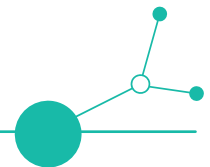


A3.2 - Innovation plan for long-term care facilities for older people

PP7 - CTU



Version 3
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Regional Innovation plan [Prague - Czech Republic]

1) Define and describe purpose for the innovation

Define a systematic innovation approach aligned with strategic goals and long-term success. Clearly outline the plan's intent to guide decisions, resource allocation, and stakeholder engagement. Please, consider the motivation for innovation and two frames of the innovation - ideal and realistic solution.

Purpose

The purpose of this innovation is to improve the safety, comfort, and overall quality of life of residents in long-term care (LTC) facilities by implementing a network of environmental sensors that continuously monitor key conditions (e.g., temperature, humidity, air quality, open windows, running water). Through this sensor network, timely responses to potential risks or discomforts can be ensured, thereby reducing preventable incidents and supporting proactive care strategies.

In addition to providing data for staff and facility management, the innovation also introduces the potential to use an interactive companion device, PetBot, as a communication channel for residents. PetBot can serve as a friendly, non-intrusive interface that relays selected environmental alerts in an understandable and comforting way, while also allowing residents to ask simple questions (e.g., "Is my room too cold?" or "What is the air quality today?").

A complementary innovation involves the development of cognitive games, designed to support mental agility, memory, and motor skills in older adults. These games are part of a broader vision for a digitally enriched care environment where safety, stimulation, and social interaction are equally prioritized. In the future, sensor data could even help optimize conditions for gameplay—for example, ensuring that rooms are quiet and comfortable during gaming sessions.

Motivation

Residents in LTC are particularly sensitive to environmental factors such as temperature fluctuations, poor air circulation, or high humidity. These conditions can result in discomfort or health risks. Manual monitoring is inconsistent and often reactive.

The sensor network addresses this by providing continuous oversight, supporting staff in proactive decision-making. The addition of PetBot strengthens the resident's role, enabling them to directly access environmental information in a simple, reassuring way. This reduces anxiety and increases autonomy.

Alongside environmental comfort, maintaining cognitive and motor skills is crucial for healthy aging. Without adequate stimulation, cognitive decline and reduced independence can accelerate. Cognitive games provide engaging and personalized ways to train memory, attention, and hand-eye coordination. Together, these innovations—environmental monitoring, PetBot, and cognitive games—form a holistic approach to LTC digital transformation, improving safety, autonomy, and quality of life.

Ideal Solution

The ideal solution is a fully integrated digital care ecosystem that combines environmental monitoring, interactive resident support, and cognitive stimulation. Such a system would:

- Continuously monitor environmental data in all relevant rooms.
- Detect anomalies and send real-time alerts to care staff.
- Automatically adjust building systems where possible.
- Visualize trends for preventive care planning.

- Integrate with PetBot to provide residents with a conversational interface for accessing selected environmental data and receiving alerts.
- Include cognitive games as part of the daily routine, providing personalized stimulation and opportunities for social interaction.
- Be non-intrusive, easy to use, and adaptable for both staff and residents.

Realistic Solution

A realistic first step is the deployment of a sensor network in selected high-risk or high-priority areas. This would:

- Send basic alerts to a central dashboard or mobile devices.
- Support timely interventions by staff.
- Be managed by IT staff and care leaders.
- Initially operate as a stand-alone system, with a roadmap for later integration into facility infrastructure.

In parallel, pilot testing of PetBot can be introduced, for example in common rooms, allowing residents to query environmental conditions directly. Likewise, cognitive games can be implemented in group activities, with staff facilitating sessions and collecting initial feedback on usability and engagement.

In this way, the purpose of the innovation is twofold: to safeguard residents through better environmental monitoring and to empower them with interactive technologies that enhance both safety and cognitive well-being.

2) Considered factors before a Innovation plan design

Review and integrate regional (and, if relevant, national) digital transformation policies, strategies, and guidelines. Focus on identifying regional priorities for LTC digital transformation, evaluating investment levels in care innovation, and recognizing the key elements for digital transformation as defined by policymakers. Evaluate impact on ecosystem, consider legal regulations and the need of processes transformation. Also identified bottlenecks and challenges.

Ecosystem Impact

The introduction of a continuous environmental monitoring system will transform the daily care ecosystem. By reducing reliance on repetitive manual checks, staff can dedicate more time to direct care and meaningful interactions with residents. The system will create a more data-informed environment, where risks are identified proactively rather than reactively.

The optional inclusion of PetBot extends this impact by directly involving residents. Instead of being passive subjects of monitoring, residents gain a supportive interface to access environmental information themselves.

In parallel, cognitive games represent another important layer of innovation. They stimulate mental and motor skills, encourage social interaction, and can be aligned with the digital care ecosystem. For example, sensor data about environmental comfort (quiet, lighting, temperature) could help identify the best conditions for game sessions, improving engagement and outcomes.

