Interreg CENTRAL EUROPE

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PROCAREFUL

D.1.4.2 Document that presents the methodology for users and practitioners needs for local ICT adaptation

WP1, Activity 1.4

Version 2

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Table of contents

1. Introduction

The purpose of this document is to detail the requirements and functionalities that address the needs of stakeholders and end-users, as well as to define the scope and limitations that apply to these functionalities.

This document presents a series of elements identified including:

- The methodology implemented to develop the PROCAREFUL platform
- A description of roles and relationships between users, their dependencies, and role division along with associated permissions and functionalities.
- A comprehensive description of the requirements and functionalities provided by the PROCAREFUL application that have been implemented to respond to users' needs.

2. Description of the Problem

The PROCAREFUL project is aimed at addressing the growing challenge of cognitive and physical decline, as well as social isolation, among people aged 55 and older. As the population ages, these issues become increasingly prevalent, impacting not only the quality of life of people, but also placing a significant burden on healthcare systems and caregivers. The project seeks to fill these gaps by developing a hybrid care model that integrates both in-person and remote activities. The model is designed to prevent or slow down cognitive and physical decline and reduce social isolation. By promoting the development and maintenance of healthy habits, the model aims to enhance people's well-being, sustaining their autonomy and independence.

A key component of the model is the digital platform that supports the creation and maintenance of healthy habits in people's daily routines. This platform is not only a tool for self-management but also serves as a remote monitoring system for healthcare professionals. By enabling remote monitoring, the platform helps to reduce the burden on caregivers and healthcare providers.

The challenge lies in ensuring this platform is adaptable to the diverse care contexts in Central Europe. This includes accommodating varying organizational structures, regulatory environments, and methods of care delivery. The platform should be flexible enough to integrate into different care systems while providing holistic, preventive care. Ultimately, the success of the hybrid model depends on its ability to address these complexities and deliver a comprehensive, user-centered solution that meets the need of seniors and their caregivers.

3. Methodology for the design of the PROCAREFUL platform

To ensure the PROCAREFUL platform responds effectively to the real needs of users and care organizations, the development process was grounded in a participatory and iterative methodology. Particular emphasis was placed on involving stakeholders from the earliest stages of the project and maintaining continuous dialogue throughout the design and development phases.

The **preliminary phase** included a thorough context analysis using business analysis tools such as a PEST analysis, a meta-analysis of existing e-care and m-health solutions, and an in-depth benchmarking exercise. The results of this work are documented in Deliverable 1.1.1 *Meta-analysis on e-care, m-health solutions, benchmark projects and literature findings* and Deliverable 1.1.2. *Analysis report that presents experts' ranking evaluation about the e-care, m-health home care*.

Building on this analysis, a series of **co-design activities** were conducted with representatives from care institutions, formal and informal caregivers, and senior users themselves. These sessions enabled stakeholders to contribute directly to the definition of the platform's main functionalities. Through facilitated discussions and collaborative work, the development team gathered insights that shaped the initial concept of the platform and its core user processes. Once the initial requirements were identified, the team developed visual prototypes of the platform, including simplified wireframes and later, more detailed mock-ups. These prototypes served as concrete tools to support further engagement with stakeholders. The results are available in Deliverable 1.2.2 *Report presenting the co-design findings of the PROCAREFUL Model*.

Throughout the project, **regular meetings** were held with experts from the project consortium, representatives of the National Working Groups. These weekly checkpoints created a space for continuous

dialogue, allowing the team to present updates, address any challenges, and integrate suggestions before moving forward with development. After each meeting, key decisions and agreed actions were documented and followed up systematically. This ensured transparency, accountability, and the rapid implementation of adjustments. Stakeholders were regularly asked to confirm that the evolving platform continued to meet their needs.

This cyclical process of design, feedback, and adaptation allowed the platform to evolve in step with the expectations of its users, rather than relying on a static or top-down approach. The collaborative nature of the process ensured that the final product would be meaningful, practical, and adaptable to diverse care settings.

Figure 1. Example of a collaborative design board used by the National Working Group to define key functionalities of the platform during weekly checkpoints

In parallel, a structured **business analysis** was carried out to ensure the platform's functionalities would directly respond to the real operational needs of care ecosystems. Particular attention was given to addressing disparities in access to care, especially in rural areas where digital infrastructure is often limited. The objective of the business analysis was to identify user needs, define business processes, and clarify functional requirements, constraints, and system boundaries. Drawing on data and resources from the Interreg Central Europe Programme, this analysis enabled the project team to map out the characteristics and expectations of the main target groups:

- Seniors (people 55+) who have signs of problems with cognitive and physical abilities and need constant care,
- Informal carers, who care for the Seniors basing on mutual relationships (family, friendship, neighborhood),
- Formal carers, who provide professional, private care in the daily functioning at the home of the Seniors,
- Policy makers - municipalities as local government units that, being closest to community members, best understand their needs,
- Other stakeholders.

