

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

WP1, Activity 1.4



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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 during the business analysis phase, including:

- Business processes executed within the Procareful application, accompanied by BPMN diagrams.
- A detailed 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.
- The process of requirements analysis and gathering from target groups.



2. Application Description and Functionalities

Preparatory phase started with the beginning of the project with pre-implementation assessment and co-design phase and ends in August 2024, before the start of the pilots.

2.1. 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.

2.2. Assignment of Seniors into Specific Groups

2.2.1. Senior assessment methods used in the application.

The assessment of the condition of a senior's cognitive and physical abilities is based in the application on the analysis of data collected during the assessment of the senior using multiple analytical methods such as:

- MOCA questionnaire

The Montreal Cognitive Assessment (MoCA) is a widely used screening tool designed to assist healthcare professionals in detecting cognitive impairments. The MoCA is particularly useful for identifying mild cognitive impairment (MCI), which can be an early sign of conditions such as Alzheimer's disease or other forms of dementia.

- IPAQ questionnaire

The International Physical Activity Questionnaire (IPAQ) is a standardized tool used globally to measure physical activity levels in populations. It is designed to assess the physical activity habits of adults, providing valuable data for research and health promotion.

- De Jong Gierveld Loneliness Scale (short) questionnaire



The De Jong Gierveld Loneliness Scale (short) is a validated and widely used tool designed to measure the experience of loneliness. It helps in identifying the levels of emotional and social loneliness in individuals, providing insights that can guide interventions and support.

- EQ-5D-5L questionnaire

The EQ-5D-5L is a standardized instrument developed by the EuroQol Group for measuring health-related quality of life. It provides a simple, generic measure of health for clinical and economic appraisal.

- PSQI Questionnaire

The Pittsburgh Sleep Quality Index (PSQI) is a standardized tool used to measure the quality and patterns of sleep in adults. It helps in identifying various sleep disorders and assessing the effectiveness of treatments for sleep problems.

2.2.2. How the Senior's assessment performs into building training recommendations in the app.

The results obtained during the Senior's assessment are analyzed by the system and reflected in the training plan recommended for the Senior.

- 1) Recommendations are based on results from “condition assessment” form that collect informations from all the questionnaires:
 - a) MOCA questionnaire
 - b) IPAQ questionnaire
 - c) De Jong Gierveld Loneliness Scale (short) questionnaire
 - d) EQ-5D-5L questionnaire
 - e) PSQI Questionnaire
- 2) Scorings from the assessment form in the application are the reference parameter for assigning activities. To assign activities and recommended intensity of the plan application uses:
 - a) MOCA scoring to assign levels of the games based on cognitive abilities of the Senior:
 - i) Normal (>26)
 - ii) Very Mild Cognitive Impairment (25-23)
 - iii) Moderate Cognitve Impairment (12-22)
 - b) Pre-IPAQ and IPAQ to assign proper activities and its recommended levels assigning the Senior to one of three main groups
 - i) Bedridden
 - ii) Mobility limitations
 - iii) No limitations
 - (1) For each group the application have three subgroups reflecting the recommended difficulty level of physical activities
 - (a) Light
 - (b) Moderate



(c) Intense

- 3) Recommended level of physical activities are based on the IPAQ questionnaire implemented in the Senior assessment form in the application:
- a) Intense:
 - i) Vigorous intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET minutes a week
 - ii) 7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET minutes a week.
 - b) Moderate:
 - i) 3 or more days of vigorous intensity activity and/or walking of at least 30 minutes per day
 - ii) 5 or more days of moderate intensity activity and/or walking of at least 30 minutes per day
 - iii) 5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET minutes a week.
 - c) Low:
 - i) If Senior is not meeting any of the criteria for either MODERATE or HIGH levels of physical activity

2.3. Outcomes of Group Assignments:

2.3.1. Generating Activity Plans - Schedules

Upon completion of the Senior's assessment, personalized activity plans are presented to the Formal Caregiver. These plans are offered in three intensity levels: Light, Moderate, and Intense. The following steps outline the process:

1) Assessment Completion

After the Senior's assessment is finished, the application presents the Formal Caregiver activity plan for the Senior

2) Plan Intensity Options

The Formal Caregiver is given three predefined schedules to choose from:

- a) Light
- b) Moderate
- c) Intense

3) Recommendation Based on IPAQ Scores:

For Seniors without physical limitations, the application uses the IPAQ scores from the assessment form to recommend one of the plans. This recommendation takes into account the Senior's cognitive and physical abilities.

4) Final Decision:



Although the application provides a recommendation, the Formal Caregiver makes the final decision on which plan intensity to choose, ensuring the selected plan aligns with the Senior's overall health and preferences.

By offering these defined plans, the application ensures that the activity schedules are tailored to the Senior's capabilities, promoting both physical and cognitive well-being while allowing the Formal Caregiver to make an informed and personalized choice.

2.3.2. Creating a Personalized Activity Plan

When a Formal Caregiver needs to create a custom activity plan for a Senior, the process involves several detailed steps to ensure the plan is tailored to the Senior's specific needs and capabilities. Here's an overview of the process:

1) Assessment-Based Group Classification:

During the initial assessment, the Senior is categorized into one of three groups based on their physical capabilities: no limitations, limitations, or bedridden. This classification determines the types of exercises that will be included in their activity plan.

2) Custom Plan Creation Form:

A specialized form is used to create the custom plan. This form lists all the exercises appropriate for the Senior's classified group. The exercises are organized into distinct categories for ease of selection and customization.

3) Intensity Level Options:

For each exercise category, there are three intensity levels available: Light, Moderate, and Intense. This allows the Formal Caregiver to tailor the exercises to match the Senior's current fitness and health status.

4) Recommended Intensity:

For Seniors in the "no limitations" group, one of the intensity levels is recommended. This recommendation is derived using the International Physical Activity Questionnaire (IPAQ), which assesses the Senior's physical activity level and suggests an appropriate intensity.

5) Exercise Selection:

The Formal Caregiver can select exercises and intensity levels based on the Senior's capabilities and preferences. This flexibility ensures that the custom plan is not only suitable but also sustainable and enjoyable for the Senior.

6) Comprehensive Plan:

The final custom plan includes a mix of physical exercises, walking, breathing exercises, and cognitive games, tailored to the Senior's assessed capabilities and recommended activity levels.

By following this structured process, Formal Caregivers can create highly personalized and effective activity plans that cater to the unique needs of each Senior, promoting their overall health and well-being.



2.3.3. Training assignment is based on the guidelines in the table below

Bedridden - Exercise in bed -Breathing exercises		
Light	Moderate	Intense
Exercise in bed - 1 time per day - 5 repetitions - 3-5 exercises	Exercise in bed - 1 time per day - 10 repetitions - 3-5 exercises	Exercise in bed - 2 time per day - 10 repetitions - 3-5 exercises
Breathing - 1 time per day - 3 repetitions - 1-2 exercises	Breathing - 1 time per day - 5 repetitions - 1-2 exercises	Breathing - 2 time per day - 5 repetitions - 1-2 exercises

Mobility limitations - Sitting exercises -Breathing exercises		
Light	Moderate	Intense
Sitting position exercises - 1 time per day - 5 repetitions - 1-2 exercises from each of 3 categories	Sitting position exercises - 1 time per day - 10 repetitions - 1-2 exercises from each of 3 categories	Sitting position exercises - 2 time per day - 10 repetitions - 1-2 exercises from each of 3 categories
Breathing - 1 time per day - 3 repetitions - 1-2 exercises	Breathing - 1 time per day - 5 repetitions - 1-2 exercises	Breathing - 2 time per day - 5 repetitions - 1-2 exercises

No limitations - Fall prevention -Breathing exercises -Walking		
Light	Moderate	Intense
Fall prevention and balance	Fall prevention and balance	Fall prevention and balance



- 3 times per week - 1-2 exercises - 3 repetitions - 4 exercises - 5 repetitions	- 5 times per week - 1-2 exercises - 5 repetitions - 4 exercises - 5 repetitions	- 7 times per week - 1-2 exercises - 5 repetitions - 4 exercises - 10 repetitions
Breathing - 1 time per day - 3 repetitions - 1-2 exercises	Breathing - 1 time per day - 5 repetitions - 1-2 exercises	Breathing - 2 time per day - 5 repetitions - 1-2 exercises
Walking - Same as now	Walking - 10% more than now	Walking - 20% more than now

2.4. Roles and Relationships Between Users

2.4.1. Roles and their responsibilities

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.	<ul style="list-style-type: none"> • Cognitive games • Physical activities: <ul style="list-style-type: none"> ○ Physical activities ○ Breathing exercises ○ Walking • Personal growth challenges
Informal Caregiver	Typically family members or friends of seniors who provide unpaid care and support.	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Dashboard with Senior's engagement data • Notification Center • Performance Warnings

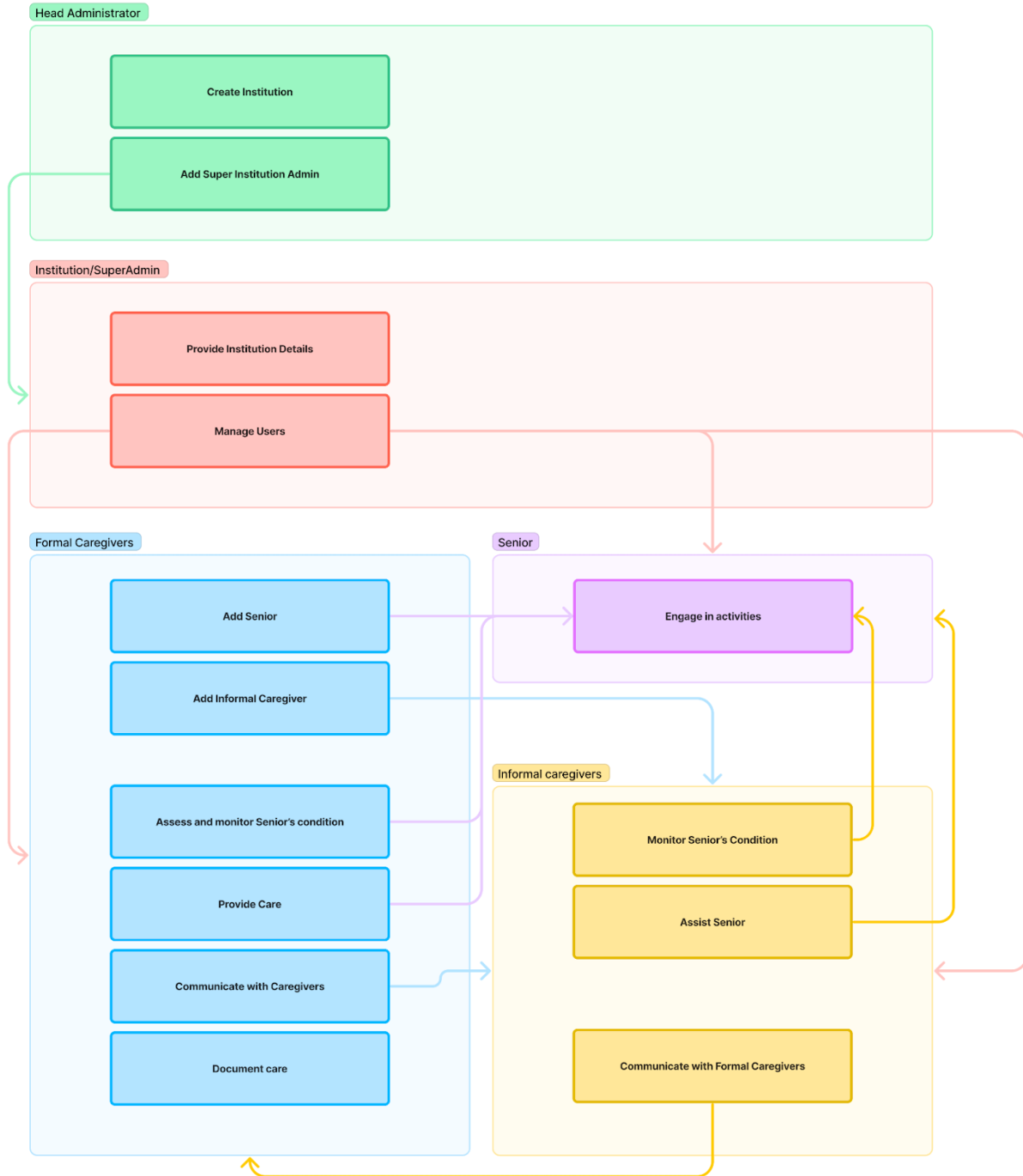


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		<ul style="list-style-type: none"> • Communicate effectively with other caregivers and seniors. • Provide medical, therapeutic, or rehabilitative care as needed. • Document care provided and maintain accurate records. 	<ul style="list-style-type: none"> • Condition Assessment form • Care Plan: <ul style="list-style-type: none"> ○ Assigning ○ Building ○ Editing • Senior Profile <ul style="list-style-type: none"> ○ 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.	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Dashboard with Institution Data: <ul style="list-style-type: none"> ○ Caregivers workload ○ Roles distribution ○ Statistics • Users management
Head Admin	Technical administrator responsible for managing Procareful at a country level.	<ul style="list-style-type: none"> • Create and manage accounts for institutions within Procareful. • Manage institution owners and their access permissions. • Provide technical support to users of Procareful. 	<ul style="list-style-type: none"> • Create Institution • Manage Institutions <ul style="list-style-type: none"> ○ Managing Institutions Administrators ○ Activating/ deactivating institutions