Legal Regulations

The innovation must comply with:

- National and EU data protection regulations (e.g., GDPR), especially when sensor data is linked to specific rooms or residents. Transparency about what is monitored and how data is used is crucial to avoid concerns of surveillance.
- Health and safety regulations regarding acceptable environmental conditions in LTC facilities.
- Certification requirements for electronic hardware deployed in care environments, ensuring safety, hygiene, and reliability.
- If PetBot is connected to the internet and responds to resident queries, additional safeguards must be implemented: ensuring that responses are safe, accurate, and appropriate for vulnerable populations. Internet connectivity may also raise concerns about exposure to unsuitable content, requiring careful configuration and monitoring.

The system must comply with GDPR and other national/EU rules, particularly regarding room-linked data. Transparency is essential to avoid concerns of surveillance. Certification of hardware is also required.

With PetBot, additional safeguards must ensure that internet-based answers are safe and appropriate. Similarly, cognitive games may collect data on reaction times or performance; this must be anonymized, securely stored, and explained to residents and families to maintain trust.

Existing Technology Infrastructure

The baseline infrastructure in many LTC facilities is limited:

- Wi-Fi coverage may be inconsistent across rooms, affecting both sensor performance and PetBot connectivity.
- Centralized dashboards or integration platforms may not yet exist.
- IT staff are often limited in number and capacity.

Despite these constraints, where basic digital documentation or communication tools are already in place, the new system can build on existing foundations. PetBot, for example, can be tested in shared spaces first, where connectivity is more stable, before being expanded to resident rooms. PetBot can be introduced gradually, starting with communal spaces. For cognitive games, infrastructure requirements are modest (e.g., NFC readers, Bluetooth devices, large buttons). Still, stability of the digital environment—consistent internet, reliable devices—is necessary for both innovations to scale.

Budgetary Constraints

Financial resources for innovation are often limited in LTC. Key challenges include:

- Initial capital for large-scale deployment of sensors in every room.
- Operating costs, including battery replacements, software updates, and IT support.
- Contracts for maintenance and external technical support.

Funding strategies must therefore include phased implementation, external innovation grants, and pilot studies to demonstrate value before full investment. PetBot integration, while adding costs, can be introduced selectively—such as in communal areas or for residents most open to technological interaction—to balance expenses with impact.

Financial limits apply to both sensors and interactive technologies. External grants and phased deployment will be required.

Introducing cognitive games has relatively low cost compared to large sensor systems, yet brings visible benefits in resident engagement and staff satisfaction. This makes them attractive as early wins in the digital transformation journey.

Resident Needs and Preferences & Staff Experience

Residents:

- Expect comfort without excessive intrusion. Some may have concerns about privacy or feel uneasy about visible devices. Transparent communication is essential.
- PetBot can improve acceptance by personalizing the interaction—presenting alerts in a friendly, non-threatening way. However, not all residents may want or be able to use such a device. Individual preferences must be respected.
- Many residents show strong motivation for cognitive games, especially when they include familiar physical elements (dice, cards, pictures) and social aspects.

Staff:

- Generally welcome tools that help them act quickly and decisively. However, if alerts are too frequent or it is too difficult to interpret the cause, stress and “alert fatigue” may result.
- Training and participatory design (involving staff in the setup of dashboards, thresholds, and alert wording) are key.
- Some staff may view PetBot as a distraction or “extra responsibility.” To address this, the device should primarily serve residents directly, while staff remain the main point of care escalation.
- With cognitive games, staff can act as facilitators or co-players. However, this dual role supports engagement but requires training and time allocation.

Process Transformation

The innovation shifts monitoring from manual to digital. Key impacts include:

- Reduced need for routine room-by-room checks.
- New workflows for responding to alerts, including assigning responsibility for follow-up actions.
- Adjustments to handovers and care documentation, as environmental data may need to be included in daily notes.
- PetBot introduces a cultural change: residents can query environmental conditions themselves, potentially prompting new staff-resident interactions (“PetBot told me my room is a bit cold—can you check it?”). This requires clear communication channels so staff see PetBot as supportive, not disruptive.

The innovation shifts monitoring from manual to digital. Key impacts include new workflows for responding to alerts and integration of environmental data into documentation.

Cognitive games introduce complementary transformations: care staff may incorporate gaming sessions into daily routines, track residents’ performance data, and use results to inform personalized care. When combined, environmental monitoring can ensure optimal game conditions, while games themselves foster well-being and social activity.

Identified Bottlenecks and Challenges

- Poor Wi-Fi coverage or unstable power supply in certain rooms.
- Unclear ownership of alerts: balancing roles between care staff, facility maintenance, and IT.
- Risk of staff ignoring frequent or irrelevant alerts.
- Resistance to changing established routines.
- Insufficient training or follow-up support.
- With PetBot: varying resident acceptance, risk of over-reliance on automation, and the need to ensure that responses remain simple and reliable.
- With cognitive games: ensuring enough staff support, avoiding technology rejection by residents unfamiliar with digital tools, and maintaining accessibility (large buttons, simple layouts).