The result was a refined understanding of each user role, their interdependencies, and their operational priorities. This foundation was essential for shaping a platform that is not only technically sound but also aligned with diverse care delivery models.

4. User Roles and Functionalities Aligned with Stakeholder Needs

The user roles defined in the PROCAREFUL platform reflect the diverse profiles, responsibilities, and care realities across Central Europe. During the co-design phase, the National Working Groups and project partners contributed to shaping these roles based on real-life use cases and care models observed in different regions. The goal was to create a flexible, inclusive, and user-friendly platform that could adapt to various caregiving contexts, while also addressing the specific needs of older adults.

Below is an overview of each main profile, including its purpose and the functionalities provided.

Role	Description	Responsibilities	Features

Senior	Individuals aged 55 and over who use the platform to enhance their cognitive and physical well-being through personalized activities and health monitoring.	Engage actively in cognitive exercises, physical activities, and personal growth challenges provided on Procareful.	• Cognitive games
			• Physical activities:
			  ○ Physical activities
			  ○ Breathing exercises
			  ○ Walking
			• Personal growth challenges

Informal Caregiver	Typically, family members or friends of seniors who provide unpaid care and support.	• Monitor the well-being and activities of the seniors they care for. • Participate in communication channels to coordinate care with formal caregivers. • Assist with daily activities and ensure the senior's comfort and safety.	• Dashboard with senior engagement data • Notification Center • Performance warnings • Senior profile • Documents • Notes • Care Plan • Senior Details

Formal Caregiver	Professionals such as health care professionals, psychologists, volunteers who provide professional care and support to seniors.	• Assess the condition and health status of seniors.
		• Develop personalized care plans based on assessments and individual needs.
		• Monitor condition and track progress over time.
		• Communicate effectively with other caregivers and seniors.
		• Provide medical, therapeutic, or rehabilitative care as needed.
		• Document care provided and maintain accurate records.
			• Dashboard with Senior’s engagement data
			• Notification Center
			• Performance Warnings
			• Condition Assessment form
			• Care Plan:
			  ○ Assigning
			  ○ Building
			  ○ Editing
			• Senior Profile
			  ○ Documents
			  ○ Notes
			  ○ Care Plan
			  ○ Senior Details

Institution	Care and service providers within a community. It employs caregivers and coordinates resources to ensure seniors' well-being.	• Provide support and services to seniors within the community.
		• Employ and manage caregivers to ensure adequate support for seniors.
		• Coordinate resources and services to meet the needs of seniors effectively.
		• Monitor caregiver workload and roles distribution using Procareful.
			• Dashboard with Institution Data:
			  ○ Caregivers workload
			  ○ Roles distribution
			  ○ Statistics
			• Users management

Head Admin	Technical administrator responsible for managing Procareful at a country level.	• Create and manage accounts for institutions within Procareful.
		• Manage institution owners and their access permissions.
		• Provide technical support to users of Procareful.
			• Create Institution
			• Manage Institutions
			  ○ Managing Institutions Administrators
			  ○ Activating/ deactivating institutions

This structure of PROCAREFUL ensures that each user accesses only the tools and information relevant to their responsibilities, enhancing usability, privacy, and efficiency.

5. How to personalize platform functionalities according to local and user-specific needs

The design of the PROCAREFUL platform is firmly rooted in the principle of adaptability, both to the diverse roles of users involved in care delivery and to the varied local care models and practices across Central Europe. From the early phases of needs assessment to iterative validation with National Working Groups, adaptability has remained a central objective, ensuring the platform would be usable, relevant, and effective across different social, institutional, and cultural contexts. Below are the core functionalities of the platform that have been designed to respond to users' needs and flexibly adapt to different local contexts. Each feature was developed based on feedback gathered through co-design activities and iterative consultations with stakeholders, ensuring their relevance and usability within a variety of care settings.

