

A Business Model for Digital Healthcare Environments: An Organic Approach and a Use Case for Handling Cognitive Impairment

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Abstract: Ageing has significant impacts on the organization of healthcare systems and on social inclusion—especially for elderly people affected by Cognitive Impairment (CI). These people are significantly exposed to undeniable risks that can affect their health and wellbeing (falling, malnutrition, hygiene issues, etc.) – especially when living alone. This paper defines a Business Model (BM) allowing independent living for elderly people affected by CI. This BM include: (i) an up-to-date, modular, flexible and scalable organizational model describing the activities to be accomplished by regulators and service suppliers; and (ii) a digital platform based on innovative and easy-to-replicate information and communication technologies. The organic approach to the development of the BM is then focused in an Italian use case as a part of “DECI”, a “Horizon 2020” project with four pilot projects in Israel, Italy, Spain and Sweden.

1 INTRODUCTION

The prevalence of Cognitive Impairment (CI) in elderly patients is one of the key issues in Western Countries since it involves loss of memory, cognitive slow down, aphasia, apraxia, sensorial and movement deficit, personality and mood disorders (Alexander et al. 2015; Rizzi et al. 2014). The elderly people with cognitive limits - especially those living in solitude - are significantly exposed to undeniable risks for their own safety: falling, malnutrition or unhealthy nutrition, hygiene issues due to lack of mobility, isolation and depression (Alzheimer’s Association 2016).

The needs of these patients range from daily aid to dedicated medical assistance (Alzheimer’s Association 2016; Miranda-Castillo et al. 2013). Though digital technologies can be one key lever to answer these needs, most of current solutions are immature for mass implementation.

In this context, the goal of this paper is to define a Business Model (BM) for supplying assistive services to elderly people affected by CI. This BM will include: (i) an up-to-date, modular, flexible and scalable organisational model describing the roles and the activities to be accomplished by policy makers and service suppliers; and (ii) a digital platform based on innovative and easy-to-replicate

Information and Communication Technologies (ICT) streamlining and simplifying the flow of information and the communication among the various key stakeholders.

2 METHODS

This paper is based on DECI – Digital Environments for Cognitive Inclusion – a project funded by the European Commission under the Horizon 2020 program (grant agreement No 643588) that is aimed at improving a healthy lifestyle for elderly people affected by CI, passing through a system monitoring vital signs, treating and managing diseases (Locatelli et al. 2015).

DECI Consortium is led by Fondazione Politecnico di Milano (Italy) and involves partners from five different countries (Italy, Sweden, Spain, Israel and The Netherlands). The consortium merges academic and research competences, care and social-care providers, healthcare authorities, ICT industry and their broad network of stakeholders. Four pilots, involving 100 to 250 patients each, will allow assessing the feasibility, the effectiveness and the potential economic benefits of the proposed measures

within specific local healthcare systems and real-life environments in Israel, Italy, Spain and Sweden.

The overall research process followed to develop the BM as well as the related processes encompassed three subsequent phases that are depicted in Figure 1 and described in the following paragraphs.

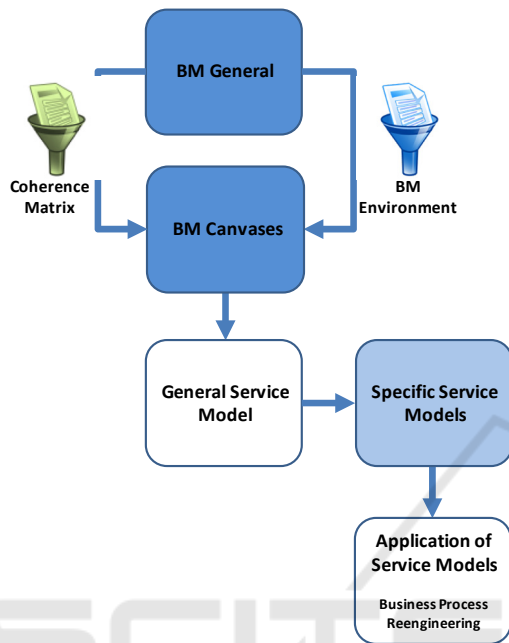


Figure 1: Research process.

2.1 First Phase

A literature review has been conducted to identify the most relevant articles dealing with the state of the art, good practices and trends related to the digital solutions for assisting elderly people with CI. The analysis of these articles allowed producing a general BM to focus the main variables that increase the likelihood of providing effective digital services.

