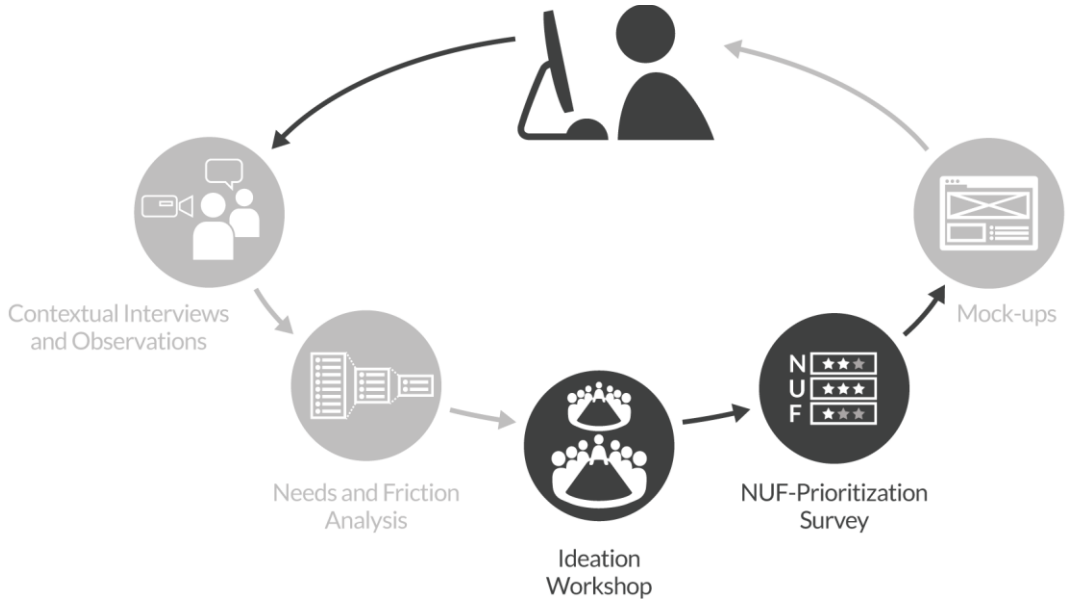

Figure 3 Overview of the phases in the multi-method approach. Black circles represent the phases covered in this deliverable; grey circles represent previous work (see D2.1).

4.2.1 Ideation Workshop

Participants of the Ideation Workshop. In order to generate a wide range of ideas we involved 15 professionals with backgrounds in software engineering, wireless communications, user experience design, marketing, psychological evaluation, sociological research, serious gaming, eLearning and telemedicine.

Procedure. For having a structured yet flexible way of brainstorming, we slightly modified the World Café method (Brown & Isaacs, 2005) by using insights of the needs–frictions analysis as input for deriving feature ideas. Thus, we formulated the overall question as: Considering these insights which concrete features would be helpful for our users? We prepared four tables, each equipped with post-its, markers, and 20–25 insights. Each table was moderated by a host who stayed at the same table and took notes of the discussion. The other participants switched tables after each round (4 rounds in total). One round lasted for 20 minutes and always followed the same procedure:

(1) *Introduction*: the host read out the insights and summarized the ideas discussed in the previous round;

(2) *Brain writing*: each participant was given five minutes to write down as many ideas as possible;

(3) *Discussion*: at each table participants discussed and developed feature ideas. At the end of the fourth round, the hosts consolidated the features ideas.

4.2.2 NUF-Prioritisation

Respondents. The goal of the fourth phase was to prioritize the feature ideas that resulted from the ideation workshop. For this purpose, the participants of the ideation workshop were asked to fill in an online survey. The prioritization was not part of the ideation workshop, as we wanted each expert to evaluate the ideas individually with no time pressure and unaffected by groupthink. We received 10 completed surveys.

Survey Design and Procedure. The survey relied on a simple design introducing each feature idea by its name and a short description, along with the insights from the needs–frictions analysis. The respondents' task was to score each feature on the three dimensions newness, usefulness, and feasibility (following the NUF approach, Gray, Brown & Macanufo, 2010). For each of the dimensions, respondents assigned any number of points ranging from 1 ('not new/useful/feasible at all') to 10 ('very new/useful/feasible'). Moreover, respondents were given the opportunity to leave comments in a text box for each feature. The survey was designed to take about 30–60 minutes to complete.

Data Analysis. **The goal of the NUF is to arrive at an overall index score per feature. First, a total score per feature was calculated across the dimensions of newness, usefulness, and feasibility. Second, means and standard deviations were calculated across respondents in order to generate a rank-ordered list of all feature ideas (see**

Table 2).

4.2.3 List of Feature Ideas

In

Table 2, we present the 41 feature ideas that resulted from the ideation workshop and the online prioritization survey. As mentioned above, the ideation workshop relied on the insights gained from the needs and frictions analysis of the contextual interviews and observations and the experience sampling. As can be seen from the list, some of the features obviously are more innovative than others. For example, the feature 'Private Digital Notebook' (#2) is certainly more new to the world than the feature 'Walking Break Scheduler' (#14). By contrast, the 'Walking Break Scheduler' is certainly more feasible—that is, less complex and therefore easier to develop—than the 'Private Digital Notebook'. Yet, both of these features are useful in the sense that they address a real need—supporting a healthy lifestyle and staying on top of things, respectively.

Table 2 Feature ideas derived from the contextual interviews and observations

#	Feature name (ref. to insights in D2.1, Table 5)	Feature description	NUF Score	
			M	SD
1	Accessibility Tool Tutorials (i47, i48, i87)	Tutorials that provide information and train older workers in the use of accessibility tools (e.g., a simple and easy-to-use zoom-function for GUIs, a text-to-speech function...)	24.00	4.71
2	Private Digital Noteboard (i2, i91)	Always visible second screen at personal desk: • Urgent tasks are highlighted • Tasks are clustered according to projects/teams • Finished tasks can be crossed out • To-Do's/notes can be sent to public noteboard	23.90	3.78
3	Make-it-mine (i61, i62, i63, i64, i65)	RFID-tool that personalizes a workplace with one simple interaction.	23.70	4.60
4	Cognitive training games (i34)	A selection of serious games to train cognitive skills to prevent mental decline with personalized training sessions	23.20	4.34
5	Task management training (i12)	A task management training tool that can help with planning the tasks to be more efficient / productive.	23.10	3.76
6	Exercise Prompter and Demonstrator (i37, i38)	A friendly exercise reminder: • Prompting physical/mental exercises through pop-ups • Avatar might demonstrate exercises • Connected to calendar to know about ongoing meetings/deadlines	22.70	3.71
7	Flexible Self-Learning Mini-Modules (i80, i83)	Tutorials on how to use new software/tools: • Ca. 15 min per session (to be completed until a fixed date)	22.10	4.12
8	Master Calendar (i84, i90)	An easy-to-use calendar tool that can combine different types of agendas (e.g., private & business).	21.80	3.97
9	Public Digital Noteboard (i1, i2)	Always visible second screen at a wall: • see #1 Private Digital Noteboard • To-Do's/Notes can be sent to private noteboard	21.50	4.12
10	Creativity trainer (i49, i50)	Software that challenges one's thinking and fosters creativity.	21.40	5.44
11	Knowledge base	Central internal knowledge base within organization:	21.40	5.83

	(i29)	• "in case of problem X, contact Mrs. Miller…" • Wiki on frequent problems / to post questions		
12	Healthy Email Mgmt (i23)	Organized as e-learning content (e.g., Guidelines/tips on how to better cope with the email load)	21.30	6.04
13	Digital Paper Calendar (i6, i30, i81, i89)	Paper calendar capable of automatically digitizing hand-written notes: • Digital paper or digital pen as input device • Tagging system (e.g. offline with different stickers or directly on the tablet/PC)	21.00	4.90
14	Walking Break Scheduler (i46, i51)	Walking time in nature as part of the daily schedule and encouraged by various means (e.g., calendar reminders, pop-ups…).	20.91	4.66
15	Availability Indicator (i8, i10, i11, i20, i66)	An availability indicator embedded in the physical work environment that signals others whether you are open and free to be approached (e.g. a 'do not disturb sign/light'). Possibly, connected with a calendar tool that signals others on the type of task that one is working on, so that interruptions can be done at the moment which fits best (e.g. during tasks with low cognitive demands).	20.90	4.79
16	Simple Time Bufferer (i13)	Task management support to create enough time between meetings to process information and execute forthcoming tasks (e.g., auto suggest time between two meetings in the agenda). People should stay in control.	20.60	4.65
17	Remote Access (i4, i5, i55, i86, i92, i93)	A cross-platform tool to support task portability via secure remote access to company resources (i.e., files, software…).	20.40	5.06
18	Quick Access to GUI Settings (i40)	e.g., contrast, font…	20.27	3.97
19	Master Contact List (i22)	Groups for managing business and private contacts to be used for email, instant messaging, etc.	20.20	3.61
20	Break Reminder (i43, i53)	A simple pop-up that motivates users to take sufficient short breaks to stay physically active (to prevent back pain).	20.18	5.78
21	Ambiance Tuner (i67, i68)	Sound levels and ambiance of individual offices should be adjusted to different types of tasks (e.g., cognitive tasks and face-to-face meetings).	19.30	5.62
22	Screen-sharing solution (i24, i25, i58)	Dedicated screen-sharing solution to interact with clients (e.g., for quick meetings).	19.30	3.71
23	Colleagues' Profiles (i32)	• Provides chance to get to know better the colleagues within the company. • Low-threshold way to get in touch with colleagues (e.g., through instant messaging, requests…)	19.10	5.76
24	Tool training courses (i75, i76, i94, i95)	Dedicated courses for learning new tools that are relevant for work.	19.00	7.13
25	Lunch Alarm (i31)	Alarm/message service to colleague: "I go for lunch, wanna join?"	19.00	5.64
26	Posture Alarm (i44)	Detects long periods of sitting in a bad position (e.g. at a kitchen table with a laptop) and gives feedback	18.91	6.63