3) Explore various levels of digitization, determine level of digitalization

Select the appropriate digital maturity level for your innovation—from Basic Digitization to Full Digital Transformation—and indicate the corresponding EU Technology Readiness Level (TRL). Describe your choice in terms of:

- *Technology Adoption: Implementation of digital tools across the organization.*
- *Process Integration: How digital technologies are embedded in core workflows.*
- *Data Utilization: Use of data for decision-making and operational improvement.*
- *Innovation Capability: The organization's ability to drive digital innovation.*
- *Cultural Shift: The extent to which digital skills and mindsets are integrated into the culture.*

The innovation plan aims to move LTC facilities from basic digitization (isolated digital records, limited use of technology) toward digitalization, where systems actively support decision-making, empower residents, and provide value-added services. The proposed sensor network, supported by interactive interfaces like PetBot and complementary cognitive games, positions the organization on a clear path toward higher digital maturity.

Current level: Partial digitization

- Some care documentation is already digital, but environmental data is not systematically collected or used.
- Staff rely primarily on manual checks and personal judgment.
- Digital tools are fragmented, with limited integration into care routines.

Target level: Digitalization (Level 3)

The goal is to move from basic digitization (Level 2) toward digitalization (Level 3) by:

- Introducing a sensor system that collects real-time environmental data.
- Providing actionable alerts and dashboards to staff for timely intervention.
- Offering residents a friendly interface—PetBot—through which they can access relevant environmental information and interact with the system.
- Expanding digital stimulation through cognitive games, which represent another aspect of digitalization by providing personalized, data-informed activities that support health and well-being.

Technology Adoption

Currently:

- Staff use basic digital tools such as tablets or phones for documentation and communication.
- Very limited use of automated monitoring or resident-facing technology.

Plan:

- Gradual rollout of sensors in priority areas.
- Integration of PetBot as a pilot resident-facing interface for communicating alerts and answering simple queries.
- Introduction of cognitive games that do not rely on mouse/keyboard input, making them accessible for seniors with motor limitations. These games expand the technology base beyond monitoring into active resident engagement.
- Technical support and training provided during the early adoption phases.

Process Integration

Currently:

- Environmental control is manual and inconsistent.
- Cognitive stimulation depends heavily on staff availability and group activities, often without structured feedback.

Goal:

- Sensor alerts integrated into existing care workflows (handover notes, emergency protocols).
- PetBot to serve as a supplementary channel, bridging staff actions and resident awareness.
- Cognitive games integrated into daily activities, supported by staff facilitators and eventually producing data (reaction time, accuracy) that could inform care planning.
- Together, these innovations create a more comprehensive digital ecosystem where safety, engagement, and well-being are supported in parallel.

Data Utilization

Currently:

- No structured use of environmental or cognitive performance data.
- Information is anecdotal and reactive.

Goal:

- Use real-time data for safety and comfort decisions (e.g., preventing dehydration or overheating).
- Aggregate environmental data for long-term trend analysis.
- Collect cognitive performance metrics from game sessions (e.g., attention span, memory performance) to track progress and adjust interventions.
- Over time, explore links between environmental conditions and cognitive engagement (e.g., whether certain conditions improve focus during games).

Innovation Capability

Strengths:

- Management is open to testing new digital tools.
- Existing pilot projects (e.g., EU-funded) create momentum.

Limitations:

- Limited in-house experience with complex digital ecosystems.
- Dependence on external technology partners.

Support Need:

- Guidance on scaling sensor-based systems.
- Expert input on safe and ethical deployment of PetBot and cognitive-game platforms.
- Allocation of time and resources to innovation champions within the facility.

Cultural Shift

Challenges:

- Some care staff are skeptical of technology, recalling past failures.
- Residents may initially feel uncertain about robotic companions or digital games.

Opportunities:

- Frame digitalization as supportive, not replacing human care.
- Showcase success stories (e.g., “Sensor + PetBot prevented cold stress” or “Cognitive games helped residents stay engaged and social”).
- Identify “digital champions” among staff to build trust.
- Encourage residents to explore cognitive games together, making them social and enjoyable rather than clinical.

4) Define and describe objectives (with dependencies and indicators) for the innovation (related to the purpose)

Set clear, SMART (specific, measurable, achievable, relevant, and time-bound—that) goals targeting outcomes like enhanced product features, improved client satisfaction, or cost reduction. Include defined KPIs and success criteria to track progress and resolve any conflicting aims early.

Objective 1: Window and Temperature Monitoring for Resident Safety

- Goal: Install sensors to detect open windows and monitor indoor temperature in resident rooms, especially during cold seasons, to prevent health risks such as cold stress, respiratory problems, or dehydration.
- Indicator(s):
 - 95% of window-opening events are detected and logged.
 - 90% of temperature drops below 20°C trigger a timely alert.
 - Response time under 10 minutes for 80% of critical alerts.