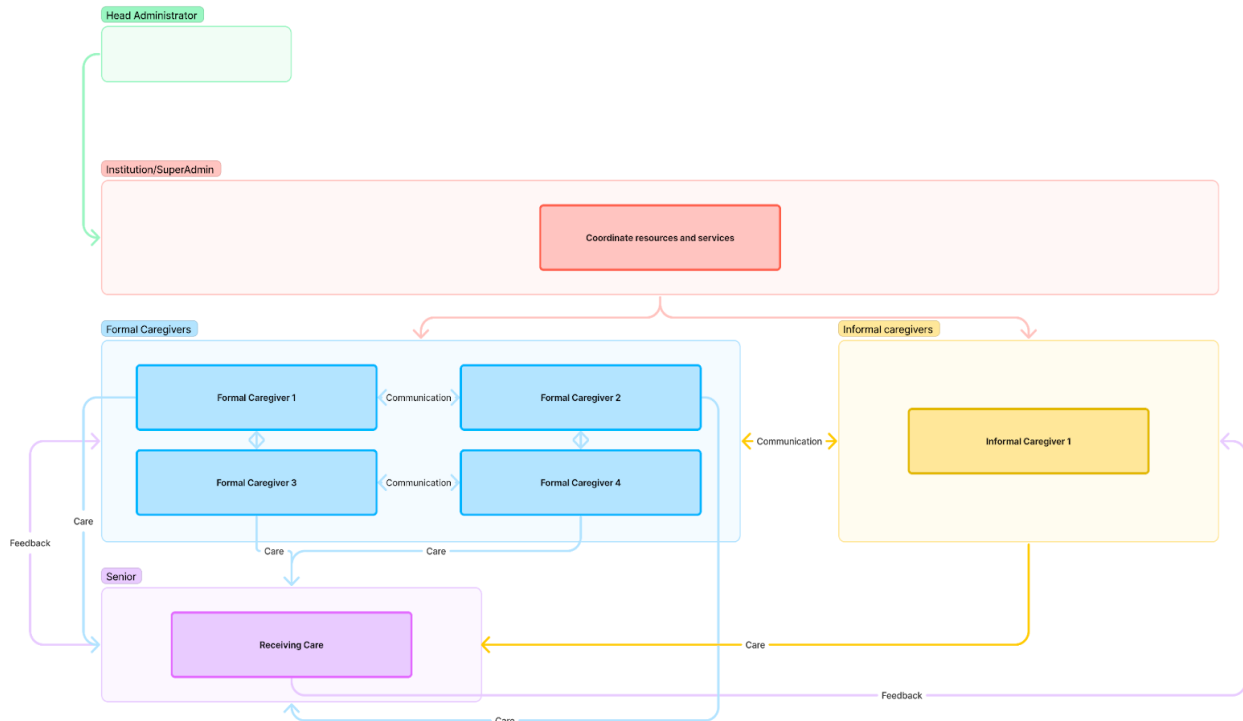


2.4.2. Structure of roles in the application and their dependencies





2.5. Functionality and Needs Fulfilment



2.6. Personalization for Users

2.6.1. Language Versions of the Application

The application is designed to be adaptable to various markets, allowing for the configuration of the appropriate language version for each market. Here's how the language customization works:

1) Market-Specific Language Settings:

The application is structured to support different language versions for each market, ensuring users can interact with the application in their native language.

2) Provision of Translations:

To prepare a new language version, translations for the specific language must be provided. These translations cover all aspects of the application's interface and functionality.

3) Head Admin Language Role:

The application allows adding a language version for the Head Admin role. All users under a specific Head Admin inherit the language version set by the Head Admin. This includes the following roles:

- Super Institution Admin
- Institution Admin
- Formal Caregiver
- Informal Caregiver



4) **Predefined Language Versions:**

During the development stage, the application was configured with several predefined language versions, including:

- a) Polish
- b) Italian
- c) Croatian
- d) Slovenian
- e) Hungarian
- f) German

This flexible language configuration ensures that the application can be effectively used in various regions, providing a localized user experience tailored to the specific linguistic needs of each market.

2.6.2. Notification Preferences Functionality in the Application

The application allows both Formal Caregivers and Informal Caregivers to customize their notification preferences. Here's an overview of the notification settings and customization options:

1) **Default Notifications:**

Certain notifications are enabled by default and cannot be changed. These include:

- 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:**

Caregivers can modify preferences for the following notifications:

- 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.



By providing these customizable settings, the application ensures that Caregivers receive the most relevant and important information in a way that best suits their needs, enhancing their ability to effectively manage their responsibilities.

Notifications settings		
Title	In-app notification	Email notification
Performance decline	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
User inactive for 7+ days	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monitoring visit request	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
New Senior assigned	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
New Informal Caregiver assigned to Senior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
User completed their daily assignment	<input checked="" type="checkbox"/>	<input type="checkbox"/>
New message	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
New note added	<input checked="" type="checkbox"/>	<input type="checkbox"/>
New document uploaded	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Schedule change - added/deleted game	<input type="checkbox"/>	<input type="checkbox"/>
Schedule change - added/deleted task	<input type="checkbox"/>	<input type="checkbox"/>

3. MVP Software Development Model

3.1. What is the MVP Model

A product development approach where a new product or website is developed with sufficient features to satisfy early adopters. The final, complete set of features is only designed and developed after considering feedback from the product's initial users.

The primary goal is to:



- quickly launch a product to market with the minimal amount of effort,
- validate a business idea with real users
- iteratively improve product based on user feedback.

This model helps in reducing the risks and costs associated with building a new product by ensuring that only the most critical and necessary features are developed initially.

3.2. Implications for the Application

3.2.1. How do we implement this software development model in Procareful?

1) Identify Target Users and Their Needs

a. Users needs:

i. Focus Groups:

1. Conducted in six partnering countries to gather diverse perspectives and comprehensive information.
2. Each partner organization facilitated focus groups, surveys, and interviews with their respective user groups.
3. Sessions aimed to understand the daily challenges, specific needs, and desired features from each group's perspective.

ii. Analysis:

1. Data from these sessions were collated and analyzed to identify common themes, problems, and needs across different regions.
2. The analysis provided a clear picture of what features are most crucial and what pain points need addressing.

b. Target group:

- i. Care Providers (Institutions): Organizations that offer home care services and manage multiple caregivers and seniors.
- ii. Formal and Informal Caregivers: Individuals who provide direct care to seniors, either professionally (formal) or as family members or friends (informal).
- iii. Seniors (Aged 55 and Over): The end-users who will directly benefit from the care and activities provided by the platform.

2) Define Primary Goals

a. Main Objective:

- i. Increase access to home care and make it easier for people aged 55+ to receive quality care.

b. Specific Goals:

- i. Enable early detection of cognitive and physical decline.



- ii. Provide personalized care plans to improve seniors' well-being.
- iii. Enhance the workflow and efficiency of caregivers.
- iv. Improve communication and coordination among all stakeholders involved in the caregiving process.

3) Prioritize Core Features Based on User Needs

a. Critical Features Identification:

i. CRM Platform for Institutions:

1. Manage users

ii. Platform for Caregivers:

1. Condition assessment tool for evaluating seniors' health.
2. AI-powered recommendations for activities tailored to individual conditions.
3. Communication hub for sharing documents, notes, and coordinating care.
4. Real-time engagement monitoring to track seniors' activities and progress.
5. Notifications to help prioritize which seniors need immediate attention.

iii. Platform for Seniors:

1. Access to a library of cognitive games, physical exercises, and personal growth challenges.

b. Feature Prioritization:

i. Rank features by importance and feasibility:

1. Start with high-impact, low-effort features.
2. Focus on essential functionalities that address the most critical user needs identified during the assessment.

4) Set Clear MVP Criteria

a. Minimum Functionality:

- i. Each platform (institution, caregiver, senior) should have the basic functionalities to be useful independently.

ii. User Feedback Mechanisms:

1. Integrate feedback channels within the MVP to allow users to provide input on their experiences and suggest improvements.

5) Parallel Development

Parallel development is a strategy employed to accelerate the MVP development process by dividing the project into multiple, independent workstreams that can be developed simultaneously. In the case of Procareful, the development tasks are distributed among specialized teams, each focusing on different core components of the platform. For instance, one team works on the CRM platform for institutions, another on the caregiver tools like the condition assessment and communication hub, while a third team develops the senior-facing features such as the cognitive games and physical exercises. Regular synchronization meetings and integration checkpoints ensure that all components progress cohesively and seamlessly integrate into the final product. This approach not only reduces the overall development



time but also allows for faster iteration and refinement based on user feedback, ultimately leading to a more robust and user-centric MVP.

6) Implementing the experience gained during the pilots in the form of functionality improvements

Implementing the experience gained during the pilots involves a systematic approach to incorporating user feedback and observations into meaningful functionality improvements for Procareful. Through the pilot phase, insights are gathered from real-world usage scenarios and user interactions across different regions and user groups. These insights are meticulously analyzed to identify pain points, usability issues, and areas where the platform can be enhanced to better meet the needs of caregivers and seniors. Based on this feedback, iterative updates are planned and implemented, focusing on refining existing features and introducing new functionalities that address identified gaps. This iterative process ensures that Procareful evolves dynamically, continuously improving its capabilities and user experience based on real user data and feedback, thereby enhancing its effectiveness in supporting home care and promoting the well-being of seniors.

3.2.2. MVP vs post-MVP features

3.2.2.1. MVP Stage Features

For the MVP stage of Procareful, we decided to focus on the core functionalities that address the most critical needs of our target users - care providers, caregivers, and seniors. The MVP features were selected based on the feedback from focus groups conducted in six partnering countries, ensuring that the platform provides essential tools for monitoring and improving the well-being of seniors. These features are necessary to achieve our primary goal of increasing access to home care and making it easier for people aged 55+ to receive quality care.

MVP Features:

- 1) Platform for Institutions:
 - a. User Management (CRM Functionality): Basic tools for institutions to manage user profiles, track engagement, and ensure compliance.
- 2) Platform for Caregivers:
 - a. Condition Assessment Tool: Allows caregivers to evaluate seniors' cognitive and physical health, providing a basis for personalized care.
 - b. Expertise-based Activity Recommendations: Provides caregivers with personalized activities based on condition assessments to promote seniors' cognitive and physical well-being.
 - c. Communication Hub: Facilitates sharing of documents, notes, and coordination among caregivers, enhancing communication and efficiency.
 - d. Engagement Monitoring: Enables caregivers to track seniors' activities and progress, ensuring that care plans are effective.
 - e. Notifications: Helps caregivers prioritize seniors who need immediate attention, improving the responsiveness of care.
- 3) Platform for Seniors:



- a. Library of Cognitive Games and Physical Exercises: Offers a variety of activities designed to support cognitive function and physical health.
- b. Personal Growth Challenges: Provides seniors with engaging tasks that promote overall well-being and personal development.
- c. User-Friendly Interface: Ensures that seniors can easily navigate and interact with the platform, enhancing their experience.
- d. Simple gamification: Enhancing engagement and overall satisfaction from participating in the program.