Web of Science™ and Google Scholar™ have been used to research the articles. The literature has been analysed according to two complementary frameworks.

Initially, we relied on the STOF framework (Bouwman et al. 2008), which provides an overall picture of a BM from four interrelated perspectives—service, technology, organization and finance.

Next, we progressively deepened each insight through the Business Model Canvas (BMC) framework (Osterwalder and Pigneur, 2010), which allowed focusing on key design elements.

2.2 Second Phase

The second phase of the research was based on two

steps that allowed to obtain, starting from the general BM developed through the first phase, the $BM_{Canvases}$ and, then, the Service Models (SMs) depicted in Figure 1. $BM_{Canvases}$ represent the Country-specific subsets of the elements included within the general BM. SMs contain configurations mainly focused on value propositions in all the considered Countries—with an emphasis on common aspects to be exploited.

The first step is made through two tools: (i) the Business Model Environment (BME) (Osterwalder & Pigneur 2010); (ii) a Coherence Matrix (CM). On the one hand, these tools have been used to reduce the multitude of elements proposed in the general BM. On the other hands, they allow prioritizing the required activities for the implementation of the pilot projects—distinguishing among relevant and irrelevant elements.

The BME organizes and describes the key contextual variables useful to synthetically characterize each Country involved in the research, according to the four macro-areas: (i) key trends; (ii) macro-economic forces; (iii) industry forces; (iv) market forces.

The CM has been developed by the research group and is characterized by the following five dimensions: (i) country; (ii) customer segment; (iii) functionalities; (iv) actions to address the needs of the patient and of the overall system; (v) relevance of the specific need. The CM describes the underlying interrelations among these dimensions and allows discerning between: (a) coherent and incoherent pairs functionality-action to address the need (i.e. need of the patient or of the overall system); (b) relevant and not relevant pairs functionality-action to address the need; (c) Country-specific and common among Country pairs functionality-action.

The second step allows switching from $BM_{Canvases}$ to SMs. It reduces the complexity of the vast number of elements of the $BM_{Canvases}$ focusing on the key building blocks of value proposition and customer segments. The path between $BM_{Canvases}$ and SMs requires to select the common value propositions among all considered Countries (general SM), and to consider also the peculiar aspects of the contexts (Country-specific SMs). All the functionalities, related to the pairs functionality-action have been clustered according to two levels: the main target of the solutions (i.e. patient, care provider, care pathway plan) and technological functionalities.

2.3 Third Phase

SMs are implemented within the third phase of the research project following a Business Process Reengineering (Hammer, 1990; Champy, 2002)

approach that includes the following phases: (1) design of the care process model, which firstly defines the macro-phases of a general care process for CI patients. (2) analysis of the AS-IS process models in each pilot site; (3) design of the TO-BE process models in each pilot site, underlining the difference between AS-IS and TO-BE process models. Considering also digital solutions (Locatelli et al. 2014).

3 RESULTS

This paragraph describes the results of the research. Firstly, the outcomes of the literature analysis and the evidences related to the STOF framework are grouped into the 9 building blocks of the BMC framework. Secondly, the results related to the application of the BME and CM are presented.

3.1 General Business Model

The general BM is characterized by the following 9 building blocks. For each of them we report the main results of the analysis of the literature accomplished.

1. Customer segments are convenient set of clients with common needs, behaviours or attributes. Following Petersen (2004), the main customer segments to be considered in CI are the following: (i) patients with dementia; (ii) patients with amnesic Mild CI (a-MCI); (iii) patients with non-amnesic Mild CI (na-MCI).

2. Value proposition is the reason why a customer chooses one product and/or service. In CI domain, a tool adopted to assess the various needs is the Camberwell Assessment of Need for the Elderly model (CANE) (Reynolds et al. 2000). The application of the model highlights that patients with dementia have more care needs than MCI patients. Furthermore, there are several solutions for the various actors involved into the care process.

3. Channels are the interfaces used to interact with the customers in order to deliver a value proposition. Literature shows that the main channels by which care services are delivered to elderly people with CI are the following: (i) caregiver; (ii) general physician; (iii) healthcare specialist; (iv) healthcare structure.