1. Role-based customization

A key aspect of adaptability lies in the clear definition of user role, including Seniors, Informal Caregivers, Formal Caregivers, Institutional Administrators, and Head Admins. Each role is associated with tailored functionalities and permissions to reflect real-life tasks and responsibilities. This allows each user to interact with a personalized interface, accessing only tools and information relevant to their role. Defining user roles is essential, as it forms the foundation for the platform's overall functionality. These roles are not isolated but interconnected, enabling coordinated workflows and seamless communication between users. By establishing clear roles from the outset, the platform ensures that information flows appropriately, responsibilities are clearly assigned, and collaborative care processes are effectively supported.

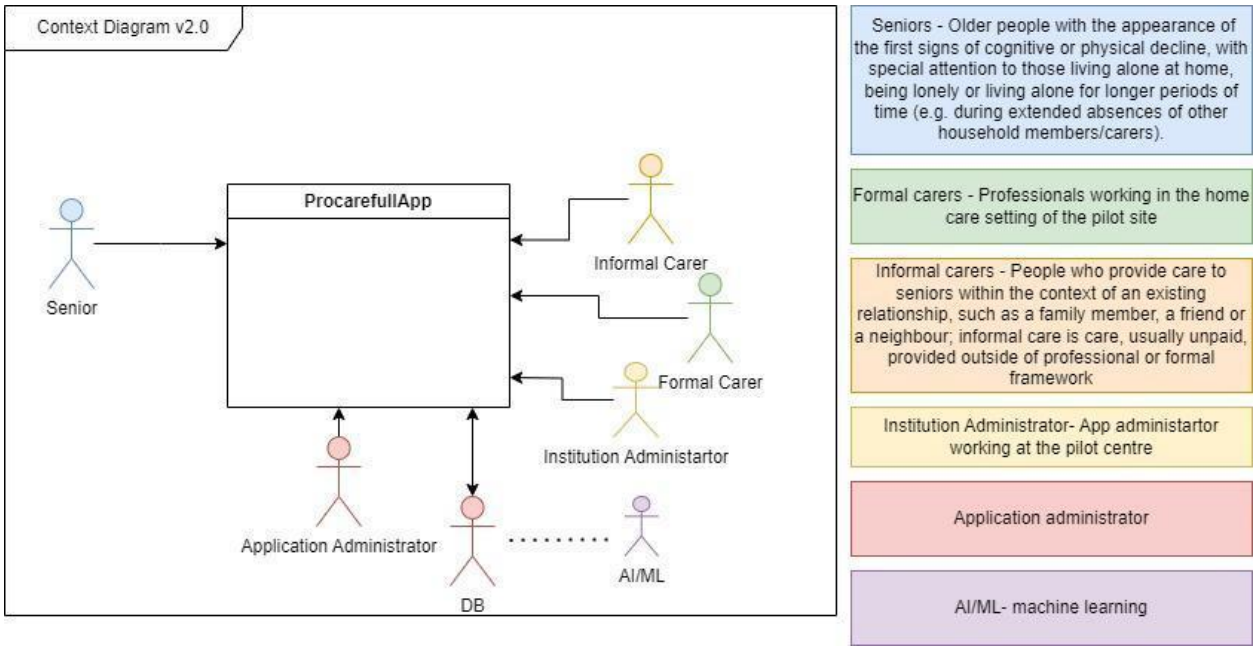

Figure 2. The system context diagram shows the system environment and the interaction of the Procareful application with its actors

Practical advice

When implementing the system, involve the care team to reflect on two key questions: *Who are the most suitable people to fill each role? What information is most useful for each of them?*

Once these are identified, you can proceed with **creating personalized user profiles** within the application. For more details on how to create different profiles in the app, see deliverable 1.3.1 Document that presents the PROCAREFUL model training manual.

2. Formal caregivers: personalized activity planning

The platform supports individualized care planning for seniors. After completing a standardized assessment, that should be performed by the formal caregiver, the application offers three levels of activity intensity (Light, Moderate, Intense). The system recommends the best care plan on the basis of the assessment. This feature is aimed at supporting the caregiver in assigning activities. However, professionals retain full control, ensuring that clinical judgement and personal knowledge of the Senior are respected. Indeed, custom plans can be created using categorized exercises and variable intensity settings. These plans are based on the Senior's capabilities: bedridden, mobility-limited, or fully mobile. This flexible approach ensures that activity plans are neither too demanding nor too simplistic, supporting both adherence and well-being. In addition to physical exercises, the formal caregiver can decide whether to assign "personal growth" activities in order to foster socialization among seniors. For more information on exercises and activities, see Deliverable 1.3.1 *Document that presents the PROCAREFUL model training manual*.