27	Task priority manager (i7, i57)	• Top-down (database, input from superior): relying on certain indicators (e.g., budget volume, contractual requirements…) • Bottom-up (user-feedback, case-based reasoning) • Synchronization with email	18.90	3.87
28	Projector Smartphone (i54, i77, i96)	Connect a pico-projector to your smartphone for projecting the smartphone screen on any surface/wall. The system should allow for touch-based input on the surface projection, in addition to touch-based input on the smartphone screen.	18.80	5.97
29	Social Window (i24, i25, i58)	Having a wall projection showing what is going on in a different office (e.g., next door or at other branch office) • Motion-triggered • „Room invitations“ could be shared • Add on: “whole room effect” • Add on: Interactions between rooms (e.g. sharing written information) • Alternative: Second Life virtual rooms • Challenge: causes a lot of data traffic	18.70	5.83
30	Instant Messaging Service (i27, i28, i59)	There is a need for an informal way of communicating with colleagues other than by email, which is also available while traveling and at other workplaces (e.g., Skype, Lync)	18.45	3.72
31	Virtual Dining Table (i39)	• Eat lunch with others, while still in front of your computer. • Creating a dining environment at the desk (changing the physical appearance with a dining kit).	18.10	5.47
32	Getting-Things-Done Tool (i14, i15, i16, i17, i21)	Support like the Getting-Things-Done (GTD) methodologies, integrated in Outlook, to further structure long and short term tasks and to function more efficient. (E.g. to prevent spending too much time on 'too good or beautiful' products, resulting in a missed deadline).	18.10	4.82
33	Workplace QuickSwitch (i69)	• Change quickly between a personalized and a professional environment (e.g., when visiting a client or when the boss pays a visit) • Removes all personalization in an instant.	17.70	7.33
34	Time sharing & job sharing (i57)	A tool that can be used to offer/request help to/from colleagues.	17.40	5.64
35	Customizable News Feed (i33, i74, i79)	Something like an RSS-feed that provides the newest updates (e.g., tutorials, external IT news, etc.) and enables sharing this with colleagues.	17.36	5.80
36	Smart filtering of E-Mails (i23, i88)	• CC • 2nd priority • Based on own name (“Dear John Doe”) • Keywords from task list for mail filtering	17.10	3.98
37	Enterprise resource planning (ERP) solution (i82)	Some centralized business management tool for ongoing project management and management of contacts.	16.60	6.40
38	Superior Avatar (i26)	• Tells you what to do • Instant help in case of difficulties	16.10	6.28

39	Organizing out-of-work activities (i31)	• Entertainment groups • Book club • Chess club • Nature lovers • Theatre/Musical group	15.10	7.68
40	Call Centre Software (i38)	• Allocate need to appropriate employee • Having a pool of people that can answer the call • End user should have control of his availability, indicating his status • Time schedule (on-call schedule) • Categorize emergencies to an elastic and elastic (their flexibility)	14.60	6.67
41	Romanian Keyboard (i56)	Romanian keyboard that features all special characters (diacritics).	14.50	6.74

4.2.4 Mapping Stakeholder Requirements and Feature Ideas

Table 3 below once again lists the features that resulted from the contextual interviews and observation. In it relevant insights from the requirements analysis of other stakeholders are mapped against those features in order to provide either additional insights for development or a further means to prioritize features. Each mapped insight contains a reference to the data source (interview or focus group), as used in the results description of D2.1 (Chapter 3 Requirements of other stakeholders).

Table 3 Other stakeholder insights mapped against the feature ideas derived from the contextual interviews and observations. References in parentheses (e.g., RRD 4) refer to the results descriptions in D2.1 (Chapter 3 Requirements of other stakeholders).

#	*Feature name* *(ref. to insights in D2.1, Table 5)*	*Feature description*	*Other stakeholder insights*
1	Accessibility Tool Tutorials (i47, i48, i87)	Tutorials that provide information and train older workers in the use of accessibility tools (e.g., a simple and easy-to-use zoom-function for GUIs, a text-to-speech function...)	Is relevant (RRD 4). See “Flexible self-learning mini-modules”.
2	Private Digital Noteboard (i2, i91)	Always visible second screen at personal desk: • Urgent tasks are highlighted • Tasks are clustered according to projects/teams • Finished tasks can be crossed out To-Do’s/notes can be sent to public noteboard	Is relevant (SiLo 1). Should include reminders (SiLo 4).
3	Make-it-mine (i61, i62, i63, i64, i65)	RFID-tool that personalizes a workplace with one simple interaction.	Is relevant (Comarg 4) Adaptation of work place is relevant for workplace ergonomics, but behaviour place bigger role (RRD 3). Particularly relevant in case of desk sharing (RRD 3)

4	Cognitive training games (i34)	A selection of serious games to train cognitive skills to prevent mental decline with personalized training sessions	Language learning could be one topic (Comarg 3). Trainings for workplace ergonomics could be one topic (RRD 3). Learning new work processes could be one topic (SiLo 1, SiLo 3).
5	Task management training (i12)	A task management training tool that can help with planning the tasks to be more efficient / productive.	Is relevant (SiLo 1). Include functionality to address lack of competencies to fulfil a task, e.g. by assigning a support worker for specific tasks (SiLo 1). Support telework or any place – any time working arrangements (SiLo 4).
6	Exercise Prompter and Demonstrator (i37, i38)	A friendly exercise reminder: • Prompting physical/mental exercises through pop-ups • Avatar might demonstrate exercises Connected to calendar to know about ongoing meetings/deadlines	Exercises to change unhealthy work methods / habits, to improve ergonomics (RRD 2& 3).
7	Flexible Self-Learning Mini-Modules (i80, i83)	Tutorials on how to use new software/tools: Ca. 15 min per session (to be completed until a fixed date)	Is relevant (Comarg 3, Comarg 4, RRD 3, SiLo 1, Comarg 6). Tutorials should be simple and efficient (Comarg 3). Part of the training modules can address off-the-shelf IT applications (such as MS Office), other would have to be developed by the company (Comarg 3, Comarg 5, RRD 3, SiLo 2, SiLo 4, SiLo 5). Allow the use of videos (RRD 2).
8	Master Calendar (i84, i90)	An easy-to-use calendar tool that can combine different types of agendas (e.g., private & business).	No matching insight.
9	Public Digital Noteboard (i1, i2)	Always visible second screen at a wall: • see #1 Private Digital Noteboard To-Do's/Notes can be sent to private noteboard	Possible additional function as a discussion board and board for announcements (e.g. by management) (Comarg 3, Comarg 4). Possible additional function to communicate about and exchange on process change (SiLo 1).
10	Creativity trainer (i49, i50)	A software that challenges one's thinking and fosters creativity.	No matching insight.

11	Knowledge base (i29)	Central internal knowledge base within organization: • "in case of problem X, contact Mrs. Miller…" Wiki on frequent problems / to post questions	Is relevant (RRD 1, RRD 2) Apply as part of knowledge conversation programme for employees nearing retirement, potentially also after retirement (Comarg 2, RRD 1, RRD 2). Apply as part of peer-learning programme (Comarg 1, Comarg 4, SiLo 3, SiLo 5). Peer-learning can be from younger to older, older to younger or long-time to new employees. Allow videos in addition to documents (RRD 2).
12	Healthy Email Mgmt (i23)	Organized as e-learning content (e.g., Guidelines/tips on how to better cope with the email load)	No matching insight.
13	Digital Paper Calendar (i6, i30, i81, i89)	Paper calendar capable of automatically digitizing hand-written notes: • Digital paper or digital pen as input device Tagging system (e.g. offline with different stickers or directly on the tablet/PC)	Is relevant (SiLo 5).
14	Walking Break Scheduler (i46, i51)	Walking time in nature as part of the daily schedule and encouraged by various means (e.g., calendar reminders, pop-ups…).	No matching insight.
15	Availability Indicator (i8, i10, i11, i20, i66)	An availability indicator embedded in the physical work environment that signals others whether you are open and free to be approached (e.g. a 'do not disturb sign/light'). Possibly, connected with a calendar tool that signals others on the type of task that one is working on, so that interruptions can be done at the moment which fits best (e.g. during tasks with low cognitive demands).	No matching insight.
16	Simple Time Bufferer (i13)	Task management support to create enough time between meetings to process information and execute forthcoming tasks (e.g., auto suggest time between two meetings in the agenda). People should stay in control.	No matching insight.
17	Remote Access (i4, i5, i55, i86, i92, i93)	A cross-platform tool to support task portability via secure remote access to company resources (i.e., files, software…).	Is relevant (RRD 1, Comarg 6).

18	Quick Access to GUI Settings (i40)	e.g., contrast, font…	Is relevant (RRD 4) Interfaces of mobile devices can be particularly challenging because of small screen size (SiLo 4). Lower screen resolution or larger font size are important settings (SiLo 5). Support alternative interfaces to circumnavigate problems with GUI (RRD 3, RRD 4, SiLo 1)
19	Master Contact List (i22)	Groups for managing business and private contacts to be used for email, instant messaging, etc.	No matching insight.
20	Break Reminder (i43, i53)	A simple pop-up that motivates users to take sufficient short breaks to stay physically active (to prevent back pain).	No matching insight.
21	Ambiance Tuner (i67, i68)	Sound levels and ambiance of individual offices should be adjusted to different types of tasks (e.g., cognitive tasks and face-to-face meetings).	No matching insight.
22	Screen-sharing solution (i24, i25, i58)	Dedicated screen-sharing solution to interact with clients (e.g., for quick meetings).	No matching insight.
23	Colleagues' Profiles (i32)	• Provides chance to get to know better the colleagues within the company. Low-threshold way to get in touch with colleagues (e.g., through instant messaging, requests…)	Include possibilities to showcase references highlighting own competencies (Comarg 1, RRD 2), e.g. projects contributed to, literature references, key clients. Allow for tracking of skills and qualifications (RRD 2). Allow for tracking of special needs, e.g. in relation to work place ergonomics (Comarg 4, SiLo 1). Denote "super users" or staff members with special knowledge that can be approached to give support (RRD 2, RRD 4).
24	Tool training courses (i75, i76, i94, i95)	Dedicated courses for learning new tools that are relevant for work.	No matching insight.
25	Lunch Alarm (i31)	Alarm/message service to colleague: "I go for lunch, wanna join?"	No matching insight.
26	Posture Alarm (i44)	Detects long periods of sitting in a bad position (e.g. at a kitchen table with a laptop) and gives feedback	Reminder to change unhealthy work methods / habits, to improve ergonomics (RRD 3).
27	Task priority manager (i7, i57)	• Top-down (database, input from superior): relying on certain indicators (e.g., budget volume, contractual requirements…) • Bottom-up (user-feedback, case-based reasoning) Synchronization with email	No matching insight.