3.2.2.2. Post-MVP Features

For the post-MVP stage, we plan to implement additional functionalities that have been labeled as "nice to have." These features will further enhance the user experience and provide more advanced capabilities to support the caregiving process. The list of post-MVP features will be updated and refined based on the feedback collected during the pilot stage from end users.

Post-MVP Features:

- 1) Enhanced Communication Hub:
 - a. In-App Chat: Real-time messaging to facilitate instant communication among caregivers, care providers, and seniors.
 - b. Push Notifications: Alerts for important updates and reminders, ensuring timely communication and actions.
- 2) Improved AI/ML Analysis:
 - a. Advanced Activity Recommendations: Enhanced algorithms for more accurate and personalized activity suggestions based on continuous learning from user data during the MVP stage.
- 3) Local Events:
 - a. Community Engagement: Tools for creating and managing local events such as chess clubs, yoga classes, and social gatherings, fostering community involvement and social interaction among seniors..
- 4) Native mobile app for Seniors:
 - a. Notifications for Seniors to keep them engaged
 - b. Possibility to Integrate App with Other Health Apps on Seniors' Devices. Examples of integration features:
 - i. Tracking the number of steps taken by seniors during the day
 - ii. Collecting sleep information, etc.
- 5) Advanced gamification:
 - a. Rewards system, to keep senior even more engaged
- 6) Improved variety of activities:
 - a. Cognitive Health: More games that engage different cognitive stimuli.
 - b. Physical Exercises: A broader range of exercises tailored to seniors' needs and abilities.



- c. Personal Growth: Additional personal growth challenges to keep seniors engaged.

4. Application Development Process

4.1. Requirement Transfer from Target Groups to Company

The requirements outlined below were collected during focus group meetings held in partnering countries. Participants included institution workers, formal and informal caregivers, and seniors. These stakeholders shared their needs and the issues they face in their daily work, providing valuable insights that shaped the development of the platform's features and functionalities.

While these initial requirements are high-level, they were further refined and detailed during the development process. They served as the foundation for the main functionalities of the platform.

Role	Description Responsibilities Features
General	<ul style="list-style-type: none"> • Include features that address the basic concerns of all stakeholders, ensuring the solution is consistent across all partnering countries. • Differentiate between user roles (Senior, Informal Caregiver, Formal Caregiver, Institution Administrator, Institution Super Admin, Application Administrator) and provide specific functionalities for each role.
	<ul style="list-style-type: none"> • Multilingual Support: Croatian, English, German, Hungarian, Italian, Polish, Slovenian. • The interface should be user-friendly and accessible for older adults and caregivers. • Design the platform to be accessible to users with varying levels of technical proficiency, providing clear instructions and support. • Ensure robust security measures for user data, especially sensitive information related to health and personal details. • The platform should be scalable to accommodate an increasing number of users and additional functionalities in the future. • Web and PWA Accessibility: The platform should be available as both a web solution and a Progressive Web App (PWA). • Support for Innovative Care: The app should use digital tools like AI and ML to enhance the care process for older people. • Hybrid Home Care Integration: The platform should be an integral part of the hybrid home care model.
Senior	<ul style="list-style-type: none"> • Provide access to cognitive games to prevent cognitive decline. • Offer physical activities aligned with the senior's needs and abilities. • Ensure access to a variety of activities that support social skills.



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	<ul style="list-style-type: none"> • Allow login without requiring an email address. • Enable the possibility to stay logged in so the user does not need to remember login credentials. • Include features that motivate seniors to participate in assigned activities.
	<ul style="list-style-type: none"> • The platform should be user-friendly, especially for seniors, with simple navigation and easy access to games and activities. • Ensure secure login methods and protect user data, even when using login options without email. • The platform should be accessible to seniors with varying levels of technical ability. • The platform should be scalable to support an increasing number of senior users and expanding content offerings. • Provide multilingual support and culturally relevant content to engage seniors from different regions effectively.
Informal Caregiver	<ul style="list-style-type: none"> • Allow tracking the engagement and progress of more than one senior (e.g., parents). • Provide the ability to see the senior's engagement in activities. • Enable the exchange of information with formal caregivers. • Allow receiving notifications about all important events related to the senior.
	<ul style="list-style-type: none"> • Ensure the platform performs efficiently, with real-time updates and notifications. • Design the platform to be accessible to users with varying levels of technical proficiency, providing clear instructions and support. • Maintain secure communication channels to protect the privacy of information exchanged between informal and formal caregivers.
Formal Caregiver	<ul style="list-style-type: none"> • Track the progress of multiple seniors assigned to them. • Select and describe their professional role to clearly identify their responsibilities. • Exchange information with other formal caregivers and informal caregivers. • Possibility to add seniors to the platform. • Perform senior condition assessments to easily monitor and track senior condition. • Collect and access historical data about senior conditions. • Assign personalized care plans efficiently. • Adjust care plans to meet the specific needs of each senior. • Easily prioritize seniors in need of immediate care. • Receive notifications about seniors' engagement and performance decline.
	<ul style="list-style-type: none"> • Ensure the platform is intuitive and user-friendly for formal caregivers, facilitating easy tracking and monitoring.



	<ul style="list-style-type: none"> • Ensure reliable access to data and consistent performance of assessments and care plan adjustments.
Institution	<ul style="list-style-type: none"> • Provide roles responsible for managing all users within the institution (seniors, formal caregivers, informal caregivers). • Enable adding formal caregivers, informal caregivers, and admins. • Allow editing and removing seniors, formal caregivers, informal caregivers, and admins. • Provide multiple levels of administrative permissions to meet the needs of different types of institutions (e.g., one super admin with additional admin roles with lower-level permissions). • Allow monitoring of the institution's status, including the number of users and roles of caregivers. • Provide support for users within the institution.
Head Admin	<ul style="list-style-type: none"> • Manage institutions at the country level. • Add or remove institutions from the platform. • Change the Institution Owner without disrupting the institution's work.

4.2. Business Requirements Analysis and Project Documentation

4.2.1. Introduction - the purpose of business analysis

The PROCAREFUL project has the goal of developing and implementing a model for hybrid home care services that considers the needs of Seniors and those people who needs support. The project aspires to enhance the quality of life of these people through the use of modern digital technologies, such as machine learning and artificial intelligence, which can significantly improve the efficiency and accessibility of home care services.

In particular, the project focuses on improving access to home health care, especially in rural areas where there is a lack of appropriate technical facilities to support independent living. By expanding social care services and shifting from a reactive to a proactive approach, the project aims to reduce gaps in the availability and timeliness of care services in both urban and rural areas.

The purpose of the business analysis is to analyze and understand the needs and, as a result, build the business processes and define the functionalities and requirements that would meet those needs. The business analysis also indicate the scope and constraints to which the functionality and data processed in the system are featured.

4.2.2. Stakeholders

- Application administrator
- Formal caregiver
- Informal caregiver



- Senior

Stakeholders are entities that affect the organization. In project management, these are people for whom the process of the project and its final outcome are important, so it is important to analyze stakeholders and understand their needs.

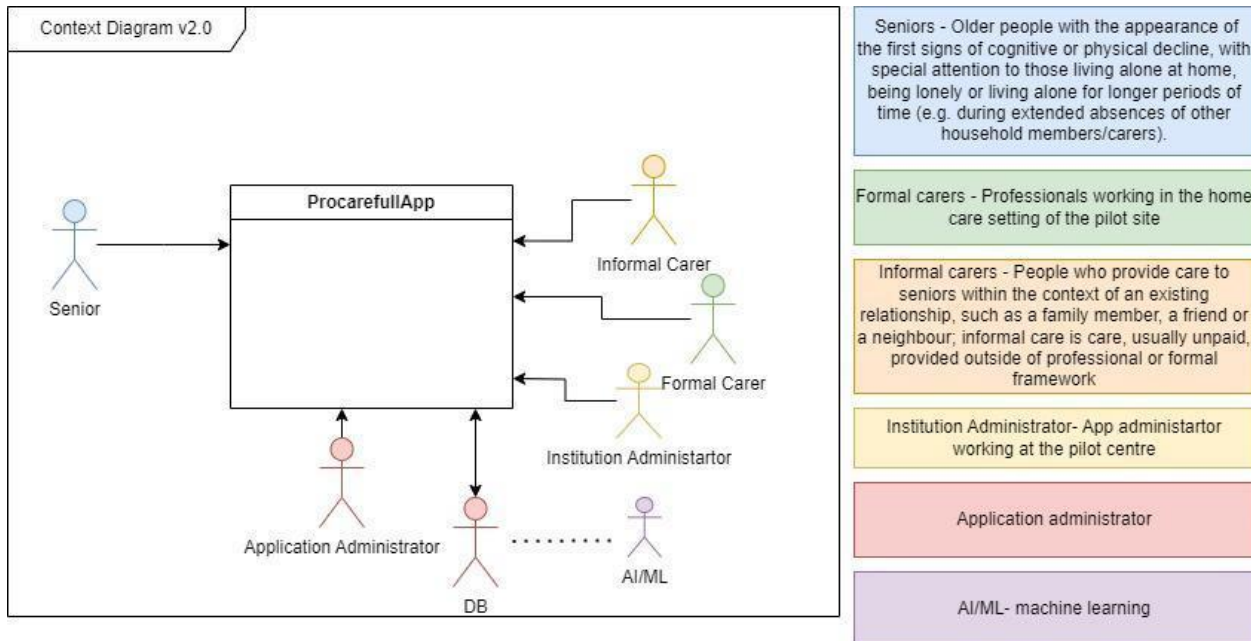
An analysis of the target groups of the Procareful application was carried out based on resources obtained from the Interreg Central Europe program. As a result of the analysis, the target groups and their characteristics were identified:

- 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.

Procareful has defined users with the following roles:

- Seniors
- Formal caregivers
- Informal caregivers
- Administrators.

A detailed description of the roles, the relationships between users and their dependencies, and the distribution of roles with their permissions and functionalities are described in *the document 1.4.2 in chapter 2.4. Roles and Relationships Between Users.*



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

4.2.3. Requirements

A PEST market analysis was carried out based on the materials obtained from Interreg Central Europe. The starting point for conducting it is the identification and collation of basic external factors:

- political,
- economic,
- socio-cultural,
- technological.

It is necessary to assign specific factors to segments, assess the impact of the factors, and determine the relationship between them and the environment. PEST analysis supports the planning process.

The requirements and functionality analysis for the Procareful project was based on the MVP model. The end-user groups and their needs were identified, the main objectives were defined, and basic functions were prioritized based on user needs.

Requirements were gathered from the target groups during meetings held in the partner countries. Stakeholders (employees of institutions, formal and informal caregivers, seniors) communicated their needs and problems, and on the basis of these, the main functionalities of the application were identified, which were elaborated and refined in detail during a deeper analysis of the requirements. The received high-level requirements were transformed into detailed application functionalities and system mockups, which were presented at weekly workshops and consultations with stakeholders to confirm the implemented solutions.

A detailed description of requirements acquisition and functionality and documentation during development work is described in document 1.1.1. *Meta-analysis on e-care, m-health solutions, benchmark projects and literature findings of existing proactive and e-care solutions* and 1.2.2 *Report presenting the co-design findings of the PROCAREFUL Model*.



4.2.4. Business process modeling

The chapter presents the business processes implemented in and using the Procareful application. The following processes are the basis for the formulation of requirements and functionalities existing in the Procareful application. The chapter describes the processes in terms of the final version of the Procareful application.

Business processes were documented using the Bizagi Modeler tool in accordance with the BPMN 2.0 notation. Analysis of the type and scope of the processes in the target version show that BPMN 2.0 can be used effectively for documenting processes. The modeling of business process diagrams using the BPMN 2.0 notation made it possible to optimize the business processes implemented in the Procareful application.

Business processes have been divided into those performed by users with the roles of Head Admin, Super Institution Admin, Institution Admin, Formal Caregiver, Informal Caregiver in the Admin application and those performed by users with the role of Senior in the Senior application.

