H2020-SC6-CO-CREATION-2016-2017 / CO-CREATION FOR GROWTH AND INCLUSION
Grant Agreement nº 769975

SoCaTel

A multi-stakeholder co-creation platform for better access to Long-Term Care services

Start date of project: 01/12/2017
Duration: 36 months

Deliverable: D4.1

Data Sources Classification and semantic interoperability

By OZWILLO

Due date of deliverable: 28/02/2019
Actual submission date: 28/02/2019

Responsible WP: WP4
WP responsible partner: CYRIC
Deliverable responsible partner: OZWILLO
Revision: vs 1.0

Dissemination level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	
CI	Classified, information as referred to in Commission Decision 2001/844/EC	

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

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DOCUMENT CONTROL

Document version	Date	Change
0.1	08/01/2019	Table of Content
0.2	15/01/2019	Description of the data source identification methodology
0.3	20/01/2019	Integration of Irish pilot site identified datasets
0.4	22/01/2019	Integration of Irish pilot site identified datasets
0.5	25/01/2019	Integration of Finnish pilot site identified datasets
0.6	04/02/2019	Integration of EU and national identified datasets
0.7	14/2/2019	Description of the Data Acquisition layer's data handlers
0.8	15/02/2019	Description of the unified data model
0.85	19/02/2019	Description of the Semantic Pre-Processing layer component
0.9	19/02/2019	Introduction, conclusion and executive summary
0.95	26/02/2019	Document ready for internal review
1.0	28/02/2019	Camera ready version for publication

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

VALIDATION

Reviewers	Validation date
P. Nicolaou (CYRIC)	27/02/2019
B. Deusdad Ayala (URV)	27/02/2019

DOCUMENT DATA

Keywords	SoCaTel, Data Sources Classification and Semantic Interoperability
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Delivery date	28/02/2019

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EXECUTIVE SUMMARY

The SoCaTel co-creation platform enables individuals to collectively improve the delivery of long-term care services. The value of the co-creation process is enhanced when the range of individuals covers all stakeholders impacted by the delivery of long-term care services, being older persons, carers, health specialists, policy makers and more.

As with all discussions, ill-founded statements, vague memories and unknowns can prevent a discussion to succeed in qualifying a real need with a real opportunity for improvement. For that reason, to improve the quality of the discussion and the decision making, a knowledge base has been designed to complement the SoCaTel co-creation platform so as to automatically source and push external insights to ongoing discussions, as a way to provide the facts that a given group of end-users needs to assess the status quo before suggesting improvements.

Examples of insights that the knowledge base will produce include:

- The list of existing long-term care services provided in the area targeted by the discussion topic to ensure the wheel is not reinvented.
- Datasets such as census statistics, research reports and governmental studies that will help characterise the nature and scale of a known issue.
- Media feeds that can highlight events and issues relevant today, to make specific discussion more relevant with fresh updates and real-world public testimonies.

Because the datasets collected by the knowledge base must be relevant and applicable to the community ideating on the co-creation platform, a process of identifying insightful datasets as part of the commissioning of the platform is necessary. A methodology that allows the team behind SoCaTel to coordinate the identification of local datasets is presented, and has been tested and validated with four pilot sites in Ireland, Spain, Finland and Hungary.

The list of existing services, datasets and media feeds identified in each pilot site is included. This list highlights the multilingual nature of the content that will be collected at each location where the platform is commissioned. Content provided to the end users of the co-creation platform must be in their native language, or in English if the language is enabled for a specific discussion group. For that reason, the knowledge base and its software components have been designed to accommodate multilingual support so that any language is supported.

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The collection of identified datasets from external data sources is described in details, with examples of the implementation of the knowledge base's Data Acquisition layer component. That component is language agnostic, and consists of collecting datasets from external repositories without content analysis.

A semantic approach is taken to produce a unified data model, to contextualise the datasets collected for maximal inference, reuse and interoperability. The knowledge base's Pre-Processing Semantic layer is presented. Semantic libraries are used to automatically identify the language of the content in the datasets collected, and the RDF data packets are modified to update their prefixes with the language information. This information will be available for parsing content to push to the co-creation platform. Vocabulary tools are also used to translate the concept of ontologies as necessary. The platform will initially support a minimum of 4 languages (English, Catalan, Finnish and Hungarian), and additional languages will be easily enabled during the exploitation phase using the mechanisms in place throughout the architecture.

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GLOSSARY

Abbreviation	Expression
API	Application User Interface
CSV	Comma-Separated Values
EU	European Union
FOAF	Friend Of A Friend
GP	General Practitioner
JSON	JavaScript Object Notation
KB	Knowledge Base
LOD	Linked Open Data
LTC	Uniform Resource Locator
MOOC	Massive Open Online Course
OECD	Organisation for Economic Co-operation and Development
OWL	Web Ontology Language
RDF	Resource Description Framework
SM	Social Media
URL	Uniform Resource Locator
XLS/XLSX	Microsoft Excel Spreadsheet
XML	eXtensible Markup Language

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1. INTRODUCTION

The SoCaTel co-creation platform enables individuals with different profiles and backgrounds to collectively improve the delivery of long-term care services. This is achieved by providing a platform allowing personal experiences, testimonies, known constraints, policies and regulations to be exchanged between the various stakeholders. In a second step, these insights and facts enable individuals to ideate on how the status quo could be improved with the development of new services, a more efficient and ubiquitous roll out of existing services or more generally better ways of doing things. The best ideas are then co-designed following state-of-the art co-creation methodologies adapted to the online world.