28	Projector Smartphone (i54, i77, i96)	Connect a pico-projector to your smartphone for projecting the smartphone screen on any surface/wall. The system should allow for touch-based input on the surface projection, in addition to touch-based input on the smartphone screen.	No matching insight.
29	Social Window (i24, i25, i58)	Having a wall projection showing what is going on in a different office (e.g., next door or at other branch office) • Motion-triggered • „Room invitations“ could be shared • Add on: “whole room effect” • Add on: Interactions between rooms (e.g. sharing written information) • Alternative: Second Life virtual rooms Challenge: causes a lot of data traffic	No matching insight.
30	Instant Messaging Service (i27, i28, i59)	There is a need for an informal way of communicating with colleagues other than by email, which is also available while traveling and at other workplaces (e.g., Skype, Lync)	No matching insight.
31	Virtual Dining Table (i39)	• Eat lunch with others, while still in front of your computer. Creating a dining environment at the desk (changing the physical appearance with a dining kit).	No matching insight.
32	Getting-Things-Done Tool (i14, i15, i16, i17, i21)	Support like the Getting-Things-Done (GTD) methodologies, integrated in Outlook, to further structure long and short term tasks and to function more efficient. (E.g. to prevent spending too much time on 'too good or beautiful' products, resulting in a missed deadline).	Is relevant (SiLo 1).
33	Workplace QuickSwitch (i69)	• Change quickly between a personalized and a professional environment (e.g., when visiting a client or when the boss pays a visit) Removes all personalization in an instant.	No matching insight.
34	Time sharing & job sharing (i57)	A tool that can be used to offer/request help to/from colleagues.	No matching insight.
35	Customizable News Feed (i33, i74, i79)	Something like an RSS-feed that provides the newest updates (e.g., tutorials, external IT news, etc.) and enables sharing this with colleagues.	No matching insight.

36	Smart filtering of E-Mails (i23, i88)	• CC • 2nd priority • Based on own name (“Dear John Doe”) • Keywords from task list for mail filtering	No matching insight.
37	Enterprise resource planning (ERP) solution (i82)	Some centralized business management tool for ongoing project management and management of contacts.	No matching insight.
38	Superior Avatar (i26)	• Tells you what to do • Instant help in case of difficulties	No matching insight.
39	Organizing out-of-work activities (i31)	• Entertainment groups • Book club • Chess club • Nature lovers • Theater/Musical group	No matching insight.
40	Call Center Software (i38)	• Allocate need to appropriate employee • Having a pool of people that can answer the call • End user should have control of his availability, indicating his status • Time schedule (on-call schedule) • Categorize emergencies to an elastic and elastic (their flexibility)	No matching insight.
41	Romanian Keyboard (i56)	Romanian keyboard that features all special characters (diacritics).	No matching insight.

5. Features of the PEARL Platform

This section introduces the features chosen to be developed for the PEARL solution. The selection of these features is strongly based on the prioritized feature ideas (see Table 2), and on the feedback of the stakeholders (see Table 3). While we kept the 15 top ranked features, lower ranked features were discussed on their feasibility with the technical partners again and dropped if necessary. In Table 4 we present these features by name and the description as well as the accordant insights of the requirements analysis (see D2.1) and the realisation of the solution in PEARL.

Table 4: The list of features that we want to develop within the PEARL project and that should be integrated in the final platform.

#	Feature name (ref. to insights in D2.1, Table 5)	Feature description	Insights	Solution in PEARL
1	Accessibility Tool Tutorials (i47, i48, i87)	Tutorials that provide information and train older workers in the use of accessibility tools (e.g., a simple and easy-to-use zoom-function for GUIs, a text-to-speech function...)	#1 I want to use the calendar on my smartphone but the text is too small. #2 On my Windows PC, of course I can use larger font sizes, however the icons are still small. I therefore developed my own 'zoom-button' toggle between magnifying all at once, and the normal displayed size. #3 I have (congenital) visual problems for which I wear special contact lenses. This results in a clear vision at about 15 cm from my eyes which is less than for normal people (about 20-30cm). Therefore I usually sit very close to the screen, paper or whatever I want to see clearly.	Provision of a tutorial (e-Learning) that explains the use of the accessibility tools.
2	Private Digital Noteboard (i2, i91)	Always visible second screen at personal desk: • Urgent tasks are highlighted • Tasks are clustered according to projects/teams • Finished tasks can be crossed out • To-Do's/notes can be sent to public noteboard	#1 I need to meet objectives but sometimes I forget them („Out of sight, out of mind") #2 I want an always visible external memory resource for frequently needed information (e.g., for technical designs, important deadlines), but my current solution (post-its) is not reliable and cannot hold a lot of information.	Provision of a dedicated pre-configured browser window or a dedicated second screen for the task management tool.
3	Make-it-mine (i61, i62, i63, i64, i65)	RFID-tool that personalizes a workplace with one simple interaction.	#1 I value a pleasant appearance of the work environment, e.g. with some art on the walls and plants. #2 I find it important to have nice work-environment (e.g. plants and personal belongings), because a large proportion of human-life is at work. #3 I have various workspaces in	The insight of plans, art and personal belongings (#1 & #2) is out of scope for PEARL. For the other insights and the feature description, the pilot partners need to inform the consortium what devices they currently have available or wish to purchase in the context of the project, so as to

			which I do not always feel at home. I think I can benefit from RFID-solutions to personalize my work environments. #4 RRD has two flexible workspaces, which are often used by part-time employees and students. These flex-workers can benefit from RFID-personalization. They can feel more comfortable at their workplace with this personalization vs. placing personal tangibles. #5 I have different workplaces: the office, home and sometimes the library. I like to change my workplace when I need a concentration boost.	demonstrate the personalisation of PEARL (e.g. light sensor, temperature sensor, table that is configurable).
4	Cognitive training games (i34)	A selection of serious games to train cognitive skills to prevent mental decline with personalized training sessions	#1 I want to train my mind but I don't know how to do it effectively? ("To train my mind I'm reading, solving crosswords").	Integration and adaptation of selected cognitive games of the existing SOCIABLE platform.
5	Task management training (i12)	A task management training tool to help with planning the tasks to be more efficient.	#1 I find it difficult to structure time demanding tasks (e.g. repairing technology) vs. ad-hoc questions of customers.	Provision of a tutorial (e-Learning) that teaches some planning methods/tools.
6	Exercise Prompter and Demonstrator (i37, i38)	A friendly exercise reminder: • Prompting physical/mental exercises through pop-ups • Avatar might demonstrate exercises • Connected to calendar to know about ongoing meetings/deadlines	#1 At my age I need to increase circulation to stay fit but I struggle in motivating myself („Even a short dance might be a good idea") #2 In order to stay fit I need to be more active but I'm not aware of suitable exercises and miss prompts.	Prompting for breaks, which can be delivered by the Task Management Tool The Exercise prompter also relates to Walking Break Scheduler (R#14) and Break Reminder (R#20). The smartphone is used for capturing and forwarding sensor data, gathering subjective reported information and for providing feedback, e.g. on the physical activity status, based on the physical activity pattern and a reference line. At the first iteration, this can be showcased via the interaction with the smartphone, while during the second iteration we can consider integrating it with the platform, probably through the task management tool.
7	Flexible Self-Learning Mini-Modules (i80, i83)	Tutorials on how to use new software/tools: Ca. 15 min per session (to be completed until a fixed date)	#1 I need to flexibly configure offers based on client requests but I'm not aware of dedicated tools. #2 I need to compile lists and make calculations but do it by hand because I lack the necessary computer skills (Excel).	Provision of tutorials that provide information in the use of new software. The functionality will be delivered via the e-Learning platform.

8	Master Calendar (i84, i90)	An easy-to-use calendar tool that can combine different types of agendas (e.g., private & business).	#1 It would be nice if there is an easier way to compare my own private agenda with my work agenda; this makes it easier to plan appointments. #2 It would be good to have a simple calendar, which reminds me of my agenda. I think a calendar version is already on my PC, but I would need a right one.	Provision of a calendar solution that can by synchronised with Google Calendar and Outlook and that can offer an additional user interfaces (see Feature 13).
9	Public Digital Noteboard (i1, i2)	Always visible second screen at a wall: • see #1 Private Digital Noteboard • To-Do's/Notes can be sent to private noteboard	#1 I need to meet objectives but sometimes I forget them („Out of sight, out of mind") #2 I need to keep track of open tasks but carrying them over (e.g. from my agenda to Outlook) takes effort.	Could be delivered by a dedicated PC / Laptop running the Task Management Tool at Team Level, and projecting it to a wall.
10	Creativity trainer (i49, i50)	Software that challenges one's thinking and fosters creativity.	#1 Creative tasks like developing something new or analysis of the data give me energy. E.g. creating a recommender system for exercises. #2 Data analysis in Vicon is less appealing to me, as it tends to be a bit boring and not so challenging.	Insight #1 and the feature description relate to mental challenges which can be delivered through SOCIABLE (see Feature 4). Insight #2 is out of scope.
11	Knowledge base (i29)	Central internal knowledge base within organization: • "in case of problem X, contact Mrs. Miller…" • Wiki on frequent problems / to post questions	#1 Solving bigger and complex problems requires effective collaboration of people with different experiences/expertise.	A suggestion is to provide: i) a document repository and ii) an interface for employees with associated "metatags" with their skills (populated by the company) from which a person can choose (e.g. to request for help). Perhaps also support categorization based on skills.
12	Healthy Email Mgmt (i23)	Organized as e-learning content (e.g., Guidelines/tips on how to better cope with the email load)	#1 I have to communicate via email but I cannot handle the load (too many emails).	Provision of tips for mail management as part of an e-Learning class.
13	Digital Paper Calendar (i6, i30, i81, i89)	Paper calendar capable of automatically digitizing hand-written notes: • Digital paper or digital pen as input device • Tagging system (e.g. offline with different stickers or directly on the tablet/PC)	# I want to archive information but there is no backup system for that. # I plan my day on paper because I don't see the benefit of digital solutions (e.g., Outlook). # We need to share information digitally but there is no efficient way of digitizing hand-written information. # I do analysis on paper and then I have to digitize my work. It makes me lose time for sure.	Provides a new hybrid user interface for a calendar is closely related with Master Calendar (Feature 8).
14	Walking Break Scheduler (i46, i51)	Walking time in nature as part of the daily schedule and	#1 I need an outdoor environment in which I can take a (lunch) walk and relax. Because I spend most	Relates to Exercise Prompter (Feature 6) and Break reminder (Feature 20).