- Priority: Must-have | short-term
- Risk & Mitigation:
 - Risk: Wi-Fi instability → Mitigation: Conduct signal testing, install boosters.
 - Risk: Staff ignoring alerts → Mitigation: Keep messages simple, involve staff in alert design.
 - Link to PetBot: In later phases, PetBot may be configured to gently inform residents about critical environmental changes, e.g., “It’s a bit chilly, please ask staff for help.”

Objective 2: Staff Training for Sensor Alert and Resident Interaction

- Goal: Ensure all care staff are trained not only to understand and respond to environmental alerts but also to facilitate residents’ interaction with PetBot and digital cognitive games.
- Indicator(s):
 - 100% of care staff complete training.
 - 85% of staff report confidence in handling the system (post-training survey).
 - 80% correct responses during simulation testing.
 - At least 60% of staff express readiness to support residents in using PetBot and/or games.
- Priority: Should-have | short- to mid-term
- Risk & Mitigation:
 - Risk: Staff turnover limits long-term effect → Mitigation: Integrate into onboarding and repeat annually.
 - Risk: Resistance to new tech → Mitigation: Use peer-led training, demonstrate success stories.
 - Risk: Added burden from supporting games → Mitigation: Frame games as part of social activities rather than extra tasks.

Objective 3: Data Aggregation for Long-Term Comfort and Engagement Analysis

- Goal: Collect and analyze environmental and resident-interaction data over 6-12 months to identify trends in comfort issues and engagement levels. Link findings to improvements in facility routines and resident well-being.
- Indicator(s):
 - 100% of installed sensors produce usable data continuously.
 - Monthly dashboard reports delivered to management.
 - At least 3 environmental or activity-related adjustments made within one year.
 - Basic gameplay data (reaction times, participation rates) reviewed quarterly.
- Priority: Could-have | mid- to long-term
- Risk & Mitigation:
 - Risk: Data overload → Mitigation: Predefine KPIs and use simple visuals.

- Risk: Staff disengage with reports → Mitigation: Discuss findings in team meetings, link to outcomes (e.g., improved sleep, reduced falls).
- Risk: Residents may feel games are too difficult → Mitigation: Adaptive game design with scalable difficulty.

Objective 4: Resident Empowerment through PetBot

- Goal: Deploy PetBot as a resident-friendly communication interface that can answer simple questions about environmental conditions (e.g., “What is the room temperature?”) and provide reassurance. Expand functionality gradually to include general information and social features.
- Indicator(s):
 - Pilot at least 3 PetBot devices in common or resident rooms.
 - At least 70% of participating residents interact with PetBot at least once per week.
 - 60% of users report feeling reassured or more independent thanks to PetBot (resident survey).
- Priority: Could-have | pilot phase, expandable
- Risk & Mitigation:
 - Risk: Some residents resist robot interaction → Mitigation: Use voluntary participation, offer staff/family introduction.
 - Risk: PetBot misunderstood as staff replacement → Mitigation: Clearly position as support, not substitute.

Objective 5: Cognitive Stimulation through Personalized Digital Games

- Goal: Introduce and expand a suite of digital cognitive games tailored for seniors, focusing on memory, attention, reaction, and fine motor skills. Use these games to maintain cognitive health, promote social interaction, and provide measurable performance data.
- Indicator(s):
 - At least 3 game types introduced within 6 months (e.g., NFC-based, dice-based, attention/reaction).
 - 50% of residents participate in at least one game session per week.
 - Performance data collected for 80% of sessions.
 - Positive feedback from ≥70% of participants and staff facilitators.
- Priority: Should-have | medium-term
- Risk & Mitigation:
 - Risk: Low adoption among less tech-savvy residents → Mitigation: Use tangible, familiar objects and group play.
 - Risk: Lack of staff time to facilitate → Mitigation: Integrate games into existing social activity schedules.
 - Risk: Data privacy concerns → Mitigation: Store gameplay data anonymized and securely.

5) Define and describe development requirements and processes for the innovation

Describe the process for planning, designing, and deploying the innovation. Define clear milestones and scope, ensuring that digital innovations are smoothly integrated into existing workflows. Evaluate technology needs, assign key roles with specific responsibilities, and incorporate diverse stakeholder perspectives to preempt challenges. Define how the innovation will be realized, whether you want to use in-house development or you plan to use external developers.

Innovation involves planning, designing, and deploying a network of environmental sensors, complemented by the integration of PetBot as a resident-facing interaction interface and the implementation of digital cognitive games. Together, these elements support safety, empowerment, and cognitive well-being, contributing to a holistic digital transformation in LTC.