The value of the co-creation process is enhanced when the range of individuals covers all stakeholders directly impacted or dealing with the delivery of long-term care services, being older persons, carers, health specialists, policy makers and more. Each of them with bring valuable input, for a constructive discussion leading to a number of suggestions or solutions that would address the matters being discussed.

As with all discussions, whether they happen within the real or virtual world, it is of utter importance that they are based on facts rather than ill-founded statements, vague memories and unknowns. The latter almost never relates to an attempt by an individual to influence a discussion for personal motivations, it is just the natural way a discussion evolves based on the knowledge each person has of a given situation. For that reason, to improve the quality of the discussion and of the decision making, a knowledge base has been designed to complement the SoCaTel co-creation platform so as to automatically source and push external insights to ongoing discussions on the co-creation platform, as a way to provide the facts that a given group needs to assess the status quo before suggesting improvements.

Examples of insights that the knowledge base will produce include:

- The list of existing long-term care services provided in the area targeted by the discussion topic. The objective is that the individuals participating to the co-creation exercise do not reinvent the wheel, as it could simply be that no one knows about a public or private service that exists already. Another use of that information is the possibility for the participants to review what and how things are done today, to understand why it does not work and how to improve.

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- Datasets that can provide facts to validate thoughts and statements from the participants. For example, census statistics, research reports and governmental studies will help characterise the nature and scale of a problem, and whether the service provider is working on a solution.
- Media feeds that can highlight events and issues relevant today, for which a discussion topic could be very relevant. Participants may be notified of articles, events and other fresh announcements related to their discussion so they can immediately include these new insights in their co-creation exercise to make it more relevant.

The knowledge base is therefore primarily about collecting data from external data sources, processing and storing the insights in a way that they can be pushed to the co-creation platform user interface when relevant. A second aspect of the knowledge base is the collection of anonymised datasets from the co-creation platform itself, to run data analytics and identify key metrics. This deliverable deal solely with the collection of datasets from external data sources and its processing for use by the co-creation platform.

The datasets collected by the knowledge base need to be relevant and applicable to the community ideating on the co-creation platform. A group of individuals based in Brussels will require insights on the delivery of long-term care services in the Brussels area, at Belgium and European Union (EU) level, and in that scenario datasets peculiar to other regions and EU countries have little to no value. While the objective is to grow a knowledge base that will in time contain insights across all Europe, at the highest granularity possible, it is evident that local territories operating the SoCaTel co-creation platform will initially have to go through a process of identifying insightful datasets as part of the commissioning of the platform.

A methodology, described in Section 2, was designed to facilitate that process, considering that the teams commissioning the platform locally will have little knowledge of the concept of co-creation and what an insightful dataset is. Identifying datasets is a process that requires guidance and the methodology introduces a questionnaire that allows collection of data with minimum knowledge about what the platform does with it.

The methodology has been tested and validated with the four pilot sites, and confirmed that coordination between the local team and the team behind the SoCaTel co-creation platform is necessary to validate and discard data sources. Section 3 presents the list of existing services, datasets and media feeds that

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have been identified as the most relevant to long term care in each pilot site. As part of the development and piloting of the platform, a majority of these datasets will be integrated, even if some may be discarded or added on the way for reasons unknown to us as yet.

Content provided to the end users of the co-creation platform must be in their native language, or in English if the language is enabled for a specific discussion group. For that reason, the knowledge base and its software components have been designed to accommodate multilingual support so that any language is supported.

The collection of identified datasets from external data sources is described in details, with examples of the implementation of the knowledge base's Data Acquisition layer component. That component is language agnostic, and consists of collecting datasets from external repositories without content analysis.

The knowledge base architecture was fully documented in Deliverable D3.2 "SoCaTel Platform Concrete Architecture Design". Collecting data from external data sources is done via the Data Acquisition layer, with handlers containers designed to connect to and collect datasets. Section 4 describes in detail the implementation of the Data Acquisition layer component applied to a subset of the pilot sites' datasets. That component is language agnostic, and consists of collecting datasets from external repositories without content analysis.

Finally, a semantic approach was taken with the goal to produce a unified data model, where all datasets will be linked in a knowledge graph. The idea is to contextualise the datasets collected as opposed to dumping them into a database with minimal reuse and interoperability attributes. Storing data collected in a semantic database allows the knowledge base and its software components to automatically identify dependent datasets and infer additional information from them. Moreover, this modelisation provides an abstraction of the data source providing the datasets, meaning that the same data type in the knowledge base can be provided by different data sources depending on the localisation. This semantisation technique requires a pre-processing of the datasets after being collected by the Data Acquisition Layer and before they are inserted into the semantic database, so they are converted to the right format. Section 5 documents the procedure and ontologies already created in the unified data model. Semantic libraries are used to automatically identify the language of the content in the datasets collected, and the RDF data packets are modified to update their prefixes with the language information. This information will be

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available for parsing content to push to the co-creation platform. Vocabulary tools are also used to translate the concept of ontologies as necessary. The platform will initially support a minimum of 4 languages (English, Catalan, Finnish and Hungarian), and additional languages will be easily enabled during the exploitation phase using the mechanisms in place throughout the architecture.