		encouraged by various means (e.g., calendar reminders, pop-ups…).	of the work day inside. I also feel this need, because of the back pain I experience. #2 An outdoor environment is important to me. #3 I take fewer breaks since I smoke e-cigarettes at my desk.	The initial suggestion was that the task MGT tool sends a notification to the Google calendar and the Google calendar is responsible for generating the notification. Perhaps Use Google calendar directly from the Task MGT tool.
15	Availability Indicator (i8, i10, i11, i20, i66)	An availability indicator embedded in the physical work environment that signals others whether you are open and free to be approached (e.g. a 'do not disturb sign/light'). Possibly, connected with a calendar tool that signals others on the type of task that one is working on, so that interruptions can be done at the moment which fits best (e.g. during tasks with low cognitive demands).	#1 I have a lot of distraction in my work (like colleagues asking short questions, and phone calls), which takes a lot of unnecessary time. #2 It was hard for me to get used to the fact that I needed to share a room with a colleague, while I had an office for myself in my previous job. #3 I do not like to take notes, because elaborating those takes a lot of time. After a long meeting I am already tired and especially then I need my concentration to formulate a coherent story which is even more exhausting. #4 Staying focused is harder when there is a lot of distraction from colleagues walking in and phone calls which I have to answer for both me and my colleague with whom I share the office. #5 My family finds it more difficult to keep work and private separate and disturb regularly with brief questions.	Insights #2, #3 and #5 are out of scope of PEARL. We want to use some kind of ambient environment and signal availability. Based on the personal calendar but also on user-triggered input a light indicator (red, green, yellow) will signal availability of a colleague.
16	Simple Time Bufferer (i13)	Task management support to create enough time between meetings to process information and execute forthcoming tasks (e.g., auto suggest time between two meetings in the agenda). People should stay in control.	#1 I find it difficult to structure time demanding tasks (e.g. repairing technology) vs. ad-hoc questions of customers.	Little function to be added to the task- and time management tool.
17	Remote Access (i4, i5, i55, i86, i92, i93)	A cross-platform tool to support task portability via secure remote access to company resources (i.e., files, software…).	#1 I want to be flexible in the choice of my work environment but accordant company policies are required for that #2 I need to work from home but have to use my own devices. #3 I cannot work at home because I don't have the necessary equipment. #4 I want to work on my tasks in different contexts / environments but there is no seamless way of	Provision of tutorials via the e-Learning platform that provide information on the use of tools available (e.g. VPN / TeamViewer etc.).

			doing so. #5 The Cloud is an energy saver. I can easily find my own work and share this information with others. #6 When working from home I only use my laptop. Sometimes it is difficult to work on my laptop, because I do not have all the software installed that I need (e.g. SPSS). In addition, my computer does not have enough computation power to perform certain demanding tasks (e.g. Matlab and java programming at the same time).	
18	Quick Access to GUI Settings (i40)	e.g., contrast, font…	#1 I need to work a lot with computers but it is detrimental to my vision and concentration	This feature could include two main sub-features: 1) Personalization of the working environment upon login (higher priority). 2) Provision of tutorials that provide information in the use of accessibility tools. The functionality could be delivered via the training platform (see Feature 1).
21	Ambiance Tuner (i67, i68)	Sound levels and ambiance of individual offices should be adjusted to different types of tasks (e.g., cognitive tasks and face-to-face meetings).	#1 I like to work with some music on, regardless of my workplace (at work or at home). #2 Default sound levels are not appropriate. Therefore, I would like to be able to manually adjust the sound levels according to the environment and importance.	Personalisation of the ambient environment upon login (closely relates to R3) and should be considered as a more generic ambient tuner and not only as a sound level tuner
23	Colleagues' Profiles (i32)	• Provides chance to get to know better the colleagues within the company. • Low-threshold way to get in touch with colleagues (e.g., through instant messaging, requests…)	#1 Sharing experiences is beneficial for both elderly and younger colleagues, but my organization currently does not facilitate such cross-generational exchanges.	List of expertise (closely related to Feature 11)
26	Posture Alarm (i44)	Detects long periods of sitting in a bad position (e.g. at a kitchen table with a laptop) and gives feedback	# All week evenings I work at home at the dining table on my laptop. This posture gives me back pain.	We will cover this requirement via the provision of an online platform (Activity Coach) which gives feedback and coaches end-users. The smartphone is used for capturing and forwarding sensor data, gathering subjective reported information and for providing feedback, e.g. on the physical activity status, based on the physical activity pattern and a reference line.

6. Concrete Use Cases

6.1. Use Cases Definition and Template

A Use Case, as a description of an actor's interaction with the system-to-be, is both a description of the system's user interface and an indirect description of some function that the system will provide. A set of Use Cases is a description of the system to be designed, the thing to be built, the solution to the problem [Martin, Robert C. (2002): "UML for Java Programmers", chapter 5, Use Cases) When specifying Use Cases, it is important to note that Use Cases are not a methodology. They are a powerful **description tools to preview and analyse the functionality of a system.** It is **essential to capture the interaction between the user and the system being developed**. Another aspect to consider is that Use Cases can be used during many stages of a system development, being associated with different objectives. During the analysis stage, they can be used to prevent the occurrence of costly error correction at later stages of the development cycle. At this initial phase of PEARL development, **Use Cases have the objective of capturing the system requirements.** Use Cases are not object-oriented, they are a **broadly applicable requirements analysis tools that can be applied also to non-object-oriented projects.** This hierarchical relationship is needed to properly describe the standard templates. The use cases template is provided in tabular format in the scope of Table 5.

Table 5: Basic Use Case Description Template

Identifier / Code	*Unique Identifier of the Use Case*
Name	*Name of the Use Case*
Related Scenario(s)	*Scenarios supported by this use case*
Goal	*What is expected to be achieved? When and how will the user(s) be satisfied?*
Actor(s)	*Who is involved in the use case*
Preconditions	*Assumptions underlining the use case*
Basic Course of Action	*Flow of the use case as a series of steps*
Post Conditions	*Situation after the execution of the use case*
Target Platform(s)	*The target platform(s) (Microsoft Surface/ TabletPC) where this use case will be implemented*
Notes	*Any additional notes (e.g., clarifications) surrounding the particular use case*

6.2. Overview of PEARL Use Cases

An important feature of the PEARL Use Cases is that their "names" should reflect users' goals and should immediately convey meaning. Taking this into consideration through all processes, Use Cases provide a number of examples containing scenarios of use for PEARL, which should be of great utility for the work of Technical teams/developers, but also for stakeholders and users. The following table provides an overview of the PEARL Use Cases, listing also the actors which they involve.

Table 6: PEARL Use Cases

No.	Uses cases	Actors
1	Break Scheduler	The end-user (55+ office worker)
2.1	Exercise Prompter (1)	The end-user (55+ office worker)
2.2	Exercise Prompter (2)	The end-user (55+ office worker)
3.	Master Calendar	The end-user (55+ office worker), colleagues
4	Task management	The end-user (55+ office worker)
5	Add new project/task category	The end-user (55+ office worker)
6	Reminder tools	The end-user (55+ office worker)
7	eLearning	The end-user (55+ office worker)
8	Use Cases for cognitive training	The end-user (55+ office worker)
9	Social empowerment use cases	The end-user (55+ office worker)
10	User Identification	The end-user (55+ office worker)
11	Task Switching	The end-user (55+ office worker)
12	Automatically view tasks	The end-user (55+ office worker)
13	View shared calendar	The end-user (55+ office worker)
14	Navigate shared calendar based on page flip	The end-user (55+ office worker)
15	Live-preview of hand-writing	The end-user (55+ office worker)
16	OCR text recognition of hand-writing	The end-user (55+ office worker)
17	Display notifications	The end-user (55+ office worker)
18	Respond to appointment	The end-user (55+ office worker)
19	Navigate appointments based on page flip	The end-user (55+ office worker)
20	Assign task(s) with hand-written “action” commands	The end-user (55+ office worker)
21	Display tasks	The end-user (55+ office worker)
22	Select content by circling	The end-user (55+ office worker)
23	Share content	The end-user (55+ office worker)
24	Move items on whiteboard	The end-user (55+ office worker)
25	Download content from whiteboard	The end-user (55+ office worker)
26	Complete task by striking through with pen	The end-user (55+ office worker)

6.3. Detailed Use Cases

The following sub-section describes these use cases in more detail**.**

The following sub-section describes the use cases regarding the features: the *Walking Break Scheduler,* the *Exercise Prompter* and the *Master Calendar.*

6.3.1 Use case 1. Break Scheduler

Identifier / Code	Use case 1
Name	Break Scheduler
Related Scenario(s)	Scenario 3 - Suzy
Goal	The Break Scheduler supports the ability to stay focused during the workday and supports physical and mental health by prompting messages to take breaks whenever it detects it to be suitable based on the time gaps in the agenda. These breaks can be physical or mental by suggesting a mini-walk or relaxing exercises.
Actor(s)	PEARL end-user (55+ office worker)
Preconditions	- The end-user should wear the accelerometer to check the compliance of the end-user regarding the recommended breaks. - The end-user should make use of an agenda and has to keep it up to date.
Basic Course of Action	**System:** PEARL notices a time gap of 25 minutes between two appointments in her agenda. Subsequently, PEARL prompts a message: "*Hello Suzy! How about taking a coffee break in the coffee corner*". Followed the three options *Good idea, Maybe later* and *No thanks*. **User 1:** Suzy clicks on *Good idea* and goes for a coffee. **System:** PEARL detects via the location detection (e.g. GPS) in her smartphone that she left the building as it switches to her smartphone. **User 1:** Suzy arrives back at the office after a 15-minute break. **System:** PEARL detects via the location detection in the smartphone that Suzy is back in her office and simultaneously opens on all her devices in her office (e.g. tablet, PC, laptop).

Post Conditions	The end-user stays focused during the workday and continues to be physically and mentally healthy by taking sufficient breaks.
Target Platform(s)	The RRD activity, monitoring and coaching platform (Physical Wellbeing Layer).
Notes	-

6.3.2 Use case 2.1: Exercise Prompter (1)

Identifier / Code	Use case 2.1
Name	Exercise Prompter
Related Scenario(s)	Scenario 2 - Tibor
Goal	The Exercise Prompter **prevents e.g. back pain, RSI** and supports physical activity resulting in an increased health state by prompting messages to execute specific exercises whenever it detects it to be suitable based on time gaps in the agenda and sedentary periods.
Actor(s)	PEARL end-user (55+ office worker)
Preconditions	- Knowledge of the physical complaints of the end-user resulting from the intake questionnaire. - The end-user should wear the accelerometer to check the compliance of the end-user regarding the recommended exercises.
Basic Course of Action	**User 2:** Tibor specified in the intake questionnaire that he does not want to sit in the same position behind his desk for over 45 minutes to prevent himself from back pain. **System:** The *Activity Coach* of PEARL detects via the accelerometer a sedentary period longer than 45 minutes and consequently prompts a message to Tibor: " *The sun is shining outside, how about a lunch walk with a colleague?* " with the consecutive answer options: *Good idea*, *Maybe later, perhaps some stretching exercises* and *No thanks*. **User 2:** Tibor selects the second option: *Maybe later, perhaps some stretching exercises.*

	System: PEARL shows an overview with various stretching exercises (e.g. stretching exercises of Workrave) and automatically starts running images in which the exercises are visualized. **User 2:** Tibor starts executing these exercises behind his desk. After finishing all the proposed exercises he continues working behind his desk. **System:** Another 30 minutes later the *Activity Coach* of PEARL notices a time gap of 20 minutes between two appointments and detects a sitting period of over 75 minutes. It again shows a message: "*Hi Tibor, you sat down for over an hour now. Maybe it is time for some coffee in the park?"* followed by the options *Good idea, Maybe later, perhaps some stretching exercises* and *No thanks*. **User 2:** Tibor did not realize he was sitting in the same posture for such a long time and selects *Good idea.* **System:** PEARL detects via the location detection of his the smartphone that he is no longer in one of his pre-set work environments and switches to his smartphone.
Post Conditions	The end-user is prevented from back pain as he continues to be physically active.
Target Platform(s)	The RRD activity, monitoring and coaching platform (Physical Wellbeing Layer).
Notes	-