4.2.4.1. List of business processes in the Admin application:

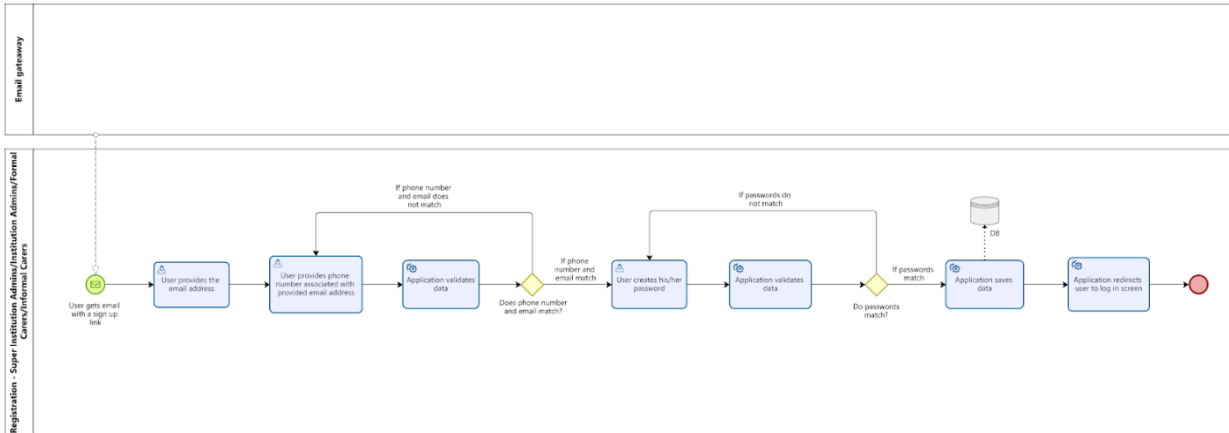
- Registration
- Secondary log-in
- First Entry - Onboarding
- Managing Super Institution Admins and Institutions
- Managing Institution Users - Super Institution Admin
- Managing Institution Users - Institution Admin and Institution
- Adding Senior - Formal Caregiver
- Activity Assignment for Senior - Formal Caregiver
- Senior profile update - Formal Caregiver
- Senior profile update - Informal Caregiver

4.2.4.2. Registration

The process represents the registration of a new user in the Procareful application. A user with the role of Super Institution Admin, Institution Admin, Formal Caregiver, Informal Caregiver receives a registration link to their email inbox. The user creates a new account using their data set. The application validates and saves the new user's data in the database, and then redirects the user to the login window.



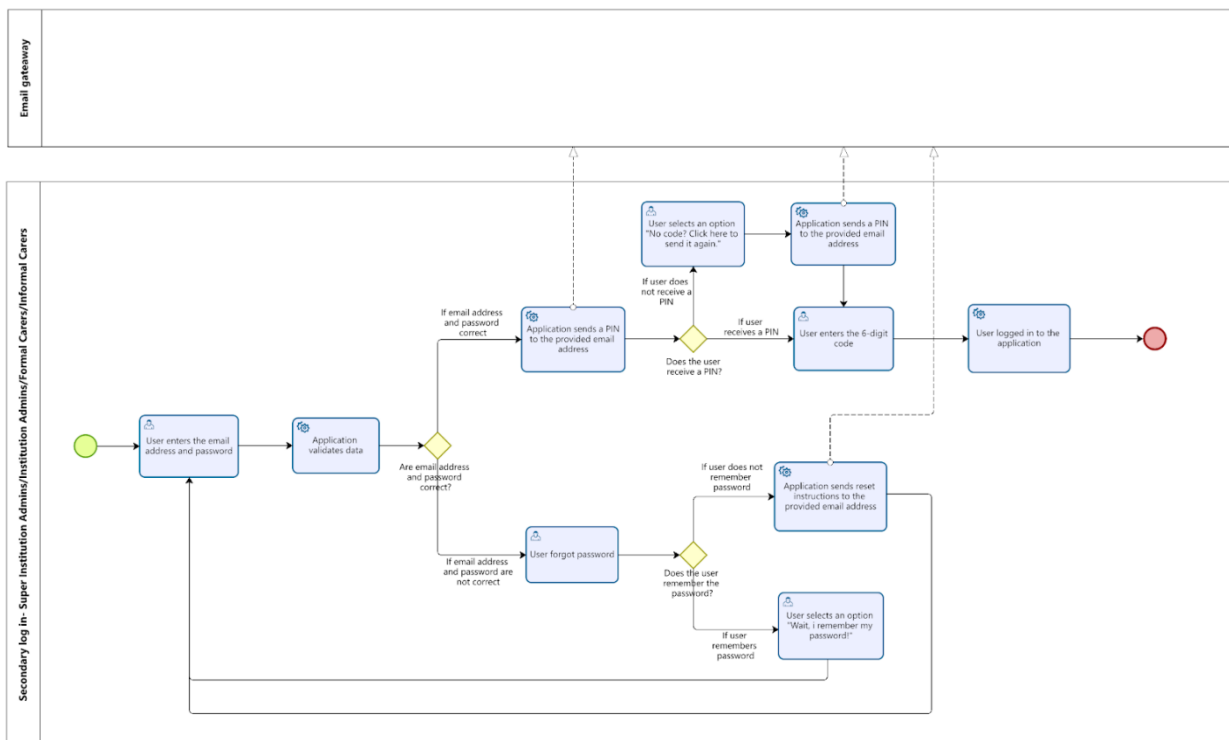
PROCAREFUL



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4.2.4.3. Secondary log-in

The process shows the login of an existing user who has a setup account in the Procareful application. The user logs into the application using their login credentials and a 6-digit PIN code, which the application sends to the user's email box. If the user has not received the code, the app allows the code to be sent to the email inbox again. After entering a valid 6-digit PIN, the user logs into the application. The application also allows the user to reset their password in case they forget it. The application sends a message to the email address provided by the user with instructions to reset the password.



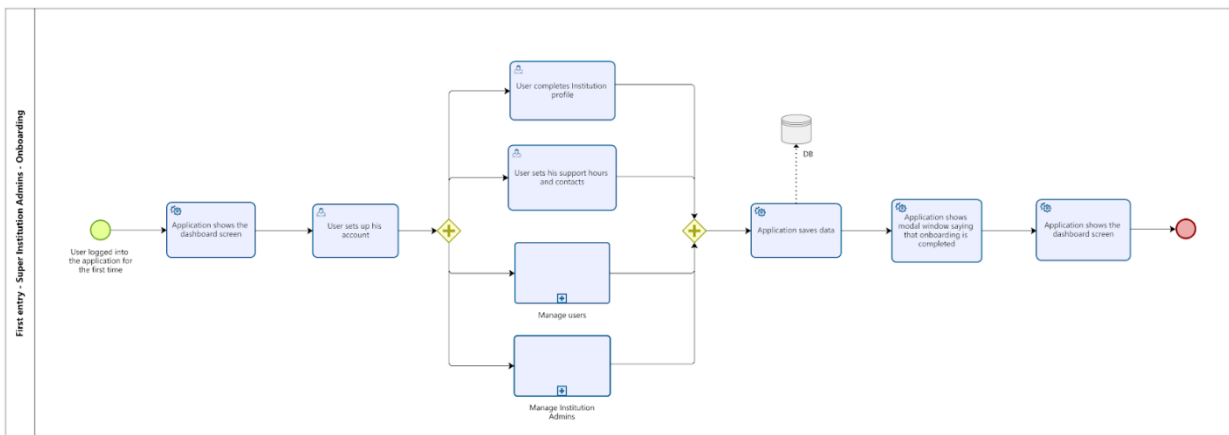
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4.2.4.4. First Entry - Onboarding

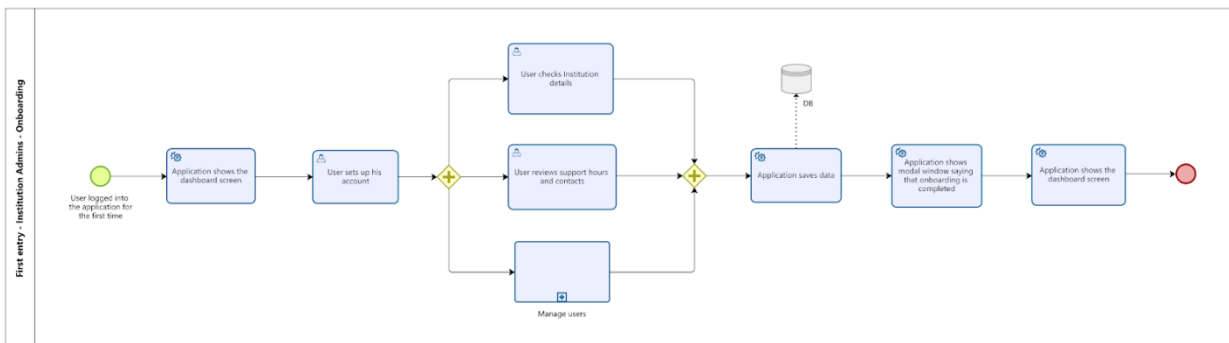
The process shows the configuration of the user account. Each user must configure their account when they first log in to the Procareful application. The user has to perform a series of actions depending on what role they are assigned in the application. Each role is assigned its own permissions and functionalities that the application gives access to. Once the configuration hours process is complete, the application saves the data in the database and then takes the user to the dashboard.

1. First entry - Super Institution Admins - Onboarding



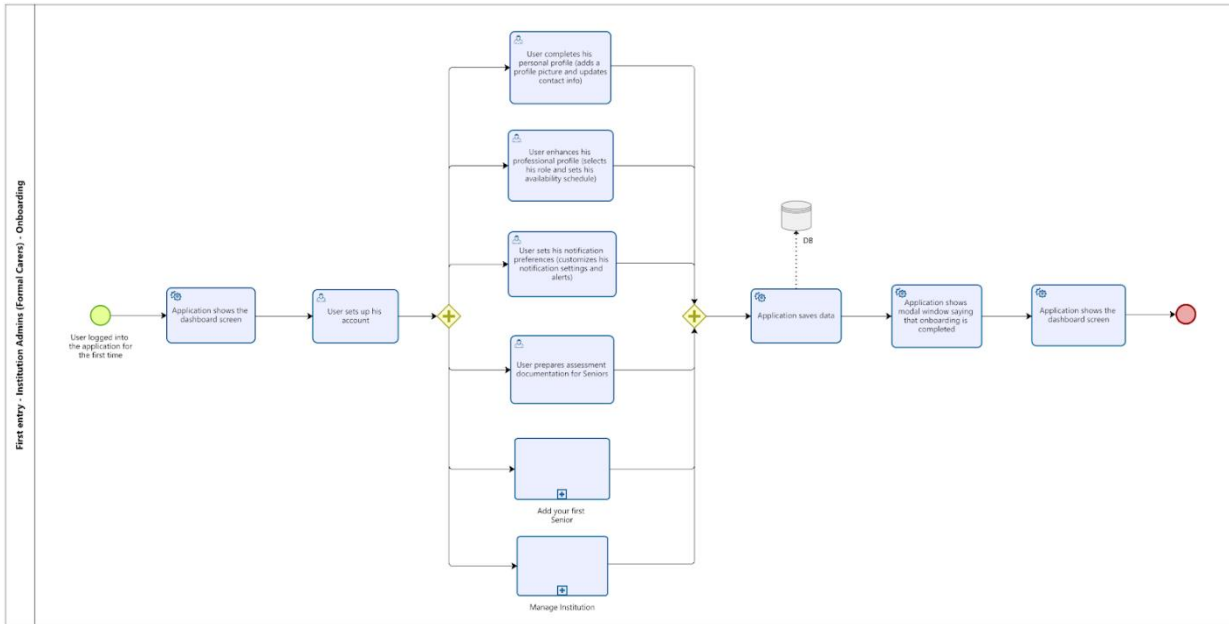
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2. First entry - Institution Admins - Onboarding