2. METHODOLOGY TO IDENTIFY INSIGHTFUL DATASETS TO SUPPORT IDEATION AT LOCAL, NATIONAL AND EU LEVEL

The commissioning of the SoCaTel co-creation platform requires external datasets to be integrated to the knowledge base. A methodology is presented to assist administrators in identifying and qualifying insightful datasets as part of the commissioning of the platform.

2.1 THE DEFINITION OF INSIGHTFUL DATASETS IN THE SOCATEL CONTEXT

In its current implementation, the knowledge base requires two types of datasets for providing actionable insights to participants:

1. The list of long-term care services available in the participants' geographical area, to inform the status quo of what services exist today and to prevent them from reinventing the wheel during the co-creation exercise on the platform.

2. The list of key governmental, research and social media data sources, to provide statistics, trending issues, and more information on the topics being discussed so that discussion topics are relevant and based on facts. Examples of such datasets are:

    a. Governmental data: social and welfare services in pilot site area, target groups and success rates
    b. Research data: social and welfare statistical data and demographic data
    c. Social media data: health-related hot topics
    d. Internal data sources: comments, ratings, votes
    e. Other data sources: questionnaires, voting forms

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It is mandatory that the datasets are provided in the language natively spoken by the individuals that will participate to the co-creation exercise, or in a language that is declared to be understood by most of the participants such as English.

Over the lifetime of the co-creation platform, it is expected that the knowledge base will evolve with its requirements, and new types of datasets will become relevant. The methodology presented therein does not restrict other datasets to be considered at a later stage.

2.2 A QUESTIONNAIRE TO IDENTIFY DATA SOURCES AND DATASETS

Now that we have established that insightful datasets are necessary to support the ideation process within the co-creation platform, and what an insightful dataset is within the SoCaTel context, it is important to focus on the methodology to identify the data sources that will provide such insightful datasets.

A central organisation, such as that commercialising or promoting the SoCaTel platform, will fail to identify valuable data sources and datasets across EU locations for multiple reasons:

- The language barrier that exists when dealing with datasets in non-english speaking countries;
- The lack of knowledge about the local area and important players and stakeholders. Each country has its own organisation and set of rules that an outsider may not be aware of;
- The plethora of platforms and databases that are managed by various organisations within a single territory, for which the usefulness and quality is unknown to someone that does not use the services.

It is therefore inconceivable that the organisation commercialising or promoting the SoCaTel platform will be able to single-handedly populate the knowledge base with the most meaningful datasets related to long term care, that for each new location in Europe when the co-creation platform is deployed.

Instead, the organisation will need to hand over the data identification process to:

1. the local entity commissioning the SoCaTel platform at the local, national or EU level,
2. the service providers in that target area, and
3. the end users themselves.

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The knowledge base will grow over time, as each new data source will join the pool of data sources integrated during previous instances of the SoCaTel commissioning process. This means that the knowledge base will rapidly build a comprehensive cartography of datasets and LTC services relevant to various EU regions. Over time, the objective is to build a complete coverage of the EU territory at the finest granularity, so that any new community willing to initiate an ideation exercise will benefit from a ready-to-go knowledge base and the commissioning effort will be limited.

In its first iterations and certainly for a long period of time, local entities commissioning the SoCaTel co-creation platform will have to go through a process of identifying an initial sample of insightful datasets, which will be completed upon over time by service providers and end users when they connect to the platform.

Local entities will not have the background and ins and outs of the platform to know what information they must seek, and where to start. This issue was rapidly identified with the pilot sites' representatives during the initial project discussions about the data source identification process. As a way to guide local entities through the process, a generic questionnaire has been designed to list all the information required, with examples, to focus and simplify the search for data. This questionnaire and overall approach to identifying relevant data sources will also be included in the Massive Open Online Course (MOOC) that will be released to assist any entity to train themselves with running the platform, from getting familiar with identifying relevant data sources to learning about co-creation techniques etc.

The questionnaire offers a reproducible and systematic approach to insightful data identification, so that this process can be streamlined. The following illustrates and documents each part of the questionnaire, taking as example the territory of Brussels, and shows how the information collected has value for the ideation process. The left column lists the information that must be provided by the local entity, and the right column is to be used for the answers.