6.3.3 Use case 2.2. Exercise Prompter (2)

Identifier / Code	Use case 2.2
Name	Exercise Prompter
Related Scenario(s)	Scenario 5 - Ole
Goal	The Exercise Prompter prevents e.g. back pain, RSI and **supports physical activity** resulting in an increased health state by prompting messages to execute specific exercises whenever it

	detects it to be suitable based on time gaps in the agenda and sedentary periods.
Actor(s)	PEARL end-user (55+ office worker)
Preconditions	- The end-user should have defined physical activity targets in the pre-set conditions. - The end-user should wear the accelerometer to check the compliance of the end-user regarding the recommended exercises.
Basic Course of Action	**User 3:** Ole specified in the pre-set conditions of PEARL that he would like to work on weekly goals aimed at physical activity. These weekly goals are further refined into daily physical activity targets. **System:** Based on these pre-set daily targets, the *Activity Coach* detects that Ole will not be able to achieve his target when continuing this pattern of physical behaviour, resulting in prompting a message in the right corner of his screen: " *Hi Ole, how about some running in the park this afternoon after your 1 o' clock meeting? "* followed by three options: *Good idea*, *Maybe later, perhaps some stretching exercises* and *No thanks*. **User 3:** Ole clicks on the first option and already starts collecting his sportswear. **System:** At 1:15 PM the *Activity Coach* detects physical movement and shows a message filling the whole smartphone screen: " *You are doing a great job, Ole! Another 2 kilometres and you are done for today ".* This message disappears automatically and a new message appears when he finished his physical activity goal for today: " *Congratulations Ole! You've achieved your physical activity goal for today ".* **User 3:** Ole clicks on the message. **System:** PEARL automatically redirects Ole to the *Physical Empowerment* module and shows a graph which summarizes his physical activity of that day. An animated image of a trophy emerges in the graph and disappears automatically.
Post Conditions	The end-user achieves his pre-set physical activity target for that day and stays physically healthy resulting from his compliance to

	the pre-set targets.
Target Platform(s)	The RRD activity, monitoring and coaching platform (Physical Wellbeing Layer).
Notes	-

6.3.4 Use Case 3: Master Calendar

Identifier / Code	Use case 3
Name	Master Calendar
Related Scenario(s)	Scenario 3 - Suzy
Goal	The aim of the Master Calendar is to easily combine different types of agendas (e.g. private and business).
Actor(s)	PEARL end-user (55+ office worker), colleagues
Preconditions	- The end-user should make use of at least two agendas (private and work related) and has to make sure they are up to date.
Basic Course of Action	**System:** PEARL informs Suzy that she got mail by briefly showing her an envelope with the title and sender of the message. **User 1:** Suzy notices an envelope in the right corner of the screen and clicks on it as she realized it came from one of her close colleagues who wants to celebrate her birthday. **System:** PEARL displays the context of the message: " *It is my birthday next Wednesday, for which I would like to invite you all for a drink that afternoon around 5 PM in the coffee corner. Hope to see you then! Best, Kirsten* ". **User 1:** Suzy normally leaves early for fitness class every Wednesday. So she opens her Outlook calendar via the follow-up menu in the e-mail to check whether she can reschedule her class and if she has no work-related appointments that afternoon. **System:** PEARL opens Outlook and displays her work agenda. **User 1:** Suzy selects the checkbox of her *Private agenda* in left sidebar of the Outlook screen.

	System: PEARL displays her private agenda right next to her work agenda and separates them via different panel tabs. **User 1:** Suzy checks her private agenda as well as her work agenda and concludes that she can attend the drink. Suzy sends back a message to confirm her attendance and creates an item in her work agenda.
Post Conditions	The end-user could easily and simultaneously check different types of agendas just within a few interactions with the system, which saves time.
Target Platform(s)	The Task and Time Management module.
Notes	-

6.3.5 Use case: 4: Task Management

Identifier / Code	Use case 4
Name	Task management
Related Scenario(s)	Scenarios 1,3,4,5
Goal	The goal is to add/edit/complete/delete a task on the private digital noteboard.
Actor(s)	PEARL user
Preconditions	A user profile has been created and a set of relevant task categories or ongoing projects has been defined during system deployment time, based on user's preferences. The user has logged in the PEARL system via his/her RFID tag and the dashboard is showing the private digital noteboard with a summary of the existing tasks (empty if this the first task to be added) and a summary of the upcoming meetings for the day/next two days/week (empty if no meeting are scheduled).
Basic Course of Action	The private digital noteboard will display the a list of user's open tasks, which will contain information about the relevant project or task category, the title, the entry date, the due date, the priority, the status and level of completion of each tasks. The user will be able to arrange the open task based on each of these parameters. The user will be able to choose whether to display all tasks or to search for and display only tasks that are relevant to a chosen project or task category. The private digital noteboard will offer the options to easily add, edit, complete or delete tasks

	1)Add - When entering a new task the user will be required to fill out a minimum set of information parameters. The required fields should be as few as possible to enable fast and easy task addition, but they should be enough to enable future task management. At this point the required parameters are determined to be:Relevant project or task category – the entry will be either selected from a list of existing categories or added as a new category/project (please refer to use case “Add a new category/project”). - Title - Due date – selected from a calendar or from a drop down menu - Priority – selected from a drop down menu (lowest, low, normal, high, highest) Additionally the user will be able to define additional information, such as contact person, level of completion (in terms of percentage), and description.. The user will be able to also identify the task as private and invisible to other PEARL users. When the information is completed the task will be added to the relevant database and displayed on the private digital noteboard. The user will be redirected to the private digital noteboard. The user will be able to discard the new task in any time, in which case hewill be redirected to the private digital noteboard page. 2)Edit Once a to-do item is created the user should be able to display a summary of it and edit itat any time. The user will be able to modify any parameter of his choice. A log of the previous changes will also be available. The user will, for example, be able to add further description, change the completion percentage status or change the due date. Once the edition is finalized the user will be redirected to the private digital note board. 3)Complete The platform will provide ergonomic UI for quick and effortless completion of open tasks. A log of all the completed task will be available.4)Delete The platform will provide an option to delete an open task that is irrelevant or that was added by mistake.The deleted task will not be logged and it will not be possible to view them any longer.
Post Conditions	*Add* A new entry will be added and displayed on the private digital noteboard. *Edit* The task details will be update and the new information will be displayed on the private digital noteboard. *Complete*

	The entry will no longer be displayed on the private digital noteboard. A summary of the all open or completed task will be available. *Delete* The deleted tasks will be removed from the private digital noteboard and can no longer be viewed.
Target Platform(s)	Task and Time Management Module
Notes	To be edited when the UI is finalized.

6.3.6 Use case 5: Add new project/task category

Identifier / Code	Use case 5
Name	Add new project/task category
Related Scenario(s)	1,3,4,5
Goal	The goal is to add a new project or task category that can be further automatically selected when a new task is added by the user. This will enable grouping of the task by type/project relevance. The categories might include any activity relevant to the PEARL user's work, for example Communication with clients, Internal communication, Internal reporting, Project proposal preparation, etc.
Actor(s)	PEARL User
Preconditions	A user profile has been created. The user has logged in the PEARL system via his/her RFID tag. The Task & Time Management tool has been launched.
Basic Course of Action	The platform will provide easily accessible ergonomic UI for adding new projects and task categories. The user will be able to add a new project/task category by entering a minimum set of required information – for example only name, or name and project code. The user will be also able to add any additional information relevant to the project planning or description of the relevant category, such as project category, coordinator, project description, team members, start and end date, deliverables, phases, etc. The user will also be able attach relevant documents. It should be possible to save the information at any time. Upon completion of the process the user will be redirected back to the Project administration page that will display list of the available projects/task categories. The details of each entry should be easily viewed and/or edited.
Post Conditions	A new project/task category will be added and can be automatically selected when a new task is added.

Target Platform(s)	Task & Time Management module
Notes	To be edited when the UI is finalized.

6.3.7 Use case 6: Reminder tools

Identifier / Code	Use case 6
Name	Reminder tools
Related Scenario(s)	2, 3, 4, 5
Goal	The goal is to encourage the PEARL users by friendly pop-up reminders to be more physically active, to complete eLearning tutorials or to enhance their mental state by playing cognitive training games.
Actor(s)	PEARL User
Preconditions	The user has logged in the PEARL system via his/her RFID tag. The Task & Time Management tool has been launched.
Basic Course of Action	The Task & Time Management module will check periodically user's availability, based on his calendar entries and will trigger pop-up reminders that encourage him to complete an eLearning tutorial, play a cognitive training game, go for a walk or perform a short exercise session. The pop-up dialog window will contain a friendly message and a direct link to the eLearning module, Cognitive Training module or Physical Wellbeing module, depending on the activity of interest. The user will be able to cancel or reschedule the reminder. The order and frequency of the reminders will be determined at a later stage.
Post Conditions	The user will be redirected to another PEARL module to perform the desired activity.
Target Platform(s)	Task & Time Management module, eLearning module, Cognitive Training module, Physical Wellbeing module
Notes	-

6.3.8 Use case 7: Active eLearning content and tools

Identifier / Code	Use case 7
Name	Active eLearning content and tools
Related Scenario(s)	1, 2, 3, 4, 5,6,7,8,9,10
Goal	This use case is activated by senior student to access and view course information such as download materials (lectures and assignments), view references, view forums, view announcements,

	and view examinations/assessments (competence codes) results. The senior student can also view lecturer profile and view course syllabus/schedule.
Actor(s)	The PEARL end-user (55+ office /home worker)
Preconditions	The senior student already login to the PEARL system. Characteristic of Activation: Action Driven (on user's demand)
Basic Course of Action	Basic Flow [eLCMS of e-doceo_001] 1. This use case begin after senior student successfully login onto the system 2. The systems verify the user ID and password and prompt the student manage this interface. 3. The system displays view announcements page with all previous announcements information which sent to him/her by the lecturer that related to the course name and group name 4. The student select **<<View Course Information>>** option, 5. The system will display view course information page 6. The senior student must select course name then click on **<<Enter >>** button. 7. The system will display course name page with all activities that related to course name. 8. The senor student select **<<Download Materials>>**option [A-1: View References] or [A-2: View Forums] or [A-3: View Announcements] or [A-4: View grades details] or [A-5: View Lecturer Profile] or [A-6: View Course syllabus/schedule] 9. The system will display download materials page with all materials information that sent to him/her by the lecturer that related to the course name and group name. 10. The senior student can view materials (documents) information or download it by click on **<<Download>>** button 11. The system will display materials information 12. The system will enable senior student to download/save documents onto local device. 13. The senior student can download more materials from the same course and/or different group name or from another course name by click on **<<Select another course>>** button. **Alternative Flow** A-1: View References (eLCMS of e-doceo_002) 1. The senior student select **<<View References>>** option 2. The system displays view references page with all previous references information which sent to him/her by the lecturer that related to the course name and group name. 3. The senior student enables to view references information to another course name by click on **<<Select another course>>** button.