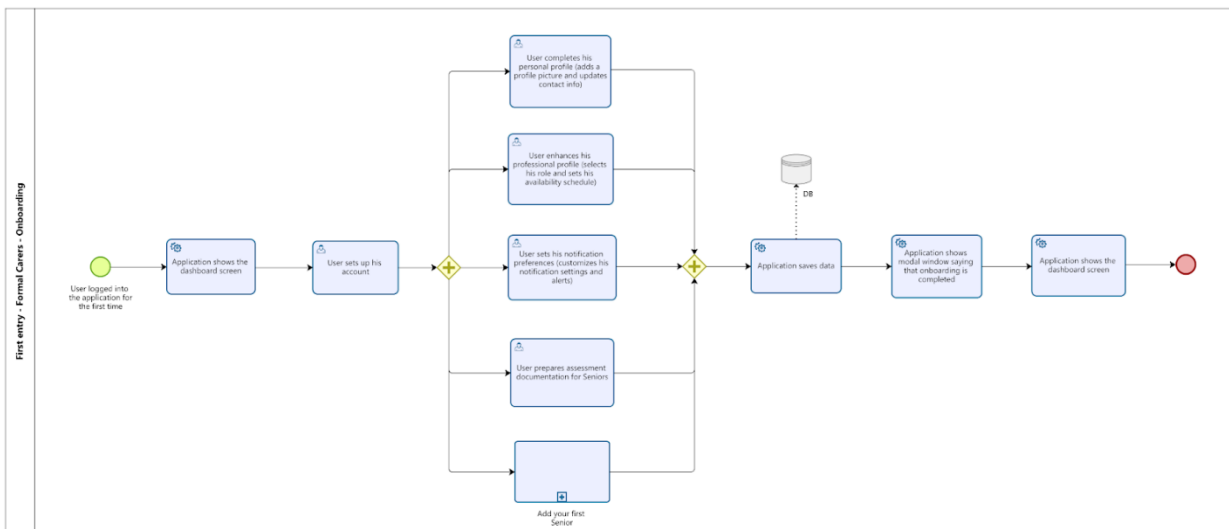
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Modeller

3. First entry - Institution Admins (Formal Carers) - Onboarding



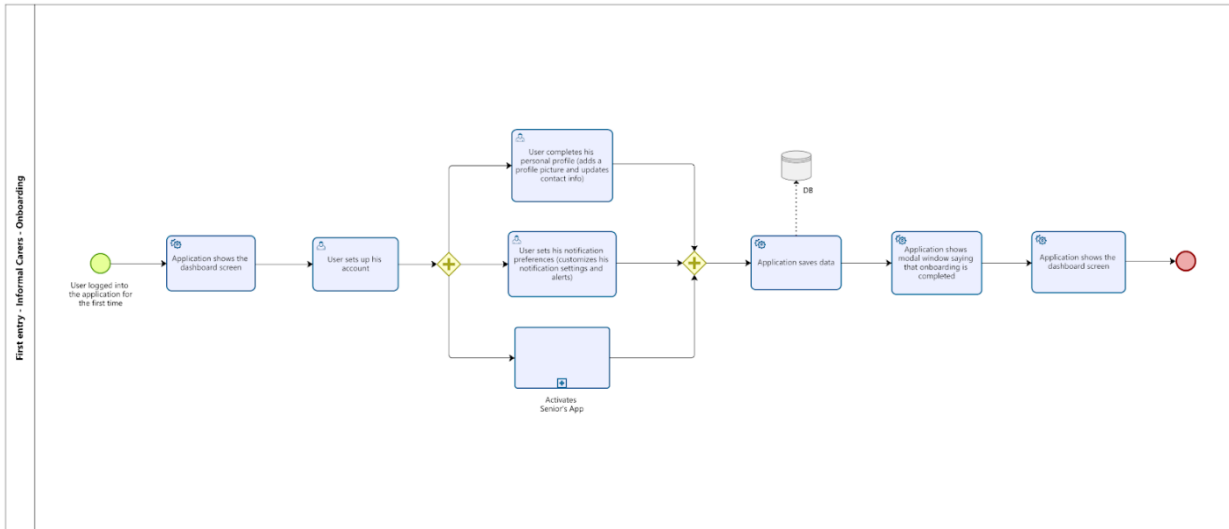
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4. First entry - Formal Carers - Onboarding



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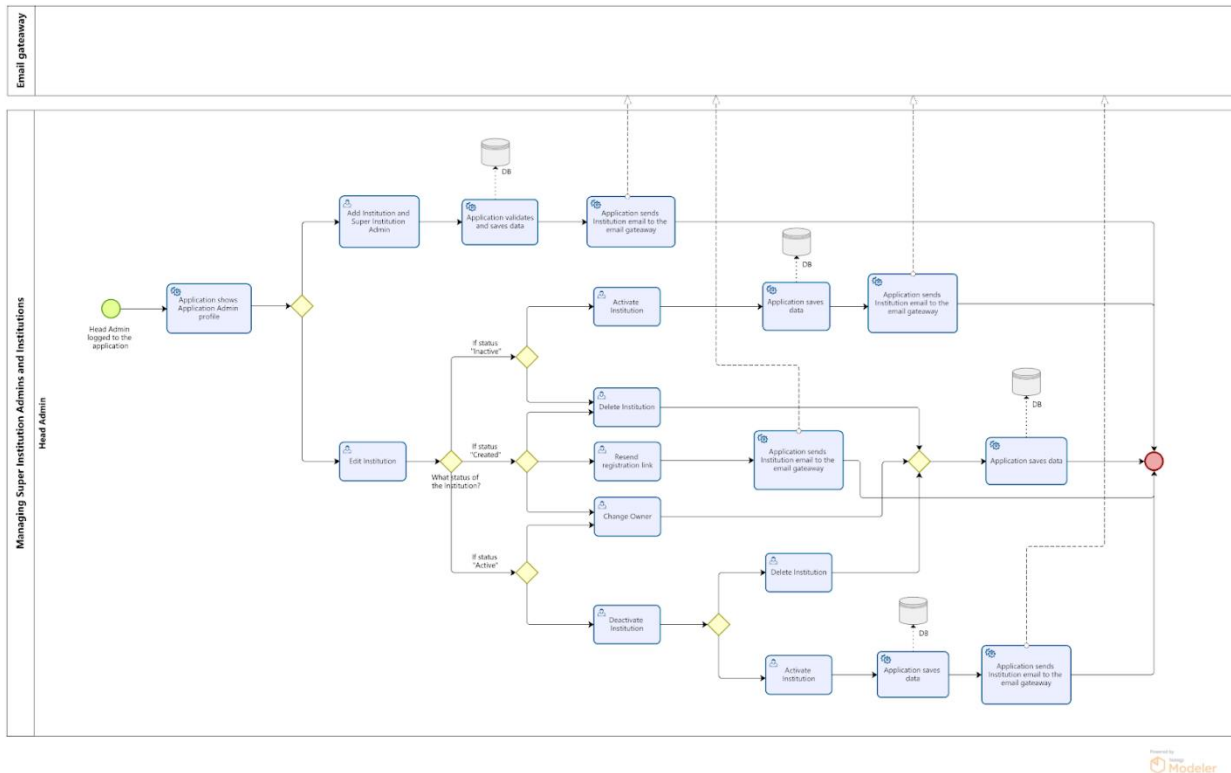
5. First entry - Informal Carers - Onboarding



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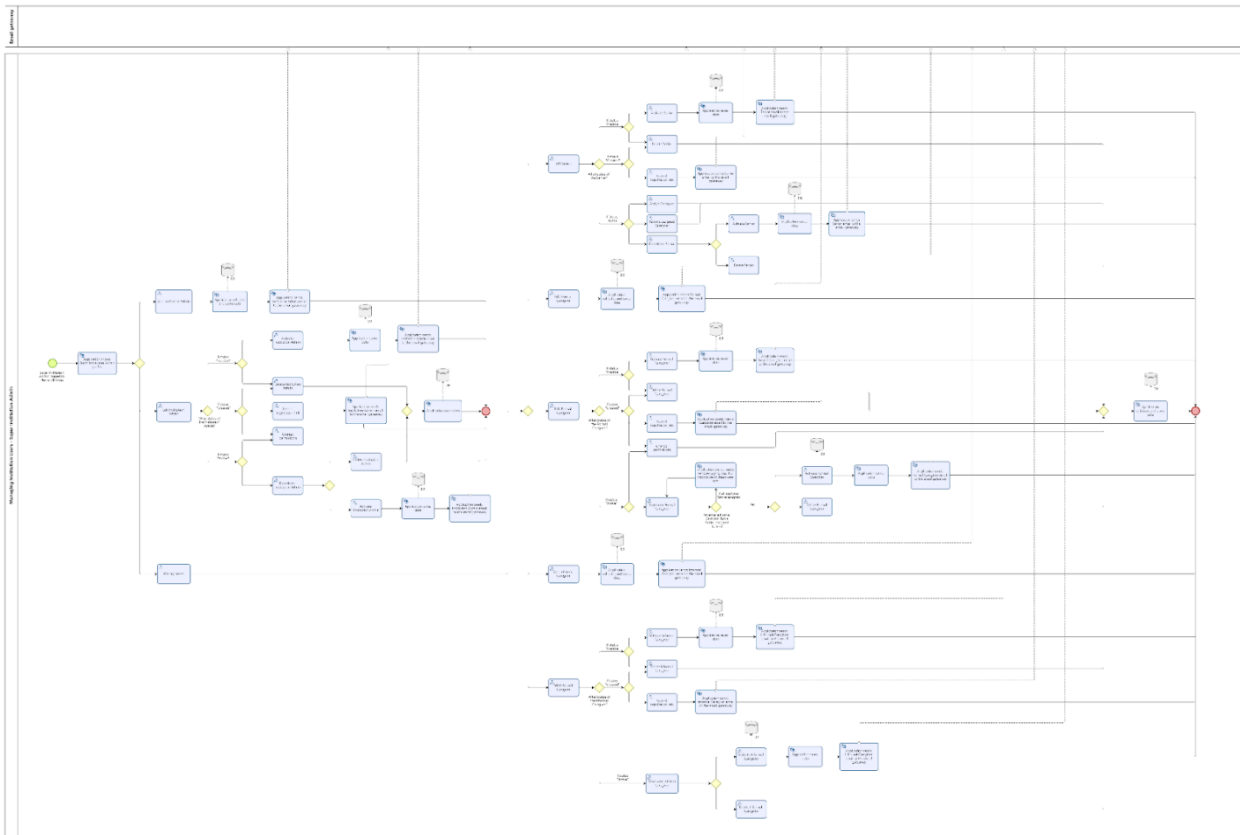
4.2.4.5. Managing Super Institution Admins and Institutions

The process shows the management of users with the Institution and Super Institution Admin role by a user with the Head Admin role. It has the ability to add users with Institution and Super Institution Admin roles. The application also allows the administrator to edit Institutions. Administrator can activate/deactivate/delete the Institution, edit the Institution's data, change the Institution's owner, and resend the registration link to an email box. The availability of the function depends on the status the Institution has in the application. After each operation, the application validates and saves the data of the new/edited user in the database. After adding, activating or selecting the option to resend the registration link, the application sends a message with the registration link to the provided e-mail address.