4. Customer relationships regards how relating with customer segments. Patients suffering from CI tend to communicate with their caregivers or social workers. These two support patients in adopting and using any digital solution for providing enhanced services. From the viewpoint of the actors involved in the care process, many companies maintain online most of their relationships with caregivers.

5. Revenue streams deal with the cash generated from every customer segment. Following Stroetmann et al. (2003), the main revenues for a digital solution in CI domain are the following: (i) service paid by insurance funds; (ii) service paid by governments; (iii) service paid by the patient or by his relatives/caregivers through out-of-pocket expenses. Three groups of people or organizations pay for the digital solution: (a) Business to Consumer (B2C): the service is sold directly to the patient or his caregiver. (b) Business to Public (B2P): the service is sold to public entities i.e. local authorities, NHSs and housing associations; (c) Business to Business (B2B): the service is sold to private companies and, in some countries, most of them are private medical insurance companies. Furthermore, there could be the following types of transactions between the provider of digital solutions and the healthcare organization: (1) healthcare organization purchases the entire system (one-time capital investment); (2) healthcare organization pays a license fee for each patient connected to the system.

6. Key resources are the essential assets necessary to create and offer the value proposition. From the perspective of the patient suffering from CI, human resources that will be crucial in the establishment of the BM are health professional and caregivers (or the social worker if the patient has not relatives that support her) (Robert et al. 2013). The human resource that is vital in the establishment of the BM is the specialist of digital services through which assisting people with CI (Kapadia et al. 2015). From the standpoint of physical assets required to provide the service, technologies play a key role both for the patient and for the overall system (Kerssens et al. 2015; Robert et al. 2013; Bharucha et al. 2009). Other key resources are patents, licenses and copyrights.

7. Key activities are actions that have to be performed in order to create and offer a value proposition. From the patient standpoint, the key activities are related to her involvement: (i) engagement of the patient; (ii) maintenance of the relationship with the patient. From the stand point of the actors involved in the care process, key activities are related to the creation and sustainment of the relationships among these key actors: (a) create the connection between healthcare specialist and caregiver/social worker; (b) maintenance of the relationship between healthcare specialist and caregivers/social workers. Following Ógáin and Mountain (2015), these activities can be supported through the contributions of governmental actors in terms of: (c) national/regional awareness campaigns; (d) financial incentives to healthcare organizations; (e) financial incentives to healthcare specialist for the

diagnosis of MCI and dementia; (f) financial incentives to healthcare specialists and healthcare organizations for the adoption of digital solutions to treat MCI and dementia. Following Robert et al. (2013), the key activities in the BM related to the technology adopted are the following: (1) production of the equipment and sensors; (2) selection of the most appropriate technology/sensor; (3) installation of technologies in patients' home; (4) calibration of the sensors.

8. Key partnerships refers to the network of suppliers useful to improve the BM. Literature on CI suggests that some key partnership for the BM could be: (a) government; (b) research center/university; (c) local regional community (Kapadia et al. 2015); (d) private organizations (König et al. 2015); (e) networks between the providers of digital solutions and healthcare organizations.

9. Cost structure deals with relevant costs characterizing a feasible BM. Literature suggests that the main costs for a digital solution in the CI domain are the following (Kapadia et al. 2015): (i) training costs; (ii) personnel costs; (iii) installation and maintenance costs; (iv) purchasing and manufacturing costs; (v) customer service costs.

3.2 Business Model Canvases

The next steps of the research allowed to move from the general BM to BM_{Canvases} through the BME and CM. BME allows to describe the context in which BM will be implemented, considering the following 4 macro areas:

1. *Key trends*: (a) national socio-healthcare system overview; (b) general government expenditure on health; (c) private expenditure on health; (d) "Out-of-pocket" expenditure; (e) *per-capita* total expenditure on health (WHO 2015);

2. *Macro-economic forces*: (a) payment mechanisms; (b) policies regarding the sources of revenue and financial flow;

3. *Industry forces*: (a) balance between public and private healthcare; (b) centralization vs. decentralization (c) main actors of the NHS; (d) number of health and social care integration hospitals per 100.000 population (e) number of psychiatric beds per million population (WHO 2015);

4. *Market forces*: (a) percentage of population aged > 60 years compared to the overall population; (b) life expectancy at age 60 (WHO 2015); (c) estimated prevalence of dementia per 1.000 population (OECD 2015; Prince et al. 2013); (d) percentage of population living in urban areas (WHO 2015); (e) population ICT readiness; (f) tendency to informal care (Lupianez et al. 2013).