	A-2: View Forums [eLCMS of e-doceo_003] 1. The senior student select **<<View Forums>>** option 2. The system displays view forums page with all previous forums information which sent to him/her by the lecturer that related to the course name and group name. 3. The senior student enables to view forums information to another course name by click on **<<Select another course>>** button. A-3: View Announcements [eLCMS of e-doceo _004] 1. The senior student select **<<View Announcements >>** option 2. The system displays view announcements page with all previous announcements information which sent to him/her by the lecturer that related to the course name and group name. 3. The senior student enables to view announcements information to another course name by click on **<<Select another course>>** button. A-4: View Grade/Competence code Details [eLCMS of e-doceo _005] 1. The senior student select **<<View Grade Details >>** option 2. The system displays view grade page with information about grades to all senior students that related to the course name and group name. 3. The senior student enables to view grade information to another course name by click on **<<Select another course>>** button. A-5: View Lecturer Profile [eLCMS of e-doceo _006] 1. The senior student select **<<View lecture profile>>** option, 2. The system will display view lecture profile page with all information of lecturer profile. A-6: View Course Syllabus/ Schedule [eLCMS of e-doceo _007] 1. The senior student select **<<View Course syllabus/schedule>>** option, 2. The system will display course syllabus information that related to the course name and group name.

6.3.9 Use case 8: Use Case for cognitive training

Identifier / Code	Use Case 8
Name	Synonyms
Related Scenario(s)	1, 3, 4, 5
Goal	The PEARL user wishes to be engaged with a serious game targeting his cognitive training.
Actor(s)	PEARL User
Preconditions	The PEARL User is registered at the platform. The PEARL User successfully logs in to the platform.
Basic Course of Action	The PEARL User logs in to the platform using his RFID card. The PEARL User is presented with the PEARL dashboard.

	The PEARL User selects the Cognitive Training layer The PEARL User selects the category of the games he wants to be engaged with The PEARL User selects the difficulty of the game The PEARL User plays the game. The PEARL User is presented with the results of the game (success / failure, and/or time left / time required to complete the game
Post Conditions	The results are stored in the user profile
Target Platform(s)	PEARL Cognitive Training Layer
Notes	-

6.3.10 Use case 9: Social Empowerment use case

Identifier / Code	Use case 9
Name	Knowledge Base
Related Scenario(s)	1
Goal	The PEARL user wishes to allocate a task to a colleague, but is not sure which colleague is responsible for or able to undertake this task.
Actor(s)	PEARL User
Preconditions	The PEARL User is registered at the platform. The PEARL User's colleagues' profiles and skills have been inserted at the PEARL Database. The user successfully logs in to the platform.
Basic Course of Action	The PEARL User logs in to the platform using his RFID card. The PEARL User is presented with the PEARL dashboard. The PEARL User selects the Social Empowerment layer. The PEARL User selects the "Company Knowledge Base". The PEARL User navigates through the knowledge base where the company employers are listed along with their position, tasks and skills. The PEARL User is able to directly contact the person that fits the requested profile, either by phone or e-mail or instant message.
Post Conditions	The PEARL User contacts the colleague whose profile fits the PEARL user's needs.
Target Platform(s)	PEARL Social Empowerment Layer
Notes	-

6.3.11 Use case 10: User identification

Identifier / Code	Use case 10

Name	User identification and workspace setup
Related Scenario(s)	1,2,3,4,5
Goal	Identify the User by utilizing his personal RFID card
Actor(s)	PEARL end-user (55+ office worker)
Preconditions	The system has already been configured and all the User's personal preferences has already been defined and stored to the PEARL database.
Basic Course of Action	The User enters his workspace and passes his RFID card over the desktop RFID reader located on his desk. The reader retrieves the unique ID assigned to the card and passes it to the Ambient Tuning Layer of PEARL. The ID is cross checked with the Configuration Manager that retrieves the User's personal configurations like general preferences (e.g., in terms of colour, layout, volume etc.), but also of the default task he is carrying out upon log in. The retrieved information is passed to the Ambient Tuning Layer which undertakes the task to configure the workspace environment based on the available ambient sensors and actuators.
Post Conditions	The workspace environment is automatically configured to match the user preferences and needs based on his medical condition and personalize requests. As an example the computer resolution could be modified, the availability indicator could turn into busy, the room light could be dimmed to optimize the viewing of the screen, the task switcher device (LCD touch screen) could provide all personalized task, etch.
Target Platform(s)	Ambient Tuning Layer, BI Layer and Ambient Sensor Configuration Layer
Notes	-

6.3.12 Use case 11. Task Switching

Identifier / Code	Use case 11
Name	Task Switching
Related Scenario(s)	1,2,3,4,5
Goal	To provide the ability to the User to easily switch between his predefined everyday tasks

Actor(s)	PEARL end-user (55+ office worker)
Preconditions	The system has already been configured and all the User's personal preferences has already been defined and stored to the PEARL database. The User has already logged in to the PEARL system and the preconfigured personalized tasks are provided thru a dedicated LCD touch screen.
Basic Course of Action	The User initiates a different task by hitting the equivalent graphical button on the dedicated touch screen. The Ambient Tuning Layer (ATL) receives the trigger and identifies the unique task ID assigned to this specific task. The ATL passes the Task ID to the Configuration Manager that helps to retrieve the User's personal configurations related with this task that includes general preferences (e.g., in terms of colour, layout, volume etc. of the personal computer), but also of the task he is carrying out. The retrieved information is passed to the ATL which undertake the task to configure the workspace environment based on the available ambient sensors and actuators.
Post Conditions	The workspace environment is automatically configured to match the user preferences and needs based on his medical condition and personalize requests. As an example the computer resolution could be modified, the availability indicator could turn into busy, the room light could be dimmed to optimize the viewing of the screen, the task switcher device (LCD touch screen) highlights the current task, etch.
Target Platform(s)	Ambient Tuning Layer, BI Layer and Ambient Sensor Configuration Layer
Notes	-

6.3.13 Use case 12: Automatically view tasks

Identifier / Code	Use case 12
Name	Automatically view tasks
Related Scenario(s)	9.1
Goal	User gets an overview of her/his tasks
Actor(s)	User
Preconditions	User is walking to her/his desk in the morning
Basic Course of Action	When user is walking to the desk the PrivBoard device notices her/his appearance. The screen on the device then shows the current upcoming tasks assigned to the user.
Post Conditions	User is reminded on the upcoming tasks
Target Platforms	PrivBoard

Notes	It's also possible to achieve this use case with the utilization of RFID cards to identify the user on the PrivBoard. tbd: when should the tasks be displayed on the device? Morning, first time appearance in the office, … ? What's a good approach?

6.3.14 Use case 13: View shared calendar

Identifier / Code	Use case 13
Name	View shared calendar
Related Scenario(s)	9.1
Goal	User sees the calendar from colleague(s)
Actor(s)	User and other colleague(s)
Preconditions	Calendars from colleagues are accessible and contain relevant events
Basic Course of Action	The user indicates on the OrganIO that she/he wants see the calendar from her/his colleagues. The display shows the colleague's events based on the open page on the OrganIO.
Post Conditions	User is aware of colleague's event
Target Platforms	OrganIO
Notes	This use case assumes the use of a day-based calendar. tbd: should it be possible to view more calendars?

6.3.15 Use case 14. Navigate shared calendar based on page flip

Identifier / Code	Use case 14
Name	Navigate shared calendar based on page flip
Related Scenario(s)	9.1
Goal	Day in a shared calendar is selected based on page flip
Actor(s)	User
Preconditions	Calendars from colleagues are accessible and contain relevant events. User indicated to view shared calendar.
Basic Course of Action	OrganIO detects the current page and switches to the corresponding calendar day on the display. When the device detects a page flip, the display switches to the corresponding day.
Post Conditions	Calendar based on current page is displayed
Target Platforms	OrganIO
Notes	

6.3.16 Use case 15: Live-preview of hand-writing

Identifier / Code	Use case 15
Name	Live-preview of hand-writing
Related Scenario(s)	9.1
Goal	OrganIO's display shows the hand-writing in real-time
Actor(s)	User
Preconditions	Must be written with OrganIO's smart pen
Basic Course of Action	User takes smart pen and starts writing on the OrganIO paper. The display renders a live-preview of the hand-writing.
Post Conditions	The hand-written snippet is displayed on the OrganIO and offers options for further actions (e.g. "share on whiteboard", "create event", …)
Target Platforms	OrganIO, smart pen
Notes	Alternative: display hand-writing after a word is finished or sentence is finished? tbd: which actions should be possible?

6.3.17 Use case 16: OCR text recognition of hand-writing

Identifier / Code	Use case 16
Name	OCR text recognition of hand-writing
Related Scenario(s)	9.1
Goal	Hand-written text is digitized for further content analyses
Actor(s)	User
Preconditions	User is writing with smart pen
Basic Course of Action	The hand-writing will be analysed in real-time and an OCR software converts the analog letters into digital text. Depending on the context suitable actions will be offered (e.g. when writing in calendar system can offer to create an event).
Post Conditions	Suitable actions based on the content and context are offered to the user
Target Platforms	OrganIO, smart pen
Notes	This use case depends on technical feasibility

6.3.18 Use case 17. Display notifications

Identifier / Code	Use case 17
Name	Display notifications
Related Scenario(s)	9.1
Goal	User is aware of the notification
Actor(s)	User
Preconditions	User is on her/his desk in order to see the notification
Basic Course of Action	When a notification is triggered (e.g. a colleague responds to an event invitation) it will be displayed on the PrivBoard in readable size.
Post Conditions	
Target Platforms	PrivBoard
Notes	tbd: should notifications be displayed somewhere else too (e.g. OrganIO)? Further details need to be specified, e.g. what is displayed before, how can a notification be listed, dismissed, postponed etc.