Roles and Responsibilities

- Management
 - Set strategic direction and ensure alignment with organizational goals.
 - Approve budgets, manage risks, and prioritize implementation phases.
 - Use sensor and gameplay data reports for high-level decision-making (e.g., investments in building systems or activity programs).
 - Support communication with residents and families to build acceptance of both PetBot and games.
- Care Staff
 - Serve as primary users of environmental alerts and local decision-makers.
 - Provide feedback on alert clarity, PetBot usefulness, and gameplay integration into daily routines.
 - Act as facilitators for game sessions, ensuring inclusivity and motivation.
 - Report malfunctions or unexpected resident responses.
- IT Staff
 - Install and maintain the sensor network and Wi-Fi infrastructure.
 - Ensure secure and stable data transfer, system uptime, and backup.
 - Support PetBot connectivity and update its software to ensure safe responses.
 - Provide technical support for cognitive game devices (e.g., NFC readers, Bluetooth dice, large buttons).
- Developers
 - Customize data flows between sensors, dashboards, PetBot, and game platforms.
 - Adjust thresholds, user interfaces, and backend processes based on pilot feedback.
 - Build modularity to allow integration of new data sources (e.g., combining environmental and gameplay data for advanced analytics).
 - Implement adaptive features in games (e.g., automatic difficulty adjustment).

- Residents and Families
 - Provide feedback on usability, acceptance, and comfort.
 - Participate in co-design workshops for games, ensuring content reflects user preferences and cultural contexts.

Development Process and Phases

- Preparation
 - Site survey of Wi-Fi and power coverage.
 - Hardware and software procurement (sensors, PetBot units, game kits).
 - Privacy impact assessment and resident communication plan.
- Phase 1: Pilot Installation and Functionality Testing
 - Install sensors in 5-10 rooms; verify data transmission.
 - Introduce PetBot in one common room as a trial, focusing on environmental queries.
 - Test initial cognitive games with a small resident group, ensuring accessibility.
 - Collect baseline data on resident comfort and engagement.
- Phase 2: Training and Early Adoption
 - Conduct staff training on interpreting sensor alerts, guiding residents in using PetBot, and facilitating games.
 - Scenario-based tests (e.g., open window in winter night, resident asks PetBot for information).
 - Collect resident feedback on PetBot's voice, interaction style, and usefulness.
 - Use co-creation workshops to refine game design and adapt to residents' needs.
- Phase 3: Pilot Evaluation and Iteration
 - Review system data (sensor reliability, alert responses, gameplay participation).
 - Adjust thresholds, alert wording, and PetBot's dialogue to avoid overload.
 - Expand game library based on resident interest (e.g., memory, attention, reminiscence therapy).
 - Compare comfort and engagement outcomes with baseline.
- Phase 4: Scale-Up and Integration
 - Extend sensor installation to entire ward or facility.
 - Deploy PetBot to selected resident rooms and group spaces.
 - Make cognitive games a routine activity, supported by staff and volunteers.
 - Integrate environmental and cognitive performance data into regular reports to management.

Project Coordination

- One designated project coordinator from the facility ensures milestone tracking and internal communication.
- External vendors (sensor suppliers, PetBot provider, game developers) collaborate directly with IT and development teams.
- A cross-functional working group (care staff, IT, management, therapists) meets regularly to align perspectives.
- A resident advisory group is involved in pilot testing of PetBot and games.

Implementation Control Approach

- Each development phase includes Go/No-Go checkpoints to evaluate success before scaling up.
- Agile methods are applied: feedback is gathered continuously and adjustments made in short cycles.
- Success stories (e.g., “Sensor prevented overheating” or “Cognitive game improved social interaction”) are communicated to maintain motivation.

Cooperation on Innovation

- Staff involvement in early discussions (e.g., choosing sensor placement, alert wording, game themes).
- Open dialogue between care staff, IT staff, residents, and families.
- Feedback channels established (forms, digital board, regular check-ins).
- Shared ownership of success stories: residents, staff, and management all recognized as contributors.

Evaluation and Delivery Milestones

- Milestone 1: Sensors installed and tested in pilot rooms (Month 1).
- Milestone 2: PetBot pilot functional in one common area (Month 2).
- Milestone 3: First gameplay sessions with resident feedback completed (Month 2-3).
- Milestone 4: Staff training completed, with $\geq 80\%$ demonstrating competence (Month 3).
- Milestone 5: Monthly reports presented to management (Month 3+).
- Milestone 6: Go/No-Go for facility-wide scale-up (Month 4).

Implementation Evaluation and Testing

- Utility tests
 - Confirm sensor functionality under different conditions (e.g., cold room, open window).
- Scenario tests
 - Simulate real care situations (e.g., window left open during winter night).
 - Measure how fast and appropriately staff respond.
- Collect qualitative feedback on usability and stress level after alerts.

Allowable Rollback Criteria

- Rollback pilot or pause expansion if
 - More than 15% of alerts are false or irrelevant.
 - Staff report increased confusion or burden.
 - Data flow is unreliable for more than 3 days in a row.
- Revert to manual processes in affected units if technical fixes require more than 5 working days.

Technology Selection and Flexibility

- Sensors must be
 - Wireless, low-power, and suitable for care environments.
 - Capable of real-time or near-real-time reporting.
- System must allow
 - Manual adjustment of thresholds.
 - Easy user management.
 - Data export for long-term evaluation.
- PetBot: Configurable responses, internet-enabled with safety filters, user-friendly for older adults.
- Cognitive games: Tangible, accessible, multi-language, scalable difficulty, capable of collecting gameplay metrics.
- Open protocols and APIs prioritized for future integration (e.g., connecting game data with health records or linking sensors to HVAC systems).