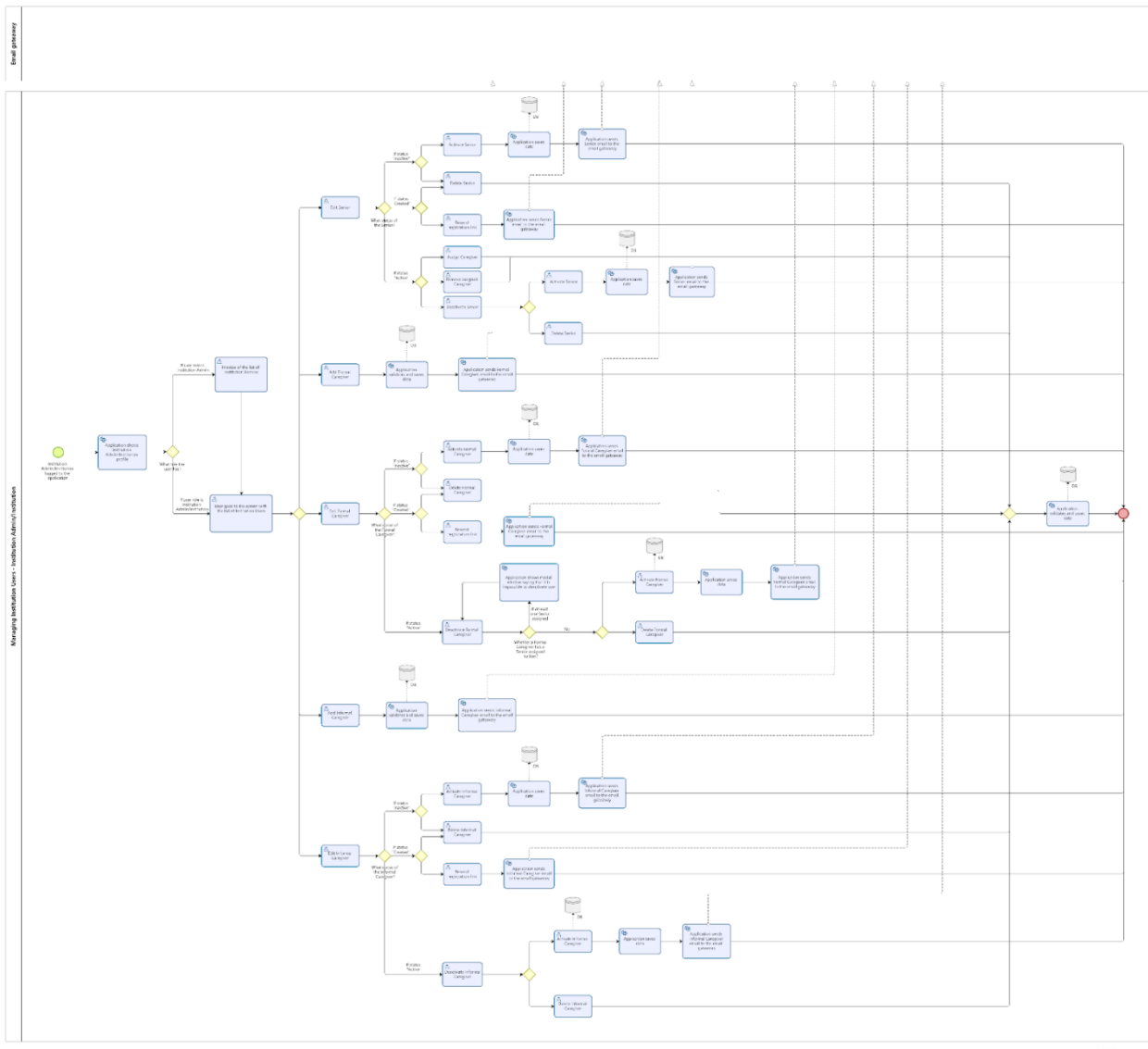
4.2.4.6. Managing Institution Users - Super Institution Admin

The process shows the management of users with the Institution Admin, Formal Caregiver and Informal Caregiver roles by a user with the Super Institution Admin role. Super Institution Admin has the ability to add users with Institution Admin, Formal Caregiver, Informal Caregiver roles. The application also allows the administrator to edit users with the above roles and edit users with the Senior role. Among other things, Super Institution Admin can activate/deactivate/delete users, edit user data, change user permissions, or resend a registration link to an email inbox. An important function in the context of users in the Senior role is also the assignment and removal of their caregivers. The availability of the function depends on the status the user has in the application. After each action, the application validates and saves the data of the new/edited user in the database. After adding, activating or selecting the option to resend the registration link, the application sends a message with the registration link to the provided e-mail address.



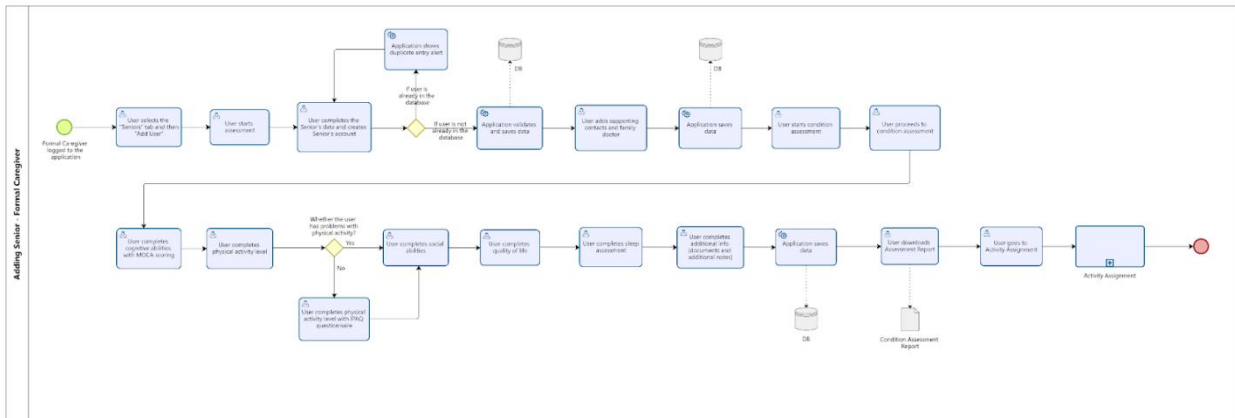
4.2.4.7. Managing Institution Users - Institution Admin and Institution

The process shows the management of Institution users by users with Institution Admin/Institution role. The application gives them the ability to add users with the Formal Caregiver, Informal Caregiver roles. Institution Admin/Institution also has the ability to edit users with the above roles and edit users with the Senior role. Among other things, Institution Admin/Institution can activate/deactivate/delete users, edit user data, and resend the registration link to an email inbox. An important function in the perspective of users with the Senior role is also assigning and deleting their caregivers. In addition, a user with the Institution Admin role has the ability to view the list of Institution administrators. The availability of the function depends on the status the user has in the application. After each operation, the application validates and saves the data of the new/edited user in the database. After adding, activating or selecting the option to resend the registration link, the application sends a message with the registration link to the provided e-mail address.



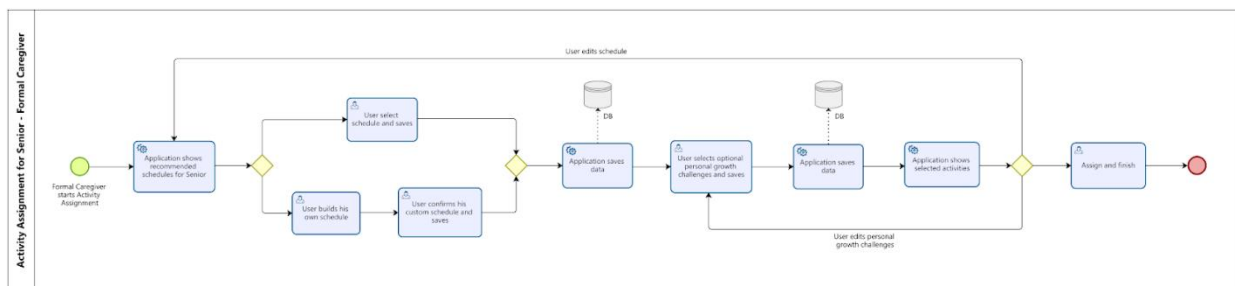
4.2.4.8. Adding Senior - Formal Caregiver

The process shows the addition of a new Senior by a user with the role of Formal Caregiver. In order to add a new Senior to the system, the user has to create a new Senior account with a set of required data, complete a series of questionnaires assessing the Senior's cognitive, social and physical abilities, and perform the activity assignment process. After each step completed, the application saves the data in the database. On the other hand, after completing the questionnaires assessing the Senior's cognitive, social and physical abilities, the application generates a summary report of the Senior's condition, which the user can download to his or her drive.



4.2.4.9. Activity Assignment for Senior - Formal Caregiver

The process shows activity assignment for a Senior at the stage of adding a new Senior by a user with the Formal Caregiver role. Based on the completed and saved questionnaires assessing the Senior's cognitive, social and physical abilities, the application generates recommended activity schedules for the Senior. The user can select one of the recommended schedules or build their own schedule. In addition, the app allows the user to select optional additional activities that help the Senior's personal development. After each step taken, the application saves the data in a database.

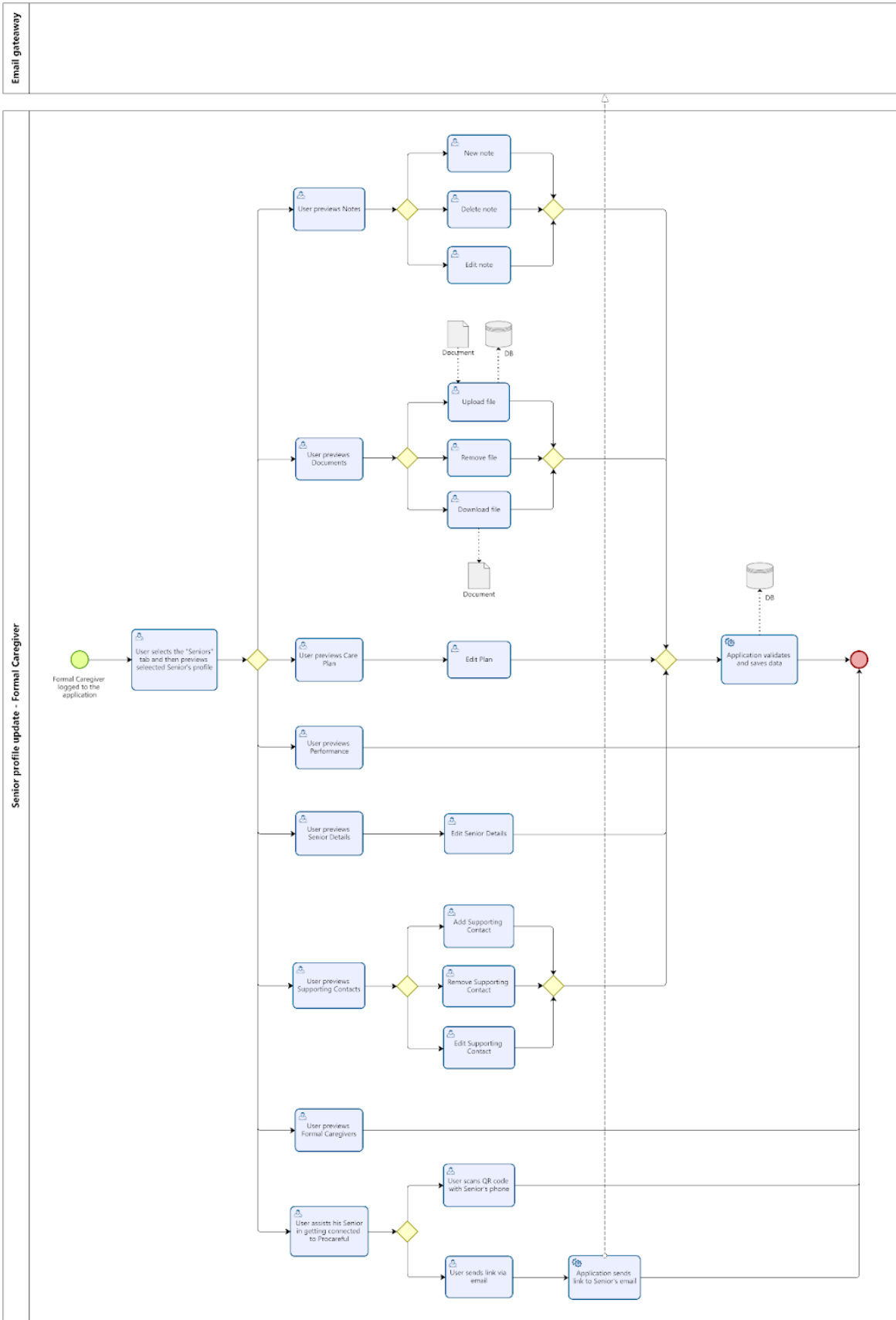


4.2.4.10. Senior profile update - Formal Caregiver

The process shows the editing/updating of a Senior's profile by a user with the Formal Caregiver role. From the Seniors list page, the user has access to view all the data of the selected Senior. The application allows to perform a number of actions: add/delete/edit notes, upload/delete/download document file, edit activity schedule for Senior, edit Senior's data, add/delete/edit contacts. After each action, the application validates and saves the edited user's data in the database. In addition, the app allows the user to assist in activation the application for the Senior. The Formal Caregiver has the option to download the app by scanning the QR code on the Senior's phone or by sending a message with instructions and a link to download the app to the provided email address.