6.3.19 Use case 18: Respond to appointment

Identifier / Code	Use case 18
Name	Respond to appointment
Related Scenario(s)	9.1
Goal	User has responded an appointment
Actor(s)	User(s) who receive(s) appointment, User who sends or edited appointment
Preconditions	Receiver needs to respond to an appointment (e.g. another user sent invitation, postponed appointment etc.)
Basic Course of Action	When a sender created or edited an appointment the receiver(s) is/are notified on the OrganIO display about the appointment. The receiver(s) can choose to (1) accept or (2) decline the appointment.
Post Conditions	Sender can be notified about the chosen options
Target Platforms	OrganIO
Notes	Options depending on the actual backend service

6.3.20 Use case 19: Navigate appointments based on page flip

Identifier / Code	Use case 19

Name	Navigate appointments based on page flip
Related Scenario(s)	9.2
Goal	User can see appointments of a specific day
Actor(s)	User
Preconditions	User has appointments
Basic Course of Action	OrganIO detects the current page and displays the appointments on that day on the display. When the device detects a page flip, the display switches to the corresponding day.
Post Conditions	Appointments on based current page (day) are displayed
Target Platforms	OrganIO
Notes	-

6.3.21 Use case 20: Assign task(s) with hand-written “action” commands

Identifier / Code	Use case 20
Name	Assign task(s) with hand-written “action” commands
Related Scenario(s)	9.2
Goal	Task(s) assigned to a project
Actor(s)	User
Preconditions	User has written some tasks on a list on paper
Basic Course of Action	User writes the word “todo” in front of some notes she/he wrote earlier. OrganIO detects the word and suggests to a task(s) (i.e. a preview of the task is displayed create). The user can then decide to assign this content to a project and optionally assign a time to be reminded.
Post Conditions	Task(s) saved in the system and reminders are set
Target Platforms	OrganIO, smart pen
Notes	The “action” words or tags can e.g. be written in an extra column for better visualisation.

6.3.22 Use case 21: Display tasks

Identifier / Code	Use case 21
Name	Display tasks
Related Scenario(s)	9.2

Goal	User gets a quick glance of the tasks
Actor(s)	User
Preconditions	User is on her/his desk and has assigned tasks
Basic Course of Action	User indicates to view tasks. The assigned tasks are displayed on the PrivBoard.
Post Conditions	User is reminded on the assigned tasks
Target Platforms	PrivBoard
Notes	

6.3.23 Use case 22: Select content by circling

Identifier / Code	Use 22
Name	Select content by circling
Related Scenario(s)	9.3
Goal	Content is selected by circling with smart pen
Actor(s)	User
Preconditions	Written content on page exists
Basic Course of Action	User indicates with the back side of the smart pen that an item (i.e. a note) needs to be selected. The selected item appears on the screen. The item can be deselected on the OrganIO screen.
Post Conditions	Selected item is displayed on the screen and further actions can be chosen
Target Platforms	OrganIO, smart pen
Notes	

6.3.24 Use case 23: Share content

Identifier / Code	Use case 23
Name	Share content
Related Scenario(s)	9.3
Goal	Share content written on OrganIO
Actor(s)	User
Preconditions	Content is selected
Basic Course of Action	After a paper scribble is selected the user can choose to share the piece of content to (1) person (2) white board or (3) PrivBoard, or

	cancel the action otherwise.
Post Conditions	Content is shared to target
Target Platforms	OrganIO, white board, PrivBoard
Notes	Sharing options can be limited/extended

6.3.25 Use case 24: Move items on whiteboard

Identifier / Code	Use case 24
Name	Move items on whiteboard
Related Scenario(s)	9.3
Goal	Content on the whiteboard is rearranged
Actor(s)	User
Preconditions	Content is available on the white board (e.g. when shared earlier)
Basic Course of Action	User indicates that she/he wants to move a piece of content on the whiteboard by selecting it. She/he can then move the content with natural gestures.
Post Conditions	
Target Platforms	Interactive whiteboard
Notes	

6.3.26 Use case 25: Download content from whiteboard

Identifier / Code	Use case 25
Name	Download content from whiteboard
Related Scenario(s)	9.3
Goal	Content from whiteboard is downloaded
Actor(s)	User
Preconditions	Content is available on whiteboard and OrganIO is connected to whiteboard
Basic Course of Action	User indicates on OrganIO that she/he wants to download the content from the whiteboard on the device. The content is downloaded on stored on the device.
Post Conditions	Content stored on device
Target Platforms	Interactive whiteboard, OrganIO
Notes	Where will the content be saved? Date-based? Attached to appointment in calendar?

6.3.27 Use case 26: Complete task by striking through with pen

Identifier / Code	Use case 26
Name	Complete task by striking through with pen
Related Scenario(s)	9.3
Goal	Task is marked as completed
Actor(s)	User
Preconditions	Task is written on OrganIO's paper
Basic Course of Action	User crosses out an item on the paper. OrganIO notices which item was crossed out and marks the task as completed on the screen.
Post Conditions	Task is marked as completed, reminders on PrivBoard are removed
Target Platforms	OrganIO, PrivBoard, smart pen
Notes	How are tasks separated from calendar? Should they only exist digitally? Undo functionality? (although real paper has no "undo" either)

7. Integrated functionalities

The following table provides information regarding the integrated functionalities of the PEARL platform based on the user requirements elicited. These functionalities are split in five categories, namely Functional, Usability, Accessibility, Reliability and Security.

Category	#	Requirements	Priority	Corresponding Use Case
Functional	**FUR#01**	The PEARL platform must support the utilisation of RFID cards for login to the user's personal computer	High	10
	FUR#02	The PEARL platform must support the utilisation of RFID cards capable of loading predefined configuration plans and personal settings	High	10, 11
	FUR#03	The PEARL platform must support connection with ambient devices and sensors (e.g. light and temperature) that can be configured by the user	High	10, 11, 12, 13, 14, 15, 17, 21
	FUR#04	The PEARL platform must support personalisation of the workspace	High	1, 2, 8, 10, 11
	FUR#05	The PEARL platform must support quick access to GUI settings	High	10
	FUR#06	The PEARL platform must support the indication of the availability of the employee to be disturbed	High	10, 11
	FUR#07	The PEARL platform must support reconfiguration of the settings by the user based on his/her preferences	High	10
	FUR#08	The PEARL platform must support the automatic proposition of workspace models and	Medium	10

		configuration plans based on the user's profile		
	FUR#09	The PEARL platform must support the provision of a digital noteboard / digital calendar with which the user can interact as if s/he was utilising a paper noteboard / calendar	High	3, 12-26
	FUR#10	The PEARL platform must support tracking and managing working time and organising tasks	High	4,5, 12, 18-20, 26
	FUR#11	The PEARL platform must support reminders	High	1, 6
	FUR#12	The PEARL platform must support prompts for breaks and physical and cognitive exercises	High	1, 2
	FUR#13	The PEARL platform must support the provision of a master calendar that can be synchronised with calendars that the users currently use.	High	3, 12-26
	FUR#14	The PEARL platform must support cognitive training through the utilisation of serious games	High	8
	FUR#15	The PEARL platform must support the provision of tutorials and training courses for a plethora of issues including for example tutorials and courses on accessibility tools, demonstration of exercises, e-mail management, remote access to corporate resources etc.	High	7

	FUR#16	The PEARL platform must support the provision of a knowledge base of the personnel of the company	Medium	9
	FUR#17	The PEARL platform must support detection of long sitting periods	High	1
	FUR#18	The PEARL platform must support the (automatic) suggestion and provision of training plans	High	1,2
	FUR#19	The PEARL platform must support social empowerment through the provision of tools that will boost the social interaction between the employees of a company (such as for example a corporate forum, a corporate blog, a corporate wiki and a live chat)	Medium	7, 9
	FUR#20	The PEARL platform must support asynchronous communication with caring personnel	Medium	2
	FUR#21	The PEARL platform must support the evaluation of the user's work performance	Medium	10
	FUR#22	The PEARL platform must support the evaluation of the user's cognitive training performance	Medium	8
	FUR#23	The PEARL platform must support the localisation of the platform and its services	High	10
Usability	**UUR#01**	The PEARL platform must facilitate easy access to information	High	-

	UUR#02	The PEARL platform must have a well and comprehensive structure	High	-
	UUR#03	The PEARL platform must provide a friendly, simple, and easy-to-use interface	High	-
	UUR#04	The PEARL platform must provide help documentation on how to use the platform	Medium	-
Accessibility	**AUR#01**	The PEARL platform must be available on computer	High	-
	AUR#02	The PEARL platform must be available on smartphone, tablet for easy access	Medium	-
	AUR#03	The PEARL platform must be available all the time	High	-
	AUR#04	The PEARL platform must be available from everywhere	High	-
Reliability	**RUR#01**	The PEARL platform must support transparency.	High	-
Security	**SUR#01**	The PEARL platform must support user authentication and authorisation	High	-

8. Illustrated Scenarios

8.1. Use Case diagram as illustration of Scenarios

UML Use case diagrams are used to present a graphical overview of the functionality of the planned system. With Createlyit or YUML we can **draw use case diagrams online** and store them in one place for easy accessibility. Use case diagrams are usually used in the planning stage. With this excellent real-time collaboration functionality it is easy to share and work together on our use cases. (More: http://creately.com or http://yuml.me/diagram/scruffy/usecase/draw2.