After assigning the care plan, formal carers can remotely monitor seniors' performance. The platform allows to monitor progress over time, tracking both cognitive games performance and activities at two levels: overall group performance and individual senior engagement. This flexible setup enables the collection of data that is useful for both general trend analysis and personalized care insights.

Moreover, the assigned training program is fully adjustable: if the formal carer decides it is necessary to change the intensity of exercises or repeat the assessment, these modifications can be easily made through the platform. Care plans can always be modified by the formal caregiver.

Practical advice

To ensure a care plan truly reflects the senior's needs, the assessment and activity assignment must be completed before the senior can start using the PROCAREFUL App. It is essential to dedicate sufficient time to this phase, as it directly impacts the relevance and effectiveness of the proposed exercises. A well-executed assessment ensures that the activities are safe, appropriate, and aligned with the Senior's physical and cognitive capabilities.

3. Formal and Informal caregivers: notification preferences for personalized monitoring

Both formal and informal caregivers have access to customizable notification settings. Notifications support remote monitoring by sending targeted alerts to caregivers regarding the senior's activity execution. This enables the professionals and family members to promptly identify and address any potential issues that may arise, ensuring more focused and effective oversight. Notifications are:

1) **Default Notifications** enabled by default and cannot be changed:
   a) Performance Decline
   b) User Inactive for 7+ Days
   c) Monitoring Visit Request
   d) New Senior Assigned
   e) New Informal Caregiver Assigned to Senior
2) **Customizable Notifications** can be selected by caregivers:
   a) User Completed Their Daily Assignment
   b) New Message
   c) New Note Added
   d) New Document Uploaded
   e) Schedule Change - Added/Deleted Game
   f) Schedule Change - Added/Deleted Task
3) **Independent Preference Settings:**

   Preferences for each type of notification can be adjusted independently for email notifications and in-app notifications. This allows Caregivers to tailor how and where they receive alerts based on their personal preferences and workflow.

This flexibility allows caregivers to manage their workload effectively and stay informed according to their preferences and routines.

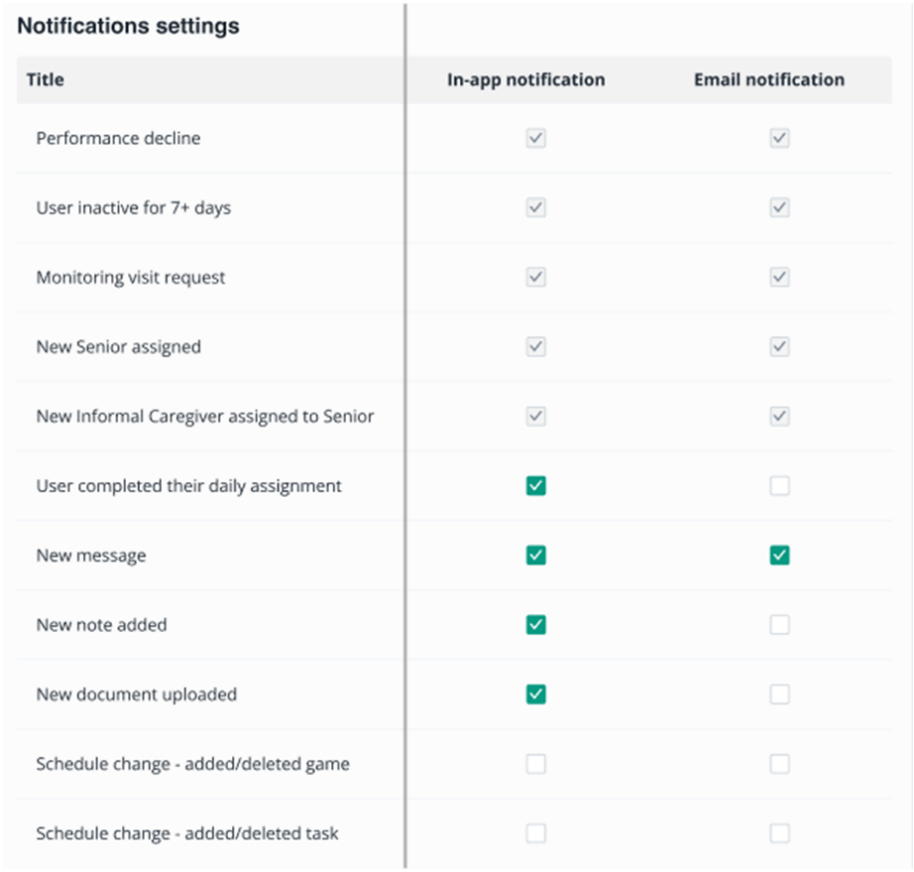

Figure 3. Example of caregiver's interface for managing notification settings

4. Senior App: Log-in

To ensure accessibility for older adults with varying levels of digital competence, the PROCAREFUL platform offers two distinct login methods for users with a Senior role: *with or without caregiver assistance*. This dual-access approach reflects the platform's strong commitment to digital inclusion, allowing individuals with limited technological familiarity to engage with the application through supported login pathways.