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Name of entity commissioning the SoCaTel platform	"Ageing in peace" association
Contact person	Jim Smith - jim.smith@entity.be
Target area	Brussels city
Target users of the platform	Older persons ● Day Care Centre attendees across a wide socio-economic and age range incorporating groups comprised of: women only, men only, mixed gender groups and patients with cognitive impairment ● Older Adults with Alzheimer's Disease Advocates ● Health and Wellbeing Groups; ● Third Age social groups Carers ● Family members ● Friends of older persons ● Professional home care aidants Service providers ● Public Health Nursing Services ● Multi-Disciplinary Primary Care Team, Reablement Team ● Home Care Agencies, For Profit and Not for Profit incorporating both Carers and Managers ● Acute Hospital; Social Workers ● Integrated Care Services; Consultant Geriatrician, Advanced Nurse Practitioner, Clinical Nurse Specialist, Public Health Nurse ● Older Adults' Helpline Volunteers
Open Data portals providing public datasets relevant to the target area	https://opendata.bruxelles.be/pages/home/ http://opendatastore.brussels/en/dataset
Datasets in those Open Data portals related to a) Social Services (availability, use, popularity, other), b) Population and Demographic Statistics, c) Civic/Public Services (availability, popularity, other)	List and location of defibrillators http://opendatastore.brussels/en/dataset/defibrillator/resource/fdc11a31-cddd-484e-9cf5-28c0034f8391 Pharmacies sur le territoire de Bruxelles https://opendata.bruxelles.be/explore/dataset/pharmacies0/information/ Hôpitaux publics (membres du réseau IRIS) sur le territoire de la Ville de Bruxelles https://opendata.bruxelles.be/explore/dataset/hopitaux-publics/information/
Web pages describing or listing existing social and	Social Brussels, la carte bilingue de l'offre sociale-santé en Région Bruxelles-Capitale https://social.brussels/sector/147

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care services provided by the state or private organisations in target area	La Commission communautaire commune (Cocom), acteur majeur en région bruxelloise, dans les domaines de l'aide aux personnes et de la santé. http://www.ccc-ggc.irisnet.be/fr/aide-aux-personnes#Personnes-%C3%A2g%C3%A9es-:-accueil-ou-h%C3%A9bergement Le site du service public fédéral (SPF) Santé publique, Sécurité de la Chaîne alimentaire et Environnement https://www.zorg-en-gezondheid.be/per-domein/ouderenzorg/dagverzorgingscentra/adressen
Published academic and research data relevant to the target area	Willemé, Peter, The Long-Term Care System for the Elderly in Belgium (May 28, 2010). ENEPRI Research Report No. 70. Available at SSRN: https://ssrn.com/abstract=2033672 Willeme, Peter. (2010) The Belgian Long-term Care System. ENEPRI Research Report No. 70, 28 May 2010. Available at http://aei.pitt.edu/14688/ Interfederal Centre for Equal Opportunities, Monitoring Report on The Human Rights situation of Older Persons in Belgian Residential Care Settings, March 2016. Available at http://www.ennhri.org/IMG/pdf/belgium.pdf Belgian Health Care Knowledge Center, RESIDENTIAL CARE FOR OLDER PERSONS IN BELGIUM: PROJECTIONS 2011 – 2025, 2011. Available at https://kce.fgov.be/sites/default/files/atoms/files/KCE_167C_residential_care_in_Belgium_synthesis.pdf
Facebook groups that publish news and events about long-term care in the target area	https://www.facebook.com/QuestionSanteAsbl https://www.facebook.com/WalloniaEhealthLivingLab
Twitter accounts that publish news, regulation and events about long-term care in the target area	https://twitter.com/santebelgique https://twitter.com/StentCare https://twitter.com/defi_eu

Providing links to datasets, service provider listings and media feeds relevant to long term care allows the team commercialising or promoting SoCaTel to access the data sources and qualify them, i.e. confirm URLs are correct, content relevant and data formats machine readable. Analyse the data format and License associated to each dataset is a necessary step as the local entity cannot reliably handle those aspects that may be too technical and require expertise. A second step is to connect the associated datasets to the knowledge base using software components described in the following sections, so that they can be analysed and pushed to the users of the co-creation platform.

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Once the platform is commissioned and deployed, end users and service providers will have the possibility to join the platform and contribute to the ideation process. At that stage, they will also be given the means to import and attach relevant material (documents, online videos and other media) to a given discussion, and list additional long-term care services provided by the service provider itself or other organisations in order to complement the initial datasets uploaded during the commissioning process.

3. DATASETS IDENTIFIED AT THE PILOT SITES

This section describes the relevant data sources identified for each pilot site, where the methodology introduced in section 2 was applied. Each dataset comes with a description of the data source, data format, its access means and its processing value after anonymisation when required.

3.1 THE IRISH PILOT SITE - NORTH DUBLIN AREA

3.1.1 List of long-term care services

A large number of websites and organisations related to healthcare services for the elderly exists in Ireland. From the list provided in Appendix 1, a shortlist of long-term care service providers has been identified for the Dublin area, which will be stored within the knowledge base under the list of services already available. This will allow the platform to prompt these existing services to the end-users when a topic discusses a related matter.