In addition to BME, the implementation of the CM returns different combinations of coherent, relevant and Country-specific technological functionalities and actions to address patients' needs. The tool allows highlighting the value propositions to focus the attention on while designing BM_{Canvases}. The synthesis of the findings related to BME and CM allows defining the BM_{Canvases}. The latter, though grounded on already established frameworks (e.g. Business Model Canvas, BME, etc.), take advantage of the flexibility of the tools adopted to build them, thus making them adaptable to the various possible contexts (i.e. specificities of the various countries) or other patients' clusters different from those adopted in this research.

3.3 Service Models

In order to design a general SM able to encase a value proposition common to all the four countries involved in DECI, the needs marked by clinicians as extremely relevant have been highlighted and clustered as follow:

N₁. Diagnosis and assessment: (i) overall medical condition; (ii) behavior and mood; (iii) assess the risk of malnutrition; (iv) Activities of Daily Living (ADL); (v) risk for falls.

N₂. Patient psychological needs: (i) cognitive stimulation; (ii) online cognitive training.

N₃. Clinical team needs: (i) coordination of care; (ii) clinical team information sharing; (iii) improve diagnosis method; (iv) advising on deciding course of action; (v) better access to and relevance of non-pharmacological therapies; (vi) standardized care pathway.

N₄. Follow-up: (i) monitoring overall condition; (ii) measurement of adherence and compliance of patients to treatment; (iii) assess timely changes evolving needs for social care support.

Starting from these clusters, it is possible to cluster also the technological functionalities that allow meeting these needs, and which are common to all Countries. Regarding the patient layer, the following 5 clusters have been identified (technological functionality in brackets):

TFP₁. Patient's status (monitoring): (i) automatic remote-based measurement of patient's blood pressure; (ii) automatic remote-based measurement of patient's O₂ saturation; (iii) automatic provision and submitting of questionnaires (of various nature, including patient's health status and to support change detection) to care-involved subjects; (iv) gathering on non-structured information on patient's health status from informal caregivers or social caretakers; (v) evaluation and monitoring of cognitive

skills and monitoring of decay curves and other trends.

TFP₂. Patient's status (alert): automatic provision of feedbacks and alerts on patients' progresses or deterioration.

TFP₃. Patient's status (communication-cognitive stimulation): (i) cognitive games/exercises to stimulate patients to preserve cognitive/ executive functions; (ii) tele-consultation (tele-presence) functionalities allowing patients and professionals to communicate to each other visually.

TFP₄. Patient's Activities (alert): (i) automatic provision of remote real-time feedback on patients' activities, including non-pre-scheduled activities; (ii) automatic provision of remote real-time patient-tailored motivational messages based on patients' activities, including non-pre-scheduled activities; (iii) automatic provision of remote feedback on patients' activities, building on long-time data analysis on patients' status.

TFP₅. Patient's Activities (monitoring): activity monitoring through accelerometer for elderly monitoring (also outdoor, with batch data download once reconnected to base station): stand / sit / walk / steps + intensity of activity; GPS-based patient monitoring and structured health-based data gathering for outdoor step counting or activity monitoring (including detection of falls); registering of pre-scheduled activities performed by the patient (who is monitored real-time by sensors when performing the activity).

TFP₆. Patient's status (storage and sharing information): (i) activity monitoring through accelerometer for elderly monitoring (also outdoor, with batch data download once reconnected to base station): stand / sit / walk / steps + intensity of activity; (ii) GPS-based patient monitoring and structured health-based data gathering for outdoor step counting or activity monitoring (including detection of falls); (iii) Registering of pre-scheduled activities performed by the patient (patient is monitored real-time by sensors when performing the activity).

Regarding the actors involved in the care process, the following 4 clusters have been identified:

TFS₁. Care providers (communication): informal communication (messaging) among various actors (e.g.: family members and doctors);

TFS₂. Care providers (teamwork): enablement of multidisciplinary teamwork across care providers, doctors and informal caregivers (or some of these);

TFS₃. Care pathway/treatment plan (monitoring): coherence check between clinical

guidelines/protocols and data gathered as part of care activities;

TFS₄. Care pathway/treatment plan (sharing information): sharing of a treatment plan among caregivers, doctors and family members (or some of these).