Reference Documents and Agreements

- Internal
 - Data Privacy Impact Assessment (DPIA)
 - Internal SOPs on response to environmental alerts
 - Staff training checklist
- External
 - Supplier agreement (hardware, warranty, SLA)
 - Integration agreement (if third-party system is used)
 - Regulatory compliance certificate for sensor devices

6) Define and describe implementation requirements and plan for the innovation

Deploy the innovation in manageable phases—from testing and pilot projects with care teams to a full-scale launch and review. Define goals, timelines, and resource allocations for each phase, and track progress using metrics like time-to-implementation, staff adoption rates, and cost efficiency.

The implementation plan is designed as a phased rollout, beginning with pilot testing in selected rooms and activity areas, followed by structured staff training, evaluation, and gradual scale-up. The innovation covers three interconnected components: environmental sensor monitoring, PetBot as a resident interface, and cognitive games for stimulation and engagement.

Branch 1: Sensor Installation & System Functionality

- Objective: Deploy and verify functioning of environmental sensors in selected rooms, ensuring stable connectivity and reliable alerts.
- Milestones
 - Sensors installed and transmitting data to the dashboard.
 - Alerts tested (e.g., window opening, temperature drop).
 - Staff confirm alerts are understandable and actionable.
- Indicators
 - $\geq 90\%$ of sensors online and delivering valid readings.
 - $\leq 10\%$ of alerts identified as false or irrelevant during pilot.

Branch 2: PetBot Deployment & Resident Interaction

- Objective: Introduce PetBot as an optional, resident-facing communication interface, initially in common rooms, later in individual resident rooms.
- Milestones
 - 2-3 PetBot units configured and connected to the sensor system.
 - Pilot residents trained to ask basic questions (e.g., “What’s the temperature?”).
 - Internet connection tested with restricted, safe information access.
- Indicators
 - At least 60% of pilot residents interact with PetBot weekly.
 - 70% of pilot users rate PetBot’s interaction as “helpful” or “reassuring.”

Branch 3: Cognitive Games Introduction & Integration

- Objective: Implement digital cognitive games tailored to seniors’ needs, focusing on memory, attention, fine motor skills, and social engagement.
- Milestones
 - At least three game types piloted (e.g., NFC-based memory, dice-based tasks, attention/reaction buttons).
 - Group game sessions organized weekly in common spaces.
 - Gameplay data collected to assess usability and engagement.
- Indicators
 - $\geq 50\%$ of residents in pilot ward participate in at least one session.
 - $\geq 70\%$ positive feedback from participants and staff facilitators.
 - Data recorded for $\geq 80\%$ of sessions (reaction time, participation rate).

Phases Overview

Phase 1 - Pilot Setup & Functionality Test

- Time: 1.5 months
- Activities
 - Sensors installed in 5-10 rooms.
 - PetBot deployed in one common area for basic environmental queries.
 - First small-scale game sessions tested with volunteers.
- Indicators
 - ≥90% sensors operational.
 - PetBot successfully answers 80% of resident queries.
 - ≥60% of pilot participants report games as enjoyable.

Phase 2 - Staff Training & Scenario Testing

- Time: 1.5 months
- Activities
 - Training for care staff on sensor alerts, PetBot interaction, and game facilitation.
 - Scenario-based tests (e.g., resident asks PetBot about cold room; staff responds).
 - Collect qualitative feedback from residents and staff.
- Indicators
 - ≥80% of staff confident in handling alerts and PetBot.
 - ≥75% correct responses during simulations.
 - ≥50% of residents engaged in at least one game session per week.

Phase 3 - Data Use & Operational Adjustment

- Time: 2 months
- Activities
 - Full pilot zone (one ward) equipped with sensors and PetBot.
 - Regular game sessions integrated into weekly activity schedules.
 - Monthly reports generated combining sensor and game data.
- Indicators
 - At least 2 operational adjustments (e.g., heating schedules, activity timing) based on data.
 - ≥70% of staff provide positive feedback on system usefulness.
 - Cognitive game data used in at least one resident care meeting.

Phase 4 - Facility-Wide Scale-Up

- Time: 4-6 months after pilot success

- Activities
 - Sensors expanded to full facility.
 - PetBot deployed to selected resident rooms and activity areas.
 - Game library expanded with new content, adaptive difficulty, and multilingual support.
- Indicators
 - ≥80% of residents have access to at least one of the three innovations.
 - Long-term data informs at least 3 facility-wide improvements per year.

Risk and Change Management Integration:

Implementing an environmental sensor system in LTC involves not only technical and organizational changes but also shifts in routines, staff roles, and mindset. Proactive risk and change management are embedded across phases and branches to ensure smooth adoption and long-term success.