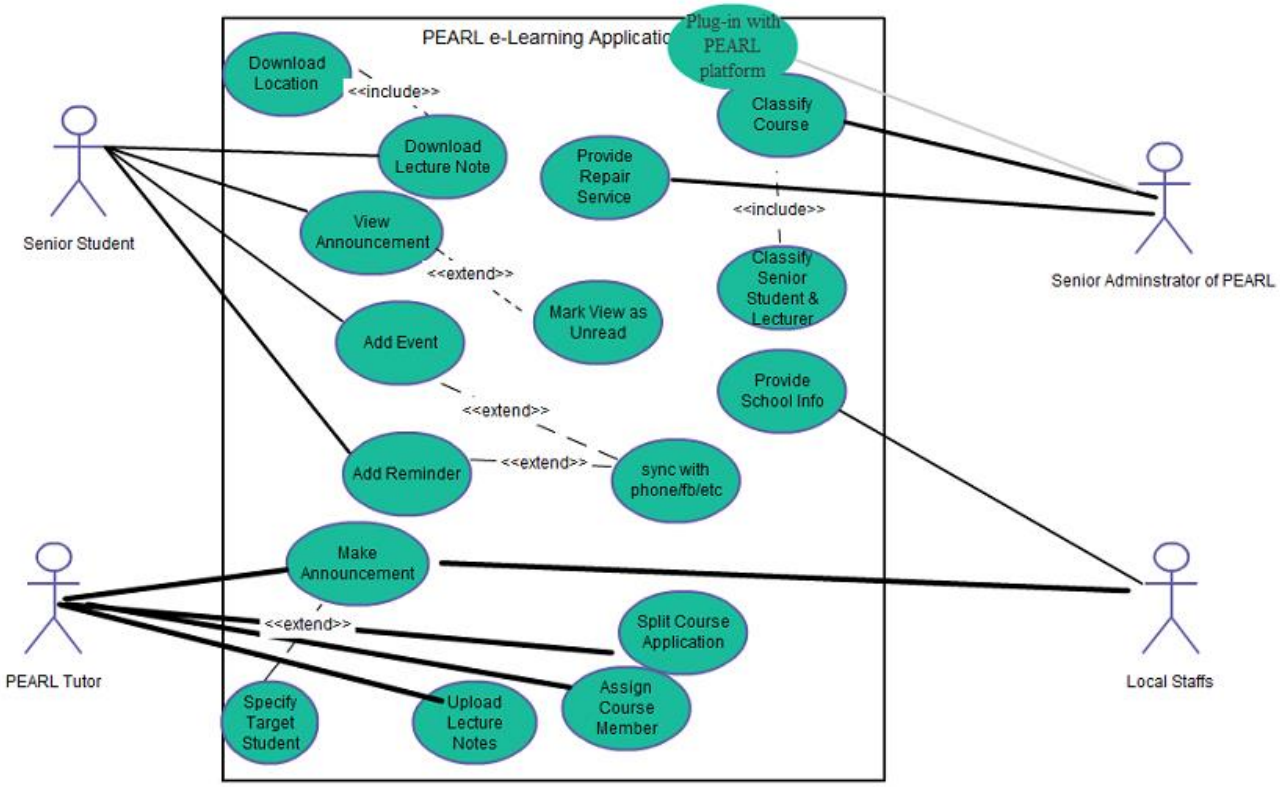

Fig. 3. UML Use case 7 Active eLearning content and tools

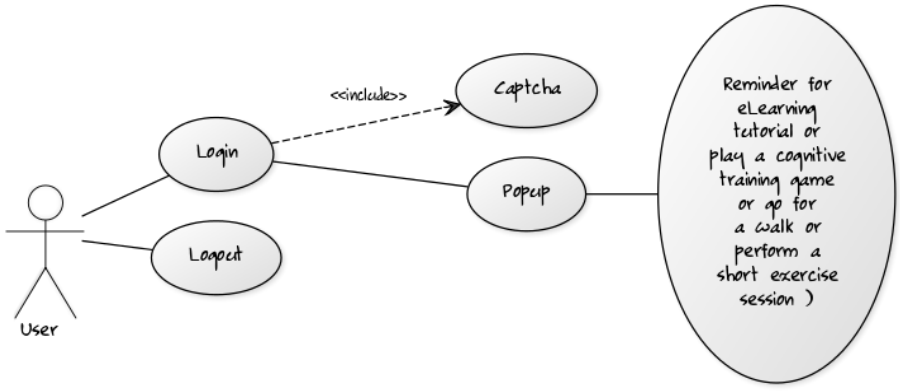

Fig 4. UML Use Case 6 Reminder tools

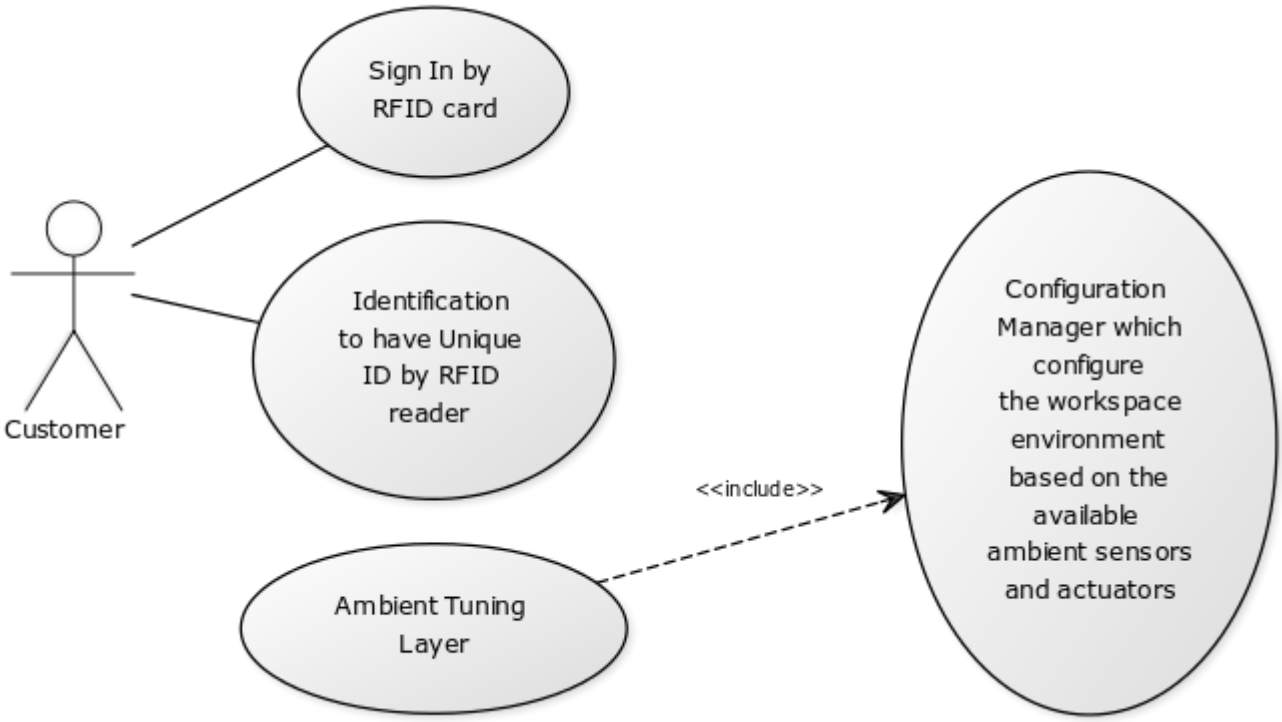

Fig 5. UML Use case 10 User identification

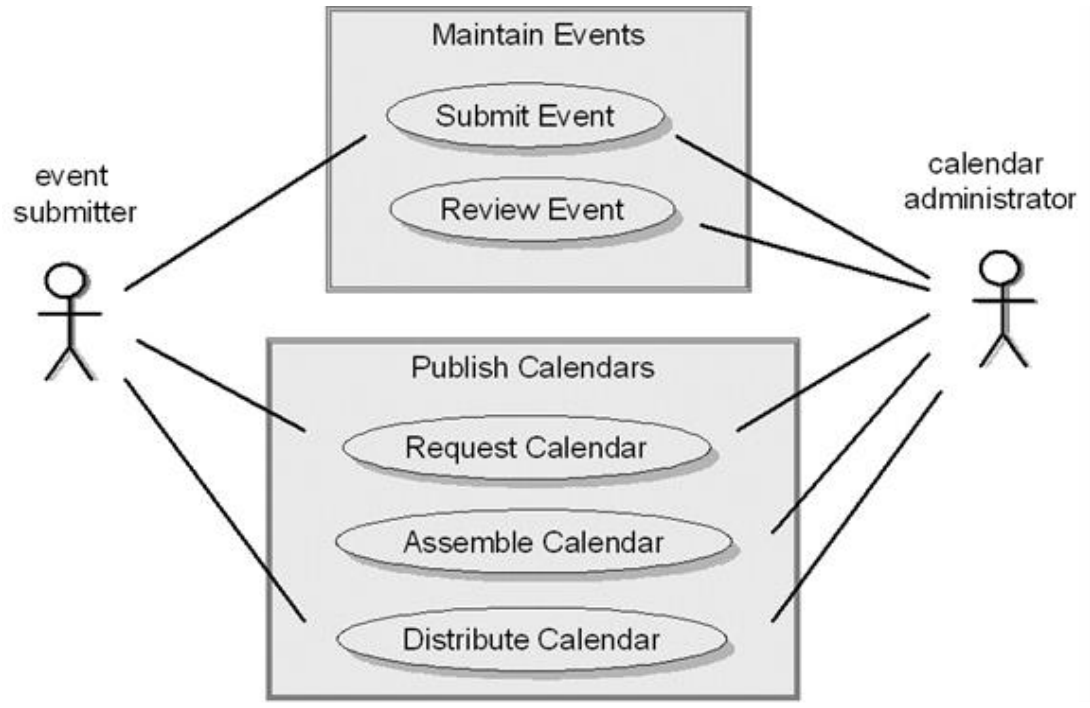

Fig 6. UML Use case 3 Master Calendar

9. Conclusion/Further Work

To come from the user needs to the development of the components and integration into one platform we followed a user driven open innovation approach.

Perhaps the greatest challenge within PEARL facing the diversity of the project partners is sharing the vision of the final platform among each other and with the end-users. All end-users and stakeholders (project-developers, multipliers, software managers or customer managers) must achieve a common understanding of what PEARL as a platform will be and do. Therefore, we need ways to accurately capture, interpret, and represent the “voice of the customer”, their needs, when translating the requirements into specifications for the PEARL platform.

Often the end-user presents as "needs" some combination of: the problems he/she has in his/her work that he/she expects the system to solve; the solutions he/she has in mind for an expressed or implied problem; the desired attributes of whatever solution; and the functions the system must let him/her perform. The problem becomes more complex if the systems analyst is dealing with surrogate end users, who purport to speak for the actual end users of the application. The challenge to the analyst is to distinguish among these four types of input and identify the real functional requirements that will satisfy the end-user's real needs.

The PEARL consortium used a technique for eliciting user requirements to account for the voice of the end-users in the design process. This method is called: user driven open innovation. The use case approach is an effective technique for specifying system requirements and test cases to prepare the next project stages.

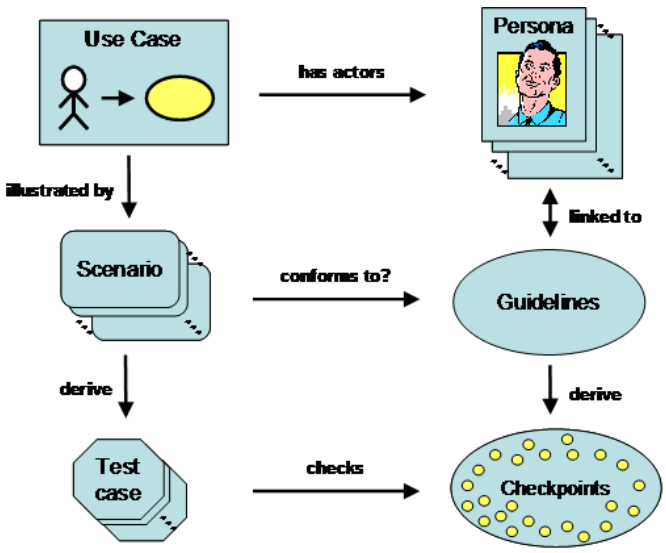

Fig 7. *Zimmermann, G & Vanderheiden, G (2007):* Accessible design and testing in the application development process.

WP3 is dedicated to the adaptation of the background platforms that will comprise the PEARL technological infrastructure, and WP4 deals with the added-value integration of the various components that comprise PEARL. To this end, the PEARL partners implement web-based APIs enabling access to the low-level capabilities of the various components, while also providing tools and techniques for combining those capabilities.

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