Service ID	IE-1
Service name	Home support services
Service provider	HSE
Website	https://www.hse.ie/eng/home-support-services
Goal	The HSE Home Support Service aims to assist and support people to remain at home and support informal carers: ● getting in and out of bed ● dressing and undressing ● personal care such as showering and shaving ● help at mealtime and/or with essential domestic duties

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Special conditions	• Aged 65 or over • Need support to continue living at home or to return home following a hospital stay • Not a 24hr care • Assessed on care needs and not on income level • Free service
Datasets	Location of HSE-approved Home Support providers https://www.hse.ie/eng/home-support-services/approved-home-support-providers/

Service ID	IE-2
Service name	Nursing Homes Support Scheme - Fair Deal
Service provider	HSE
Website	https://www2.hse.ie/services/fair-deal-scheme/about-the-fair-deal-scheme.html
Goal	The HSE Nursing Homes Support Scheme aims to provide financial support to help pay for the cost of care in a nursing home through the Fair Deal scheme.
Special conditions	• Payment depends on income and assets • Short-term care such as respite, convalescent or day-care not covered • Extra fees charged by the nursing home for services like hairdressing, therapies or activities • When the person has assets including land and property, they can delay paying for their care until after their death using these assets to secure the costs.
Datasets	

Service ID	IE-3
Service name	Older People Services where you live
Service provider	HSE
Website	https://www.hse.ie/eng/services/list/4/olderpeople/mao-older.html
Goal	A website listing older people services provided in any given local health office, that they can access through their GP or Public Health Nurse.
Special conditions	• Payment depends on income and assets • Short-term care such as respite, convalescent or day-care not covered • Extra fees charged by the nursing home for services like hairdressing, therapies or activities • When the person has assets including land and property, they can delay paying for their care until after their death using these assets to secure the costs.
Datasets	List of hospitals and homes for older persons, and hospital care services.

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Service ID	IE-4
Service name	Meals on Wheels
Service provider	Kare Social Services
Website	http://www.karesocialservices.ie/page.php?pid=12
Goal	Volunteer drivers deliver meals 3 days a week to your home.
Special conditions	• Required to pay a contribution towards the cost of your meal (partial HSE grant) • Meals not be left on your doorstep • Meals must be eaten on the day of delivery. • Can accommodate dietary requirements but not individual tastes.
Datasets	

Service ID	IE-5
Service name	Bringing friendship and companionship
Service provider	Friends of the elderly Ireland
Website	https://friendsoftheelderly.ie/about/
Goal	Friends of the Elderly works hard to provide a wide range of social programmes for older people who would benefit from a friendly chat or a social outing
Special conditions	• Free • Confidential
Datasets	

Service ID	IE-6
Service name	Find your nearest hospital health centre, GP and more
Service provider	HSE
Website	https://www.hse.ie/eng/services/maps/
Goal	Health Atlas helps you to find essential health services on a map, General Practitioners, GPs, Family Doctors, Pharmacists, Dentists, Hospitals. It also provides contact phone numbers.
Special conditions	• Free • Confidential
Datasets	

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3.1.2 List of third-party data sources

Static datasets are valuable in that they offer snapshots of the healthcare situation for the elderly. They can be made known to participants when a topic being discussed could benefit from facts, such as insights on unpaid hours spent each week by home carers, or percentage of households with computing/internet access etc. The Open Data portal from the Irish government provides valuable data sources based on the 2016 census taken throughout the country.

Source ID	IE-S1
Dataset name	Registered Pharmacies per county and Dublin area
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/psi-registered-pharmacies-january-2019/resource/a3dcbc71-18d5-4941-aaaf-bc2ee4c90eb8
Added value	Identification of potential gaps in the area coverage and opportunities to use local pharmacies as part of innovative services
File format	PDF
License	Creative Commons Attribution 4.0

Source ID	IE-S2
Dataset name	CD801 - Persons with a Disability as a Percentage of All Population by Age Group, CensusYear, Statistic and Sex
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/cd801--disability-as-a-percentage-of-all-population-by-age-group-censusyear-statistic-and-sex-5b03/resource/ff1a42e7-f4fd-4536-95bd-3e7fcddbdf3a#&r=Age%20Group&c=Sex
Added value	Population per age group, sex, and variations from previous census years can indicate potential trends towards aging that can motivate the establishment of a specific service.
File format	json-stat / CSV
License	Creative Commons Attribution 4.0

Source ID	IE-S3
Dataset name	CD817 - Population Aged 15 Years and Over With a Disability (Number) by Social Class, Age at which Full Time Education Ceased, CensusYear and Sex

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Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/cd817-ility-number-by-social-class-age-at-which-full-time-education-ceased-censusyear-and-sex-a9f0
Added value	Population with a disability by social class, age and education, and variations from previous census years can indicate potential traits towards which population is affected by disability and can help focus the reach of a given service.
File format	json-stat / CSV
License	Creative Commons Attribution 4.0

Source ID	IE-S4
Dataset name	CD868 - Carers Usually Resident and Present in the State (Number) by Religion, Regular Unpaid Help, CensusYear and Sex
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/cd868-dent-and-present-in-the-state-number-by-religion-regular-unpaid-help-censusyear-and-sex-2e04
Added value	Population of carers by number of unpaid hours completed per week, useful to inform the number of carers in the area and the amount of help being provided overall, valuable to justify the need for better services to assist or replace the carers.
File format	json-stat / CSV
License	Creative Commons Attribution 4.0