Combining the clusters of common relevant needs with the clusters of common relevant functionalities, it is possible to point out the match between the two as number of notable crossings, in order to highlight packages of SM common to all four countries.

3.4 Italian Service Model

An example of the intersection between the two clusters and of the specificities of a Country is provided regarding the Italian context. Starting from the value proposition common to all the 4 countries, the general SM is enriched with further specificities related to the Italian Customer Segments.

Given Italian specific needs, further specific elements of the Italian SM are available: (i) immobility detection for elderly monitoring at home (indoor) for patient physical needs; (ii) fall detection for elderly monitoring at home (indoor) for patient physical needs; (iii) trend analyses performed on data gathered from various patients' monitoring activities for diagnosis and assessment & for caregivers needs; (iv) registering of pre-scheduled activities performed by the patient (patient is formally required to provide a yes/no answer) for patient environmental needs & for patient physical needs; (v) automatic reminder to patients for the performing of a scheduled activity for patient environmental needs & for patient physical needs; (vi) availability of personalized and adaptable remote-based training programs automatically tailored on individual patient's characteristics for patient physical needs; (vii) drug management for patient physical needs.

The functionalities clusters are enriched, for the Italian case, as follow:

Patient's status (monitoring): (i) Immobility detection for elderly monitoring at home (indoor); (ii) Fall detection for elderly monitoring at home (indoor);

Patient's activities (monitoring): (i) Trend analyses performed on data gathered from various patients' monitoring activities; (ii) Registering of pre-scheduled activities performed by the patient (patient is formally required to provide a yes/no answer);

Patient's Activities (alert): (i) Provision of automatic reminder to patients for the performing of a scheduled activity; (ii) Availability of personalized and adaptable remote-based training programs

automatically tailored on individual patient's characteristics;

Care pathway/Treatment plan (monitoring): drug management.

These packages complete the general SM, shaping the Italian specific one.

The other building blocks are grouped as follows: upstream building blocks (Key partners, Key activities and Key resources), downstream building blocks (Customer Relationships, Customer Segments and Channels), and cost and revenues (Cost Structure and Revenue Streams). The main impacts are:

Upstream building blocks: (i) Italian clinicians consider the diagnosis and assessment crucial (GPs should be involved for an early detection); (ii) given clinical team needs, it is important to provide the technological functionalities to the local health authorities to the municipalities and to the case service providers; (iii) the monitoring of the patient's status and activities meet all the 7 clusters of needs; (iv) to provide automatic reminders to patients for the performing of a scheduled activity is important to personalize the service; (v) from the point of view of the actors involved in the care process, is crucial to enable multidisciplinary teamwork across local health authorities, municipalities, case service providers, informal caregivers and voluntary associations.

Downstream building blocks: (1) from clinical standpoint, patient physical needs, caregiver needs and the ones regarding the patient environment are considered relevant; (2) the caregiver has a central role and must be engaged and informed about the evolution of symptoms and disease; (3) personal assistance based on human interaction should be preferred to meet the patient psychological needs.

Cost and revenues: (a) Revenue Streams should be a B2P and B2C mix: (a.i) B2P: some functionalities, for example the ones for the storage and sharing to external EMR or other care management tools, should be funded from general taxation; (a.ii) B2C: some services should be sold directly to the patient or his caregiver, for example the ones for monitoring the patient's status or for the cognitive stimulation; (b) Considering the central role of the caregivers, their training costs must be considered also to meet their needs.

3.5 Application of the Service Models

This paragraph is focused on the application of the SMs in the Italian pilot site, through three steps: (1) the design of a general Care Process Model for patients affected by CI; (2) the analysis of the AS-IS

Process Models in each pilot site, and finally (3) the design of the TO-BE Process Models in each pilot site, starting from the Service Model resulted from literature analysis.

3.5.1 Design of the Care Process Model

The analysis highlighted four common phases to every care process for people with CI (Figure 2).

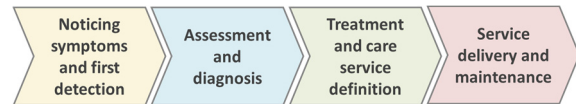


Figure 2: Care Process Model for patients affected by CI.

A. Noticing Symptoms and First Detection: this phase includes the access point of the patient with CI in the care process and it considers the first identification of the patient with suspected CI.