Branch 1: Sensor Installation

- Risk: Connectivity issues due to Wi-Fi coverage.
 - Mitigation: Pre-installation survey, boosters where needed.

Branch 2: PetBot Deployment

- Risk: Some residents hesitant to interact with robotic devices.
 - Mitigation: Voluntary use, friendly introduction, family involvement.
- Risk: Alert fatigue if PetBot relays too many system notices.
 - Mitigation: Configure PetBot to communicate only selected, relevant alerts.

Branch 3: Cognitive Games

- Risk: Limited staff availability to support games.
 - Mitigation: Schedule games within existing activity sessions, involve volunteers.
- Risk: Residents with advanced cognitive decline unable to participate.
 - Mitigation: Provide adaptive game levels and group play.

Change Management Strategy

1. Communication & Engagement

- Start internal communication **before rollout** with clear answers to “Why this change?”
- Use storytelling: “This sensor helped us catch an issue before it became a problem.”

2. Staff Involvement

- Involve care staff in early testing and scenario creation, choosing alert formats, PetBot features, and game content

- Create space for **bottom-up suggestions** (e.g., a shared feedback board or digital form).

3. Support & Reinforcement

- Appoint “Digital Care Champions” to support their peers during and after rollout.
- Reinforce use through **visual reminders**, regular updates, and feedback loops.

4. Flexibility and Iteration

- Build in feedback checkpoints after each phase to refine thresholds, PetBot dialogues, and game mechanics
- Treat implementation as **an evolving process**, not a one-time event.

Built-In Rollback and Adaptation Points

(Aligned with previous Implementation section)

- After Phase 1: Technical rollback allowed if $\geq 20\%$ sensors fail or cannot connect.
- After Phase 2: Process rollback or delay if $< 60\%$ staff feel confident with the system.
- After Phase 3: Full pilot zone if the system has no measurable effect and high resistance is reported.
- After Phase 4: Strategic pivot if the system has no measurable effect and high resistance is reported.

7) Define and describe reflection (testing, validation, verification) requirements and plan for the innovation

Regularly assess the process to address challenges such as technical issues, resistance, or resource limits. Schedule checkpoints to review progress and, based on clear criteria like unmet KPIs or negative feedback, decide when to adjust or revisit earlier steps.

Regular assessment of the innovation is essential to ensure that the system works reliably, is accepted by staff and residents, and produces measurable benefits. Reflection covers technical validation, staff and resident acceptance, and integration into daily workflows.

Unit Testing

Purpose: Verify that each component works correctly in isolation before integration.

- Sensors network
 - Test each device in controlled conditions (e.g., open window = alert triggered).
 - Validate thresholds for temperature, humidity, and air quality.
 - Confirm dashboard displays correct real-time data.
- PetBot
 - Confirm accurate retrieval of sensor data (e.g., “Room temperature is 21 °C”).
 - Test voice clarity, response time, and internet-filtered answers.
 - Validate safe fallback responses when PetBot cannot answer a query.
- Cognitive games
 - Test individual devices (NFC reader, Bluetooth dice, large buttons).

- Verify that tasks load correctly and produce accurate performance data.
- Confirm accessibility features (font size, audio instructions, color contrast).

Success Criteria:

- ≥95% of units pass functional tests.
- No false alerts or incorrect answers in controlled trials.
- Cognitive game devices perform consistently without technical interruption

Integration Testing

Purpose: Ensure that components function correctly together in real-world conditions.

- Sensors + Dashboard + Staff
 - Simulate care scenarios (e.g., window left open, staff alerted, issue resolved).
 - Measure staff response time and clarity of communication.
- Sensors + PetBot + Residents
 - Test scenario: temperature drops, PetBot informs resident, resident requests staff support.
 - Observe whether residents understand and trust PetBot's communication.
- Cognitive games + Residents + Staff
 - Run group sessions where staff facilitate games, ensuring both fun and data collection.
 - Observe user experience: ease of play, engagement, frustration points.
 - Validate whether data from games can be integrated into simple reports.

Success Criteria:

- ≥80% of alerts acted upon within 10 minutes.
- ≥70% of residents report PetBot's responses are "helpful" or "clear."
- ≥75% of residents engaged in games report enjoyment or stimulation.

Continuous Integration with Implementation:

Purpose: Use reflection at the end of each implementation phase to refine processes and systems before scaling further.

- Staff Feedback
 - Short surveys and interviews after each phase.
 - Key questions: "Are alerts useful?" "Do you trust PetBot?" "Are games enjoyable and easy to manage?"
- Resident Feedback
 - Simple rating scales ("Was PetBot helpful?" "Did you enjoy today's game?").
 - Small focus groups with residents and family members.
- Data-Based Validation
 - Environmental data reviewed monthly for false/ignored alerts.

- Gameplay data analyzed for participation rates and progress.
- Compare pilot ward outcomes with non-pilot wards (comfort, engagement, staff time).
- Examples of Integration:
 - If staff report PetBot is “too talkative,” adjust settings to limit non-essential notifications.
 - If residents say a game is too difficult, enable adaptive difficulty scaling.
 - If Wi-Fi gaps affect sensor or PetBot performance, IT addresses coverage before scale-up.