When assistance is available, the Senior can log in using their phone number and a secure 6-digit code generated within the caregiver's app, minimizing the need for direct digital interaction. Alternatively, for more digitally autonomous users, login can be completed independently via a verification code sent to the user's email address.

This adaptable login mechanism not only increases accessibility across diverse user profiles but also supports the broader objective of inclusive digital service delivery within Central Europe's heterogeneous care landscapes. Enhanced security features, including verification prompts and temporary lockouts after repeated failed attempts, ensure user safety and data protection while maintaining ease of use.

Practical advice

Before setting up access for a senior user, assess their level of digital literacy and autonomy. Is the senior comfortable using email and entering codes independently? Will they regularly need support from a caregiver to use the app? If the senior is less familiar with technology, we recommend activating caregiver-assisted login to ensure smooth and stress-free access.

5. Cognitive Games with Adaptive Difficulty

To address cognitive needs in a meaningful and motivating way, the platform integrates a set of cognitive games with multiple difficulty levels. These levels are dynamically adjusted based on the Senior's performance. Indeed, metrics such as game time, attempts, hint usage, scores, and win/loss ratios are tracked and a *machine learning module* optimizes personalization, offering levels that best match the senior's evolving abilities. This feature ensures that cognitive stimulation remains both challenging and achievable, tailored to individual progress.

How it works: the application displays a screen with a list of available games. It requires the user to play the designated game for that day. This ensures all games are played and different mental abilities are challenged. The Senior proceeds to play the required game. During gameplay, the application allows the user to clear the board to restart the game or to exit the game. If the application detects inactivity or the user attempts to leave the game, it prompts them with a message offering the option to return to the game or exit it. Upon exiting the game, the Senior is required to provide a reason for leaving. The application saves the Senior's preferences in the database and then presents a screen with the list of available games to play.

Practical advice

Before starting, explain to the Senior that the first game of the day is required: this helps encourage balanced cognitive training, even in less preferred areas. Also reassure them that the platform automatically adjusts the difficulty based on their performance, ensuring the exercises remain motivating and tailored to their abilities.

Focus box: Adaptive intelligence supporting personalized cognitive training

To ensure that the PROCAREFUL platform responds dynamically to each Senior's cognitive profile, an ***adaptive machine learning*** **(ML)** ***module*** has been integrated into the system. This module plays a central role in tailoring the digital cognitive training experience to the evolving needs and capabilities of each user.

The platform includes a suite of cognitive games, such as Sudoku, Memory, Wordle, TicTacToe, and Snake, co-designed with psychologists.

Each game offers six levels of progressive difficulty: Easy, Easy+, Medium, Medium+, Hard, and Hard+, allowing for fine-tuned adaptation to individual skills and performance.

The ML module functions by continuously analyzing gameplay data in order to calibrate the level of challenge to the user's current abilities. It tracks multiple performance indicators, including:

- time spent on tasks
- number of attempts required to complete a game
- use of hints
- success/failure ratios
- trajectory of progress over time.

These metrics are used to ***detect patterns of cognitive engagement***, identify plateaus or declines in performance, and automatically adjust difficulty levels to sustain motivation and maximize the cognitive benefit of the activity.

Importantly, the system not only adapts based on in-game behaviour but also integrates external assessment tools to enrich its understanding of the user's profile. Results from standardized instruments, such as the Montreal Cognitive Assessment (MoCA) for cognition, the IPAQ for physical activity, the De Jong-Gierveld scale for social connectedness, and EQ-5D for quality of life, can be cross-referenced with in-game data to uncover potential correlations.

This opens the possibility of linking digital engagement with broader health and psychosocial indicators, supporting more holistic monitoring and care planning.

In its initial deployment phase (first 6 weeks of pilot implementation), the system relies on predefined rules to calibrate game levels and collect representative data. During this phase, Senior will have the opportunity to play all the games at different levels. As data volume increases, the machine learning system will enhance its ***predictive power***, allowing for more precise personalization.