B. Assessment and Diagnosis: clinical activities aimed at the assessment and diagnosis of the CI in the patient identified in the previous phase. The phase includes: a first basic assessment of CI that can be owned by the GP, the socio-health care provider or external specialized physicians; and then, a comprehensive assessment that is usually owned the socio-health care provider, although some of the requested exams are provided by external physicians.

C. Treatment and Care Service Definition: analysis of the patient needs, both clinical (emerged from the clinical assessment delivered in the previous phase) and social needs (usually analysed with the patient and the family with a social assistant). When needs are defined, the care service is designed.

D. Service Delivery and Maintenance: delivery of the care service designed and continuous monitoring of the patient's status.

3.5.2 Analysis of the as-IS Process Models

We will describe in detail the Italian process model, in Palazzolo Institute of Fondazione Don Carlo Gnocchi Onlus in Milano, following the four macro-phases.

A. Noticing Symptoms and First Detection: the process starts though a first meeting between patients and physicians, like a check-up visit, or after an acute episode in a long term care facility. The visit can be owned by the GPs or specialized physicians (both within Palazzolo Institute as well as external). Once patients with certain kind of characteristics have been identified during a physician's visit, their path continues in the care process.

B. Assessment and Diagnosis: in case there are symptoms of CI, a basic assessment can be performed. Note that usually the GP points out the patient to specialists (at Palazzolo Institute or externally). This initial assessment consists of a basic examination of the patient with suspected CI, aimed at understanding more regarding patients' health conditions and social situation. In case the basic assessment strengthens the initial suspicion of CI, a comprehensive assessment follows. At Palazzolo Institute, for a comprehensive assessment, patients can be referred to a specialized geriatrics unit, which starts the assessment protocol aimed at reaching the diagnosis.

C. Treatment and Care Service Definition: in Italy, it is common that patients' relatives or caregivers take the responsibility for organizing the care pathway of the patient. The care pathway can be managed through the activation of home-based and facility-based services, whose activation is discussed together with the family.

D. Service Delivery and Maintenance: Palazzolo Institute delivers an integrated socio-healthcare service to patients affected by CI. During the service delivery the patient is continuously monitored by the professionals of the Institute.

3.5.3 Design of the to-BE Process Models

As regards the TO-BE process models, we will describe in detail the differences between the Italian AS-IS and the TO-BE process model. The fundamental differences from AS-IS and the TO-BE process models are linked to some new technologies, which ensure the sharing of information among the various actors enabling independent living.

A. Noticing Symptoms and First Detection: during the visit, physicians visualise the patient's medical records on the DECI platform connected with the databases of local hospitals and GP.

B. Assessment and Diagnosis: data collected by the specialized geriatrics unit are entered in a tablet and immediately shared (through a cloud service) with the other stakeholders of the care network.

C. Treatment and Care Service Definition: A first needs analysis can be performed by the patient/caregiver filling in on-line questionnaire on the DECI platform. Then a visit could confirm the results of the questionnaire.

D. Service Delivery and Maintenance: A wearable sensor could be used to detect abnormalities in the level of activity and send alert messages to family members or assistance operator. The GP and specialists can share the information collected

through the DECI platform and plan together a revision of the medication and treatment plan, and schedule visits. The program can alternate sessions in physical presence of the physiotherapist with tele rehabilitation sessions. Some cognitive stimulation and rehabilitation exercises could be done also at home through the online platform. The platform can also be used by the case manager to communicate with the patient or the caregiver.

4 CONCLUSIONS

The approach adopted to design the BM is relevant because: (i) it adopts already established frameworks (e.g. Business Model Canvas); (ii) it highlights common traits and differences among the Countries within the DECI project; (iii) it allows distinguishing firstly between coherent and not coherent elements, then between high-priority and low-priority ones; (iv) it provides information about the impact of the various digital solutions; (v) it is applicable in other contexts (i.e. Countries) therefore it can overcome the boundaries of the DECI project thanks to its scalability; (vi) it supports decision-making processes also after the pilot phases because, once the first most relevant needs are addressed, it will be possible to proceed with the actions to address the needs with a lower relevance.

Furthermore, the approach was validated and refined also through a Scientific Advisory Board with the involvement of external stakeholders. Finally, the approach is aimed to support the definition and implementation of a comprehensive and multifaceted BM in a complex and continuously evolving context. The next steps of the DECI project are: (1) the implementation of the Pilot site (Italy, Sweden, Israel and Spain) adopting the proposed SMs and (2) the evaluation of key performance indicators considering different perspectives (e.g.: economics, social, etc.) in order to highlight the potential benefits of the designed approach.