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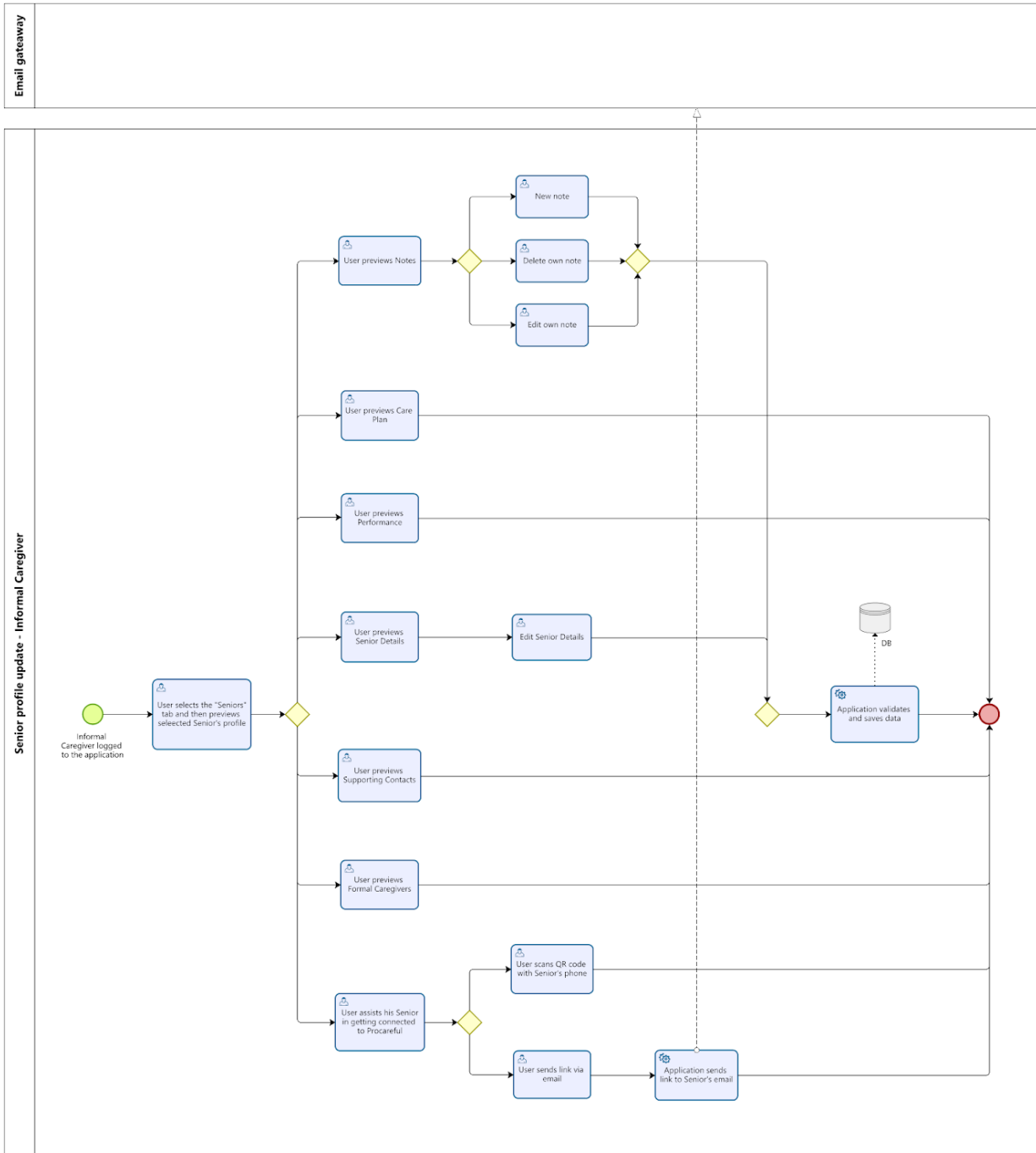




4.2.4.11. Senior profile update - Informal Caregiver

The process shows the editing/updating of a Senior's profile by a user with the Informal Caregiver role. From the tab with the list of Seniors, the user has access to view all the data of the selected Senior. The application allows the user to perform actions: add/delete/edit notes, edit the Senior's data. After each action, the application validates and saves the data of the edited user in the database.

In addition, the app allows the user to assist and activate the app for the Senior. Informal Caregiver has the option to download the app by scanning the QR code on the Senior's phone or by sending a message with instructions and a link to download the app to the provided email address.



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4.2.4.12. List of business processes in the Senior Application:

- Log in
- Games flow - general
- Physical activity flow
- Personal growth flow

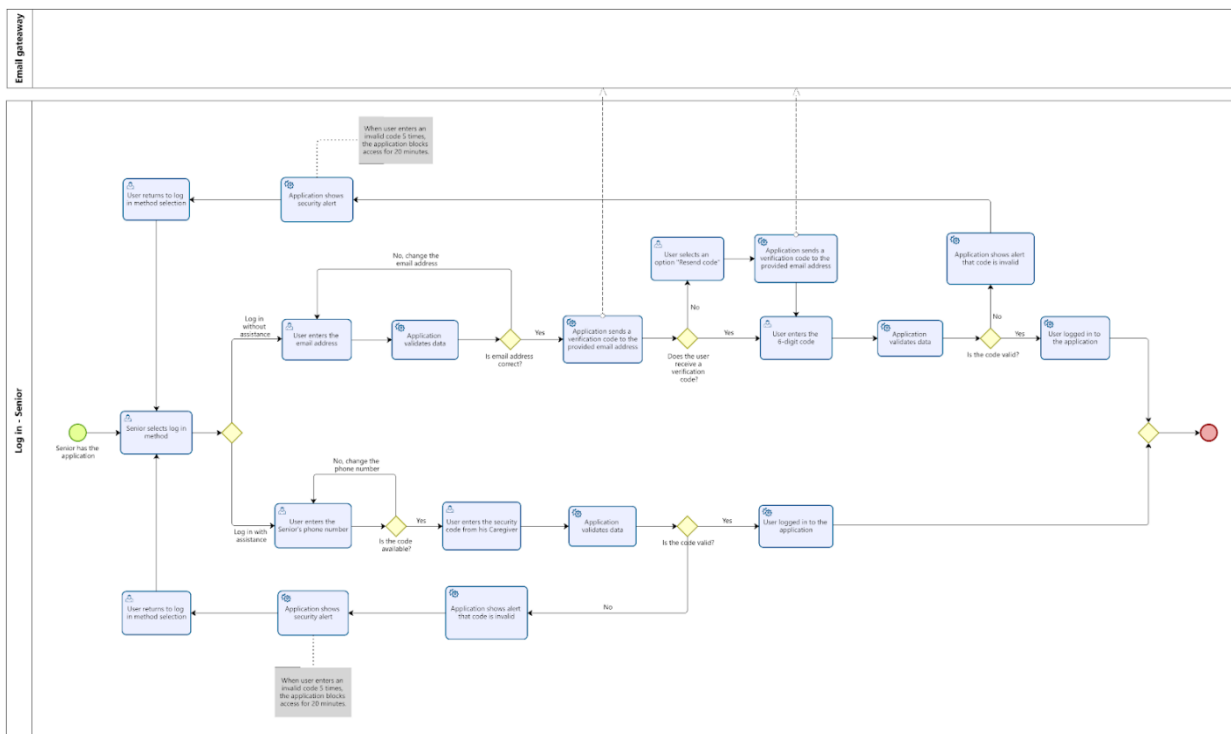


4.2.4.13. Log in

The process shows the login of a user with the Senior role to the Procareful application. The app allows the user to log in in two ways, with or without caregiver assistance. When logging in with caregiver assistance, the user enters the Senior's phone number, and then the 6-digit security code, which appears in the caregiver application. If the user has entered an incorrect phone number, the application gives the user the option to change the number. After entering the correct 6-digit code, the user logs into the application.

When logging in without the assistance of a caregiver, the user provides an e-mail address to which the application sends a verification code. If the user has provided an incorrect e-mail address, the application allows the user to change the e-mail address. In the situation when the user did not receive the code to the provided e-mail address, the application gives the option to select the "Resend code" action, after which it once again sends the code to the provided e-mail address. After entering the correct 6-digit code, the user logs into the application.

When a user enters an incorrect verification code, the application displays an alert. On the other hand, when the user enters the incorrect code 5 times, the application displays a security alert and blocks access to the application for 20 minutes.



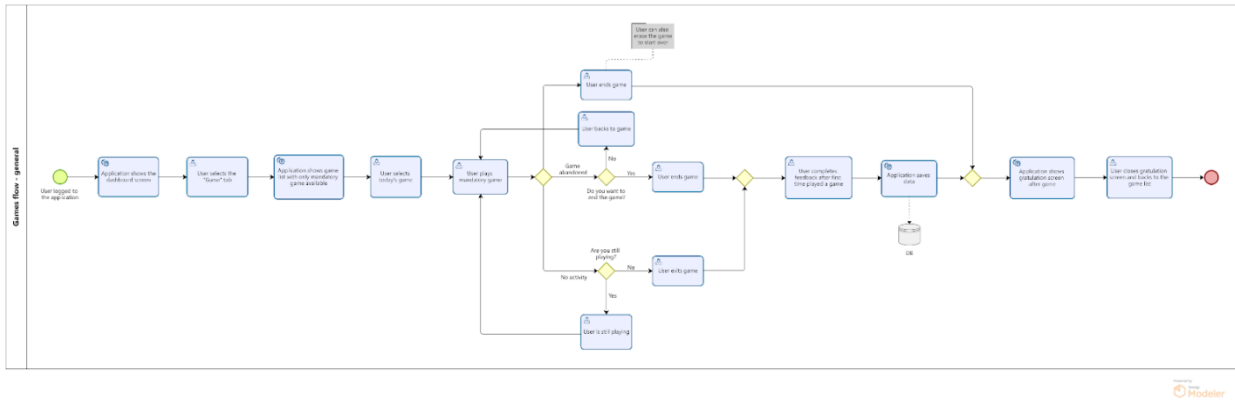
4.2.4.14. Games flow - general

The process outlines the general flow of gameplay accessible to the Senior. After successfully logging in, the user selects the "Game" tab from the main screen. The application then displays a screen with a list of available games. The application requires the user to play the designated game for that day. 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



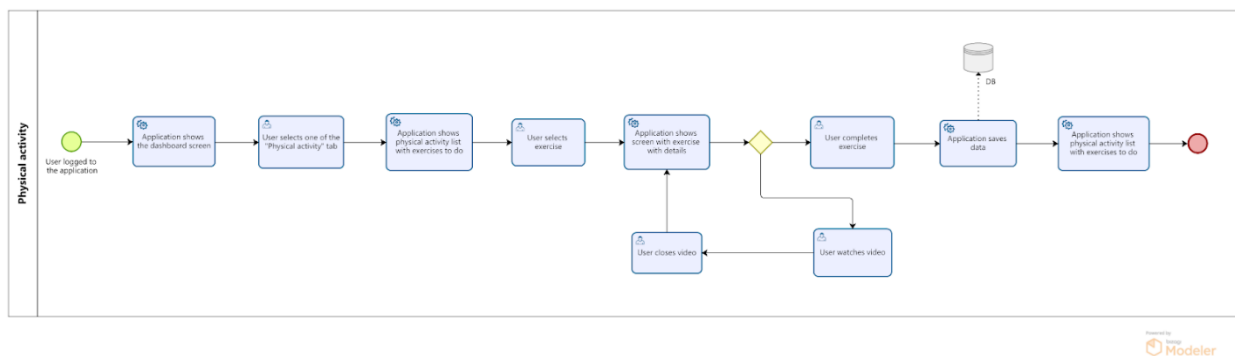
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game, it prompts them with a message offering the option to return to the game or exit it. Upon exiting the game, the Senior is required to provide a reason for leaving. The application saves the Senior's preferences in the database and then presents a screen with the list of available games to play.