Source ID	IE-S5
Dataset name	CD864 - Carers in Private Households in Permanent Housing Units (Number) by Computer and Internet Access, CensusYear and Age Group
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/cd864-permanent-housing-units-number-by-computer-and-internet-access-censusyear-and-age-group-180e
Added value	Population of carers by age group and by level of free access to computing equipment, useful to inform the number of carers in the area and their ability to use a digital system or application to enhance their situation or service they provide to the elderly.
File format	json-stat / CSV
License	Creative Commons Attribution 4.0

Source ID	IE-S6

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Dataset name	CD884 - Population (Number) by General Health, Social Class, CensusYear, Sex and Age Group
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/population-number-by-general-health-social-class-censusyear-sex-and-age-group
Added value	Population by age group and quality of health, useful to assess the overall state of the population and those really affected by chronic illnesses.
File format	json-stat / CSV
License	Creative Commons Attribution 4.0

Source ID	IE-S7
Dataset name	Disability, Carers and Voluntary Activities
Data source	Ireland's Open Data portal
Website	https://data.gov.ie/dataset/disability-carers-and-voluntary-activities
Added value	The number of persons with disabilities and their carers in communal establishments or private houses, classified by sex, age group, single year of age, marital status, type of disability, number of disability types, region and other geographic areas, principal economic status, socio economic group, social class, employment status, occupational group, nature of occupancy, nationality, birthplace, age when fulltime education ceased, level of education and qualifications, means of travel to work, school or college, status in family nucleus.
File format	TSV / GeoSpatial
License	Creative Commons Attribution 4.0

Source ID	IE-S8
Dataset name	Tips for healthy living
Data source	HSE
Website	https://www.hse.ie/eng/services/list/4/olderpeople/tipsforhealthyliving
Added value	Common health issues for old and young, and some useful tips to help keep on the go.
File format	Text
License	Unknown

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Source ID	IE-S9
Dataset name	Information for carers and relatives
Data source	HSE
Website	https://www.hse.ie/eng/services/list/4/olderpeople/carersrelatives/
Added value	Information for carers and relatives, such as supports and training for carers, carers allowance, community welfare services.
File format	Text
License	Unknown

Real-time data sources, such as Twitter or Facebook feeds, are also important to collect trending topics on important healthcare matters. For example, the Twitter account of the HSE, or from organisations dealing especially with long term care at home are interesting to collect latest updates automatically. From the list provided in Appendix 2, a number of key social media accounts is provided.

Feed ID	IE-F1
Feed URL	www.facebook.com/HSELive
Feed info	The official Facebook page of the HSE Health Service Executive organisation, with posts about ongoing programs or support services for the elderly.
Feed examples	

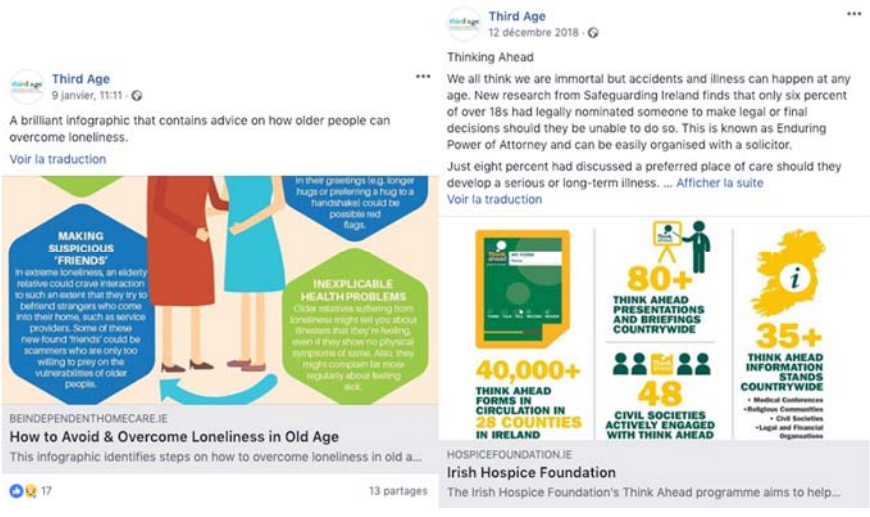
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed ID	IE-F2
Feed URL	https://twitter.com/welfare_ie
Feed info	Official Twitter account of the Department of Employment Affairs and Social Protection, who gathers relevant initiatives for improving government services and access to digital platforms.
Feed examples	

Feed ID	IE-F3
Feed URL	https://twitter.com/carefolkteam
Feed info	Award winning digital toolbox & community designed to make caregiving easier. Secure, and easy to use. It is their mission to help & support caregivers. Relevant to link to new reports on the home care situation and testimonials.
Feed examples	

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed ID	IE-F4
Feed URL	https://twitter.com/ALONE_IRELAND
Feed info	ALONE helps older people in need to age at home. They work with those who have difficulties with loneliness, ill health, poverty, poor housing or homelessness. Their feed reports testimonies from successful events and support options to the elderly facing loneliness.
Feed examples	

Feed ID	IE-F5
Feed URL	https://www.facebook.com/thirdageireland
Feed info	Third Age Ireland is a national voluntary organisation based in Ireland which both values older people's contribution to society and helps to meet their needs through innovative programmes. Their feed provides useful infographics on facts and options people have regarding long term care issues.
Feed examples	

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed ID	IE-F6
Feed URL	https://twitter.com/myhomecare_ie
Feed info	Promoting independent living within a safe comfortable environment. They tweet about healthcare, support for carers and issues affecting those who require care.
Feed examples	 

3.2 THE SPANISH PILOT SITE - TARRAGONA AREA

3.2.1 List of long-term care services

A large number of websites and organizations related to healthcare services for older adults exist in Spain. A shortlist of long-term care service providers has been identified for Catalonia area, which will be stored within the knowledge base under the list of services already available.