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REFERENCES

- Alexander, M., Perera, G., Ford, L., Arrighi, H. M., Foskett, N., Debove, C., Novak, G., and Gordon, M. F., 2015. Age-Stratified Prevalence of Mild Cognitive Impairment and Dementia in European Populations: A Systematic Review. *Journal of Alzheimer's Disease*, 48, pp. 355–359.
- Alzheimer's association, 2016. 2016 *Alzheimer's disease facts and figures*. Alzheimer's & dementia, volume 12, issue 4, pp. 459–509.
- Bharucha, A.J. et al., 2009. Intelligent Assistive Technology Applications to Dementia Care: Current Capabilities, Limitations, and Future Challenges. *The American Journal of Geriatric Psychiatry*, 17(2), pp.88–104.
- Bouwman, H., de Vos, H., Haaker, T., 2008. *Mobile Service Innovation and Business Models*, Springer-Verlag Berlin Heidelberg.
- Champy, J., 2002. *X-Engineering the Corporation: Reinventing Your Business in the Digital Age*, Warner Business Books. New York.
- Hammer, M., 1990. Re-engineering work: don't automate, obliterate. *Harvard Business Review*, 68(4):104-112.
- Kapadia, V. et al., 2015. Emerging ICT implementation issues in aged care. *International Journal of Medical Informatics*, pp.1–9.
- Kerssens, C. et al., 2015. Personalized Technology to Support Older Adults With and Without Cognitive Impairment Living at Home. *American Journal of Alzheimer's Disease and Other Dementias*, 30(1), pp.85–97.
- König, A. et al., 2015. Automatic speech analysis for the assessment of patients with predementia and Alzheimer's disease. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring*, 1(1), pp.112–124.
- Locatelli, P., Restifo, N., Cirilli, F., Moser, R., 2015. DECI: Digital Environment for Cognitive Inclusion - Improving Elderly Citizens' Quality of Life Through an ICT-enabled Patient-Centric Home Environment. *Proceedings of the International Conferences on e-Health 2015- Part of the Multi Conference on Computer Science and Information Systems 2015*, IADIS.
- Lupianez, F., Maghiros, I. & Abadie, F., 2013. *Strategic Intelligence Monitor on Personal Health Systems, Phase 2 Citizens and ICT for Health in 14 European Countries: Results from an Online Panel* F. Abadie et al., eds.,
- Miranda-Castillo, C., Woods, B. & Orrell, M., 2013. The needs of people with dementia living at home from user, caregiver and professional perspectives: a cross-sectional survey. *BMC Health Services Research*, 13, pp. 43.
- OECD, 2015. *Addressing Dementia. In Health at a Glance 2015*. OECD Health Policy Studies. OECD.
- Osterwalder, A., Pigneur, Y., 2010. *Business Model Generation* (pp. 1–288). Hoboken, New Jersey: John Wiley & Sons, Inc.
- Ógáin, E.N., Mountain, K., 2015. *Remember me*. pp.1–33.
- Petersen, R.C., 2004. Mild cognitive impairment as a diagnostic entity. *Journal of Internal Medicine*, 256(3), pp.183–194.
- Prince, M. et al., 2013. The global prevalence of dementia: A systematic review and metaanalysis. *Alzheimer's & Dementia*, 9(1), pp.63–75.e2.
- Reynolds, T. et al., 2000. Camberwell Assessment of Need for the Elderly (CANE) Development, validity and reliability. *British Journal of Psychiatry*, 176(5), pp.444–452.
- Rizzi, L., Rosset, I., Roriz-Cruz, M., 2014. Global epidemiology of dementia: Alzheimer's and vascular types. *Biomed Res Int*. 2014; 2014:908915.
- Robert, P.H. et al., 2013. Recommendations for ICT use in Alzheimer's disease assessment: Monaco CTAD Expert Meeting. *The Journal of Nutrition, Health Aging*, 17(8), pp.653–660.
- Stroetmann, K.A., Stroetmann, V.N. & Westerteicher, C., 2003. Implementation of TeleCare services: benefit assessment and organisational models. *Studies in Health Technology and Informatics*, 97, pp.131–141.
- WHO, 2015. *World health statistics 2015*, WHO Press, Geneva.