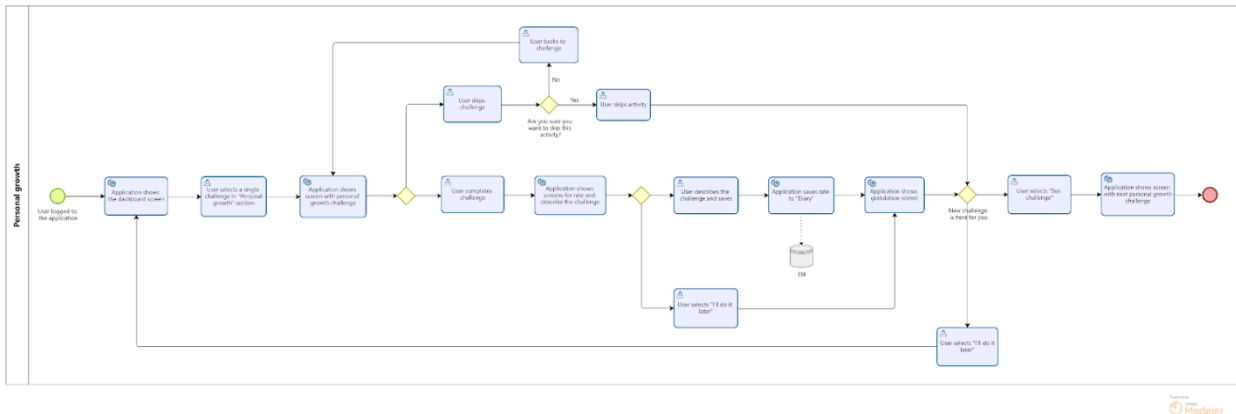
4.2.4.15. Physical activity flow

The process outlines the completion of assigned physical activities by the Senior. After successfully logging in, the user selects one of the assigned exercises from the "Physical Activity" tab on the main screen. The application then displays a screen with a list of exercises to be performed. Upon selecting a specific exercise, the application presents a screen with a detailed description of the chosen exercise. The Senior has the option to view an instructional video associated with the exercise. After completing the exercise, the application records the progress in the database and then displays the screen with the remaining exercises to be completed.



4.2.4.16. Personal growth flow

The process outlines the completion of additional activities that contribute to the Senior's personal development. After successfully logging in, the user selects an individual challenge from the "Personal Growth" tab on the main screen. Upon selecting a challenge, the application displays a screen with a detailed description of the assigned activity. The Senior can choose to complete the challenge or skip it. After completing the challenge, the Senior has the option to describe the activity and share personal insights, which are saved in the database and displayed in the Senior's personal "Diary." The application then presents the Senior with the next assigned challenge, which can be completed immediately or at a later time.



4.3. From Requirements to Mockups and Functionalities

To transform the high-level requirements gathered from the target groups into detailed mockups and application functionalities, the following approach was taken:

1. Requirement Analysis and Breakdown:
 - a. Conducted a detailed analysis to break down high-level requirements into specific, actionable items.
 - b. Engaged cross-functional teams, including designers, developers, and business analysts, to ensure comprehensive coverage of all requirements.
 - c. Created user stories to capture the needs and expectations of each stakeholder group.

i User story

As a Formal Caregiver I want to add new Senior to the Institution.

✓ Acceptance criteria

1. On the "Seniors" screen there is an "Add user" button.
2. Clicking on "Add user" butto redirects to information screen which contains:
 - "Before you start" informations
 - "Important notice!" how to fill the assessment form.
 - checkbox "I understand that the Senior will gain access to their activities only after I complete the Condition Assessment"
 - At the bottom of the page there is "Start assessment" button which is active after chcking checkbox I understand that the Senior will gain access to their activities only after I complete the Condition Assessment"
3. Add Senior form contains "Basic Information" and "Senior Details" section.

2. Wireframing and Mockups:

- a. Developed wireframes to visualize how requirements would be translated into features.
- b. Created high-fidelity mockups based on these wireframes, incorporating visual design elements and interactions to represent the final look and feel of the application.



3. Iterative development:

- a. Scheduled regular review sessions with stakeholders to present progress, gather feedback, and make necessary adjustments.
- b. Adopted an Agile methodology to use an iterative development process, continuously refining and enhancing the application based on stakeholder feedback and testing results.

4.4. Workshops and Consultations

To ensure that the implemented solutions align with the requirements and receive timely feedback, the following approach was undertaken:

1. Weekly Design Checkpoint Meetings:

- a. Held online meetings on a weekly basis to review the progress of the project.
- b. Agenda: Presented updates on the design and development of the platform, highlighting key achievements and any issues encountered.
- c. Discussions to address missing requirements, challenges, and any adjustments needed to align with stakeholder expectations.

2. Meeting Summaries and Action Items:

- a. After each meeting, the Consortium received a summary detailing the discussions, agreements, and action items.
- b. Follow-Up: Ensured that all agreed-upon actions and changes were implemented promptly and reflected in subsequent updates.

3. Stakeholder Confirmation:

- a. Regularly confirmed that the implemented solutions met the requirements of the National Working Group and other stakeholders.
- b. Incorporated feedback from the National Working Group into the development process to address any discrepancies or additional needs.



This approach ensured that all implemented solutions were continuously validated against the requirements, facilitating timely adjustments and confirming that the project remained aligned with stakeholder needs.

5. Building the ML Module

5.1. Module Assumptions Based on Requirement

The assumption behind the development of the application is to support Seniors in maintaining them in good mental and physical condition for as long as possible, by engaging them in a variety of activities. An important part of the application is the functionality supported by a machine learning module whose responsibility is to adjust the cognitive activities to the level of the Senior's skills as best as possible, which makes it possible to constantly improve competence and provide the necessary positive stimuli for progress. In order to implement this function, a set of simple cognitive games covering the mentioned requirements was created in cooperation with psychology specialists. Senior will be able to play:

- Memory
- TicTacToe
- 2048
- Word guess
- Wordle
- Sudoku
- Snake

Requirements and logic have been developed for each game, adapted to the level of all users included in the target groups. Each game has multiple levels of difficulty, which makes it possible not only to adjust the level to the Senior's capabilities, but also to raise or lower it adapted to the Senior's performance in the game. Levels in cognitive activities are set independently for each game. A player can be assigned one of the following levels:

- Easy
- Easy +
- Medium
- Medium +
- Hard
- Hard +

The responsibility of the machine learning algorithm will be to learn the capabilities and predispositions of a given Senior and to predict, based on the analytical data collected, the user level for each cognitive activity and its calibration according to the Senior's progress so as to always offer him/her gameplay at the highest level possible for the Senior to complete.



The application also has the ability to future develop the machine learning model to search for relations between performance in cognitive games and other activities and the data collected in the Senior Assessment Form containing a range covering different areas of Senior's health:

- Cognitive abilities - MoCa scoring
- Physical activity level - IPAQ Questionnaire
- Social abilities - DeJong Gierveld Scale (short)
- Motivation - declarative level of motivation to participate in programm (high, medium, low)
- Quality of life - 5Q-5D-5L questionnaire

5.2. Data Collection

In order to achieve the objectives, the machine learning model collects a lot of data from the application which is later analyzed on the basis of which the model assigns activity levels. The data that are necessary are:

1. Time spent on gameplay
For the purpose of analysis, the application monitors the time spent by the Senior to complete the gameplay of one of the 7 games designed to keep cognitive abilities on an appropriate level. For each game and for each of the 6 levels, a time limit is set in which the gameplay should be completed. Exceeding or completing the gameplay before the time limit indicates changes in cognitive abilities and can contribute to raising or lowering the level of the game.
2. Number of tries
For each game, a maximum number of attempts that leads to loss has been defined. The number of attempts that a Senior will use in a given game is gathered to give the application an information of how the Senior performs on particular tasks designed to increase cognitive abilities and can contribute to raising or lowering the level of the game.
3. Number of used hints
A hint option has been introduced for some games. Using a hint at a given stage of gameplay gives the application the information that a given level of gameplay may be too high or too low for the Senior's current level of cognitive ability, and may contribute to raising or lowering the level of the game.
4. Scores
For some games, the indicator that shows how well a Senior is doing is the points gained. Earning a certain number of points can contribute to raising or lowering the level of the game.
5. Ratio of number of games won to lost
This data are collected to determine how the Senior is performing at a certain level. If the rate of losers is high, the level is lowered. With a high rate the level of a particular game is increased.
6. Level change for a given game relative to the base level
This indicator shows how much progress the Senior has made in a given game in relation to the base level with which he started.
7. Number of all played games
Data collected to later build a ranking of the most engaged Seniors and later analyze the relationship between Senior's involvement in games and assessment results.



8. Completed activities
Data on completed activities from the entire schedule of Senior's activities is collected for later determination of performance and Senior's involvement.
9. Percentage of activity plan implementation
This indicator determines the level of the Senior's commitment to the goals of the activity schedule prepared for him. A low indicator is an information to the caregiver that the Senior may have some problem with completing the tasks.

5.3. Data Analysis by the Model and Benefits of Data Collection

One of the values produced during the project is the data taken away, which can help make better decisions, monitor the patient's condition or contribute to pivot solutions. In order to best understand the data, to discover the relationships and connections hidden in it, machine learning-based solutions work best. However, when building a machine learning-supported system, it is essential to have the right data, which is why the project was divided into an analytical part and an ML part.

5.3.1. Analytical part

Systems using machine learning require the collection of a sufficient amount of data to achieve satisfactory accuracy. Therefore, in the first phase of the project, an analytical system has been prepared that will expertly manage the collection of data and the assignment of game levels for a given senior. This approach will enable the collection of a representative sample of data. Diverse data, covering a wide range of cases, includes a broad spectrum of cases are crucial from the ML point of view. They allow to achieve a higher generalization ability, thus the model is more universal and better reflects real-life scenarios. In order to achieve the aforementioned goals, it was decided that the first phase should last 6 weeks. During this phase, Senior will have the opportunity to play all the games at different levels. Then, in order to collect more data and increase the senior's satisfaction with the game, the following business logic was 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:

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

5.3.2. Machine Learning Part

Once the part of collecting data and managing gamification level selection analytically is completed, an machine learning based tool can be built to achieve the best results. The advantages of the approach supported by machine learning are:

- Machine learning models are designed to work with huge data sets. Traditional methods can struggle to efficiently process and analyze large amounts of information
- Machine learning algorithms are capable of identifying complex and subtle patterns in data that may be imperceptible to traditional analysis methods



- Machine learning models show a high ability to forecast future events based on historical data. Traditional methods of analysis often focus on describing data and identifying relationships rather than making predictions.

An extended version of the system could be a system that uses a machine learning model, the purpose of which would be to forecast future values of a Senior's performance. Based on the collected data, i.e. historical games, such a system can estimate the future values of a given senior's performance levels by identifying the trend in the data and by discovering relationships between variables. In implementing such a process, it is necessary to perform the next steps.

5.3.2.1. Step 1: Historical data analysis

1. Analyze data in terms of wins and losses, changes in difficulty level, playing time, etc.
2. Detect patterns and trends in Senior's behavior, e.g., whether wins are more frequent at lower difficulty levels or at certain times of the day.
3. Analyzing correlations between different games, e.g., whether skills in one game affect performance in another.j.

5.3.2.2. Step 2: Estimating future levels

1. Predictive modeling:
 - Using the collected data to build predictive models. Machine learning algorithms such as linear regression, decision trees, and neural networks can be used to predict future Senior's performance.
2. Simulation and validation:
 - Conduct simulations using historical data to test the accuracy of the predictive model.
 - Validate models by comparing predicted results with actual results collected during new games.

5.3.2.3. Step 3: Implement the system

- System implementation.
- Continuously monitor performance and adjust predictive algorithms based on new data.
- Regular updates to the system to improve its accuracy and efficiency.

6. Adaptation for Local Needs

The structure of the Procareful application has been carefully designed to ensure both ease of product adaptation to the specifics of new markets and effective management in diverse care environments. The application consists of two main components: the institution and user management system and the Senior application, which are mutually integrated and inherit the language version assigned by the Head Admin. In this way, the application maintains functional and linguistic uniformity at the national level.



Relationships between users of the application are based on a hierarchical system of roles, which allows precise management of individual functions and responsibilities. The highest role in the management structure is the Head Admin - the user responsible for overseeing all institutions in the country involved in the implementation of the care model and the Procareful application itself. Head Admin performs a key function, deciding, among other things, the language version, which is automatically assigned to all users in a given country, ensuring consistency of service at each level of the structure.

Under the Head Admin role are further administrative roles, such as Super Institution Admin and Institution Admin, which are responsible for managing specific care centers. Then there are operational roles, which include Formal Caregiver, Informal Caregiver and Senior Caregiver - the end consumer of the application's services. The Formal Caregiver is the professional caregiver, while the Informal Caregiver is the person most often associated with the senior on a personal basis, such as family or friends.

With such an expanded but clear role structure, the Procareful application can be effectively implemented and managed, while maintaining flexibility and consistency across countries and care centers.