Service ID	SP-1
Service name	Information system for people with care needs
Service provider	Department of Work, Social Affairs and Families (Catalan Regional Government)
Website	http://treballiaferssocials.gencat.cat/ca/ambits_tematics/persones_amb_dependencia/
Goal	A website listing older people and LTC services provided in Catalonia
Special conditions	None
Datasets	List of services, laws and resources related to LTC

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Service ID	SP-2
Service name	*Amics de la Gent Gran* (Friends of the Elderly)
Service provider	*Fundació Amics de la Gent Gran*
Website	http://amicsdelagentgran.eu/es
Goal	• Volunteers, who visit older adults at home 1 or 2 days per week to reduce isolation and loneliness. • Bringing friendship and emotional companionship. • Loneliness observatory. • Volunteers' training program. • Social awareness program.
Special conditions	• Free and confidential service. • Previous evaluation of Social Work and/or Social Services needed.
Datasets	http://amicsdelagentgran.eu/ca/transparencia

Service ID	SP-3
Service name	Informal carers association (association for family caregivers, so as to support each other).
Service provider	*Associació de cuidadors familiars* (Informal carers' association)
Website	https://cuidadorsfamiliars.wordpress.com/
Goal	*Associació de cuidadors familiars* is an association of informal carers (all relatives) located in the city of Barcelona. Its aim is to help and share experiences among them, provide training and support for families to better cope with an increase of care burden due to care needs.
Special conditions	None
Datasets	

Service ID	SP-4
Service name	Family caregiver support
Service provider	*La colla cuidadora* (The caregivers' team)
Website	http://www.lacollacuidadora.net/
Goal	*La colla cuidadora* is a civil group of f informal carers (all relatives) established in the city of Barcelona.Its aim is to help and share experiences and to receive training for taking care of their relatives with care needs.
Special conditions	None

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Datasets	

Service ID	SP-5
Service name	Sírius – *Centre per a l'Autonomia Personal* (Centre for Personal Autonomy)
Service provider	Department of Work, Social Affairs and Families (Catalan Regional Government)
Website	http://sac.gencat.cat/sacgencat/AppJava/organisme_fitxa.jsp?codi=5997
Goal	To inform and advise about solutions for people with disabilities and care needs. To inform and train their caregivers.
Special conditions	Addressed to people with disabilities and care needs, to their families and their formal and informal caregivers; health care professionals, associations and students.
Datasets	http://sac.gencat.cat/sacgencat/AppJava/document.jsp?doc=7_12051.pdf

Service ID	SP-6
Service name	Ceapat – *Centro de Referencia Estatal de Autonomía Personal y Ayudas Técnicas* (State Centre for Personal Authonomy and Technical Support)
Service provider	Ministry of Health, Consumption and Social Welfare
Website	http://www.ceapat.es/ceapat_01/el_ceapat/index.htm
Goal	Catalogue of support products and goods for improve autonomy.
Special conditions	None
Datasets	

3.2.2 List of third-party data sources

The Open Data portal from the Spanish government and other platforms provide valuable data sources based on the 2016 census taken throughout the country and other matters relevant to long term care.

Source ID	SP-S1
Dataset name	System for the Autonomy and Care of Dependent Person (*Sistema para la Autonomıa y Atencion a la Dependencia*, SAAD)
Data source	IMSERSO (Institute for Older Persons and Social Services) – Ministry of Health, Consumption and Social Welfare Open data portal
Website	http://www.imserso.es/imserso_01/documentacion/estadisticas/info_d/estadisticas/est_inf/otros_inf/id/index.htm

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Added value	Offers monthly statistics about people with long-term care needs
File format	PDF and DOC published monthly
License	Unknow

Source ID	SP-S2
Dataset name	LTC in Catalonia
Data source	Department of Work, Social Affairs and Families (Catalan Regional Government)
Website	http://treballiaferssocials.gencat.cat/ca/ambits_tematics/persones_amb_dependencia/dades_dependencia/
Added value	Statistical of forms, programs, services of Dependency System of Catalonia
File format	PDF
License	Unknown