After 6 weeks, the following business logic is adopted, which is that if the ratio of games won to lost is high, the game level is increased. Otherwise, if the ratio is low, the game level is lowered according to the following thresholds:

1. 0%-25% of losses from the last 10 games (maximum 2 losses from 10) - increase in level by 1.
2. 25%-50% of losses from the last 10 games (3-5 losses from 10) - no level change.
3. 50%-100% of losses from the last 10 games (6-10 losses from 10) - decrease in level by 1.

This approach not only **improves engagement** but also offers a **scalable method** to adapt digital interventions to Seniors with differing abilities across varied care settings.

This intelligent personalization approach delivers **multiple benefits**: it increases user engagement by avoiding frustration or boredom, provides a scalable method for tailoring interventions across diverse populations, and offers potential early-warning indicators of cognitive decline or disengagement. The flexibility of the model makes it particularly well-suited to the varied health profiles, digital skills, and support structures of Seniors across different Central European regions.

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6. Senior App: Social growth challenges

This feature offers a flexible and individualized space for Seniors to engage in personal development activities that go beyond cognitive and physical training. After logging in, the Senior can access the Personal Growth section and select from a list of optional challenges. Each challenge includes a detailed description, allowing the user to decide whether to complete or skip the activity, depending on their motivation and energy levels that day.

Once a challenge is completed, the Senior is invited to reflect on their experience by writing a personal note. These reflections are saved in a private "Diary" section, visible only to the Senior and not accessible to caregivers or other users, fostering a safe and personal space for self-expression.

This functionality is especially valuable for addressing the emotional and social well-being of older adults, adapting to varying levels of engagement and offering the freedom to proceed at one's own pace.

Practical advice

Encourage the Senior to explore the Personal Growth section at their own rhythm. Explain that there is no obligation to complete every activity and that their diary entries remain private. This autonomy can enhance motivation and foster a greater sense of self-confidence.

7. Multilingual and Regional Adaptation

To support implementation across multiple Central European regions, the application was designed with predefined language versions (Polish, Italian, Croatian, Slovenian, Hungarian, German), ensuring that users can interact with the system in their native language.

In addition, the user interface accommodates varying levels of digital literacy, especially for Seniors:

- Simplified login processes (including staying logged in)
- Intuitive navigation
- Culturally appropriate content and vocabulary

6. Summary and Conclusion

An initial driving force behind PROCAREFUL was the imperative to shift care from reactive intervention to proactive prevention. By encouraging **healthy and active lifestyles**, the platform aims to reduce, or at least delay, the need for future intensive care services. To achieve this, the technology was built to support structured at-home exercise and cognitive routines, all under the remote supervision of care professionals. A responsive monitoring system continuously optimizes oversight, ensuring that users receive timely guidance while preserving their independence.

The PROCAREFUL platform has been meticulously crafted to **adapt to the evolving needs** of older adults, their caregivers, and care institutions across the varied social and infrastructural landscapes of Central Europe. From the outset, our methodology prioritized deep engagement with end users: Seniors, informal and formal caregivers, institutional administrators, and policy-makers, ensuring that every feature reflected real-world care challenges in both urban centres and remote rural communities.

Through an initial business analysis informed by PEST studies, benchmarking of existing e-care solutions, and direct input from National Working Groups, we identified **critical gaps** in service availability and digital infrastructure. These insights guided a series of co-design workshops, where stakeholders shaped the platform's core processes. Wireframes and high-fidelity mock-ups emerged not as static designs but dynamic discussion tools, refined in weekly consortium meetings to guarantee cultural relevance, linguistic accuracy, and seamless integration with local care models.

At the heart of PROCAREFUL lies a **role-based structure** that presents each user with a tailored interface: Seniors see only the activities and games suited to their abilities, informal caregivers access dashboards and notifications to coordinate support, and professional caregivers work with customizable care-plan templates and real-time alerts. Institutional administrators and Head Admins enjoy flexible configuration options that respect each country's regulatory framework and language requirements.

Personalized activity plans, offered in light, moderate, and intense levels, are recommended by the system based on standardized assessments but can be adjusted by caregivers at any time. **Cognitive training games**, developed with psychologists, automatically calibrate difficulty according to each Senior's performance, yet always remain transparent and intuitive. **Notifications and login pathways** are similarly designed to accommodate differing digital skills, from assisted phone-code access to independent email verification, ensuring no user is left behind.

This flexible design makes PROCAREFUL a practical and sustainable option for improving at-home care, especially preventive care, and addressing service gaps across Central Europe.