Benefits of Reflection Approach:

- Technical Assurance
 - Problems identified early before full rollout.
- User Acceptance
 - Staff and residents feel their feedback shapes the system, increasing trust.
- Iterative Improvement
 - Each phase improves usability, reduces burden, and enhances outcomes.
- Holistic Validation
 - Not only environmental safety, but also resident stimulation and empowerment are tested.

8) Define and describe delivery and sustainability requirements and plan for the innovation

Ensure the innovation is viable and scalable by planning for ongoing development, maintenance, and regular evaluations. Use both tangible outcomes (e.g., improved data use and reduced workload) and intangible benefits (e.g., increased client satisfaction) to guide future enhancements.

To ensure that the innovation delivers lasting value, it is necessary to plan for reliable delivery, long-term sustainability, and gradual expansion. Sustainability must be approached holistically, covering the technical, financial, organizational, and cultural dimensions of LTC.

Delivery requirements and rules:

This section defines the conditions and expectations for delivering the sensor-based system, ensuring that it meets quality, usability, and operational criteria – both in a Minimal Product Value (MPV) version and in a Full Version.

Core Delivery Rules (applies to all versions):

- Functionality First
 - Sensors must reliably detect environmental conditions and trigger alerts.
 - PetBot must consistently deliver correct responses and reassure residents.
 - Cognitive games must run smoothly and offer clear, engaging tasks.

- Usability
 - Dashboards and alerts must be understandable in daily care workflows.
 - PetBot must use simple, friendly language with clear audio.
 - Games must be easy to set up, playable without advanced technical skills.
- Data Protection:
 - Compliance with GDPR and relevant national regulations.
 - Sensor, PetBot, and game data stored securely and anonymized where possible.
- Documentation and Support:
 - Technical manuals, troubleshooting guides, and staff training packages included.
 - Ongoing support channels available for staff and residents.

Minimal Product Value Version (MPV)

Purpose: Demonstrate feasibility, gather feedback, and build staff and resident acceptance.

- Sensors: Installed in 5-10 rooms with highest environmental risk.
- PetBot: 1-2 units piloted in common spaces, offering only basic environmental queries.
- Cognitive games: One or two game types introduced (e.g., NFC-based memory, dice-based tasks).
- Training: One staff training session covering all three components.
- Data Use: Monthly manual reports on environmental conditions and resident engagement.

Full Version

Purpose: Provide a complete, scalable system for long-term use.

- Sensors: Deployed facility-wide, with multiple sensors per room.
- PetBot: Available in both communal areas and selected resident rooms, gradually expanding functionality (e.g., environmental data + safe internet queries).
- Cognitive games: Full library available (memory, attention, motor skills, reaction time), integrated into daily activity schedules.
- Integration: Alerts and game participation data linked into care documentation workflows.
- Ongoing Support: Regular updates, technical support, and continuous staff training.

Sustainability requirements:

To ensure the system remains functional, useful, and supported over the long term, the following sustainability aspects must be addressed:

Technical Sustainability

- Maintenance plan for sensors (battery replacement, calibration every 12-18 months).
- IT support for connectivity, PetBot software updates, and troubleshooting.
- Game hardware maintained with clear instructions for replacement parts.

- Platform flexibility to integrate future systems (e.g., smart HVAC, AI-based adaptive gaming).

Financial Sustainability

- Total cost of ownership estimated for all three components (hardware, software, updates, training).
- MPV funded via innovation projects/grants; long-term adoption integrated into facility budgets.
- Expansion supported through phased rollouts or co-financing from health and social programs.
- Cost-benefit demonstrated: reduced staff burden (sensor alerts), improved resident independence (PetBot), enhanced engagement (games).

Organizational Sustainability

- Ongoing training packages for new staff and volunteers.
- Designated responsibility for each component:
 - Sensors = IT and care leaders.
 - PetBot = activity coordinators and nursing staff.
 - Cognitive games = activity leaders/therapists.
- Clear escalation pathways: who responds to alerts, who supports residents with PetBot, who organizes games.

Cultural and Strategic Sustainability

- Promote a culture of data-informed care: use sensor and game insights in team meetings.
- Share success stories (e.g., PetBot reducing anxiety, games improving memory and social interaction).
- Regular review of resident preferences to ensure innovations remain relevant.
- Strategic alignment with regional/national digital transformation goals in healthcare and elder care.

Long-Term Vision

Over time, the innovation can evolve into a fully integrated care ecosystem:

- Sensors not only detect but also automatically regulate building systems.
- PetBot expands from answering questions to acting as a friendly daily companion, providing reminders or even facilitating game participation.
- Cognitive games become more adaptive through AI, integrating with telehealth platforms for remote monitoring of cognitive function.
- This evolution ensures that LTC facilities are not only safer but also more engaging, interactive, and supportive of residents' independence and dignity.