Source ID	SP-S3
Dataset name	People with disabilities and care needs. Working with people with disabilities.
Data source	INE – *Instituto Nacional de Estadística* (National Institute for Statistics)
Website	https://datos.gob.es/es/catalogo/ea0010587-situacion-de-dependencia-reconocida-por-grado-de-discapacidad-nacional-estadistica-del-empleo-de-las-personas-con-discapacidad2
Added value	Identification of people with disabilities and care needs.
File format	CSV: http://www.ine.es/jaxi/files/_px/es/csv_c/t22/p320/serie/10004.csv_c HTML: http://www.ine.es/jaxi/Tabla.htm?path=/t22/p320/serie/&file=10004.px JSON: http://servicios.ine.es/wstempus/js/es/DATOS_TABLA/t22/p320/serie/10004.px?tip=AM
License	Creative Commons Attribution 4.0

Source ID	SP-S4
Dataset name	National Health Survey (2017)
Data source	INE – *Instituto Nacional de Estadística* (National Institute for Statistics)

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Website	https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176783&menu=resultados&idp=1254735573175
Added value	Information about health status, use of the health services and health determinants.
File format	TXT and XLSX (both in a ZIP file) can be downloaded in the same link: https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176783&menu=resultados&secc=1254736195295&idp=1254735573175 PDF and EXCEL files can be downloaded in: https://www.mscbs.gob.es/estadEstudios/estadisticas/encuestaNacional/encuestaNac2017/encuestaResDetall2017.htm
License	Unknown

Source ID	SP-S5
Dataset name	Catalonia Health Survey (2011-2016)
Data source	Department of Health - (Catalan Regional Government)
Website	http://salutweb.gencat.cat/ca/el_departament/estadistiques_sanitaries/enquestes/esca/resultats_enquesta_salut_catalunya/
Added value	Information about health status, lifestyles and health services use.
File format	PDF : http://salutweb.gencat.cat/web/.content/_departament/estadistiques-sanitaries/enquestes/Enquesta-de-salut-de-Catalunya/documents-tecnics/document_tecnic_esca_2011_2016.pdf
License	Creative Commons Attribution 3.0

Real-time data sources, such as Twitter or Facebook feeds, are also important to collect trending topics on important long-term care matters.

Feed ID	SP-F1
Feed URL	https://www.facebook.com/imserso
Feed info	The official Facebook page of the IMSERSO (Institute for Older Persons and Social Services), includes posts about ongoing programs on support services for older adults.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed examples	 

Feed ID	SP-F2
Feed URL	https://www.facebook.com/MinSanidad/
Feed info	The official Facebook page of the Ministry of Health, Consumption and Social Welfare, posts about ongoing programs for support and improvement in health and welfare protection.
Feed examples	 

Feed ID	SP-F3
Feed URL	https://www.facebook.com/treballiaferssocialscat/
Feed info	The official Facebook page of the Department of Work, Social Affairs and Families (Catalan Regional Government), posts about ongoing programs supporting health care and welfare improvement.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed examples	

Feed ID	SP-F4
Feed URL	https://twitter.com/sanidadgob
Feed info	The official account in Twitter of the Ministry of Health, Consumption and Social Welfare of Spain.
Feed examples	

Feed ID	SP-F5
Feed URL	https://twitter.com/imserso
Feed info	The official account in Twitter of the IMSERSO (Institute for Older Persons and Social Services) posts about ongoing programs on services for older adults.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed examples	

Feed ID	SP-F6
Feed URL	https://twitter.com/aferssocialscat
Feed info	The official account of the Department of Work, Social Affairs and Families (Catalan Regional Government)
Feed examples	

Feed ID	SP-F7
Feed URL	https://www.facebook.com/amicsdelagentgran

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed info	*Amics de la Gent Gran* (Friends of the Elderly) is a NGO established in Catalonia that fights against the isolation and loneliness of older people with the support of volunteers and social workers.
Feed examples	

Feed ID	SP-F8
Feed URL	https://twitter.com/amicsgentgran
Feed info	*Amics de la Gent Gran* (Friends of the Elderly) is a European NGO also established in Catalonia that fights against the isolation and loneliness of older people with the support of volunteers and social workers.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Feed examples	

Feed ID	SP-F9
Feed URL	https://www.facebook.com/AssociacioDeCuidadorsDeGracia/
Feed info	*Associació de cuidadors familiars* (Informal carers' association, family caregivers). NGO established in the city of Barcelona. They organize some activities to support informal carers (family caregivers).
Feed examples	

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3.3 THE HUNGARIAN PILOT SITE – BUDAPEST AREA

3.3.1 List of long-term care services

A shortlist of long-term care service providers has been identified for the Budapest and Diocese of Szeged-Csanad, which will be stored within the knowledge base under the list of services already available.

Service ID	HU-1
Service name	Elderly Care Home
Service provider	Municipality of Metropolitan Municipality Kamaraerdei Elderly Home / Fővárosi Önkormányzat Kamaraerdei Idősek Otthona
Website	http://www.kamerdo.hu/index.php
Goal	The Elderly Home aims to assist and support people to remain at home and support informal carers: Care-nursing (dress-washing, regular cleaning, own kitchen - catering, home care specialist, screening tests, physiotherapist, physiotherapist, 24-hour nurse) Leisure services: excursions, presentations, celebrations, events, classical music program, library, crafts Other services: hairdresser, pedicurist-manicurist, dental technician - for a fee
Datasets	

Service ID	HU-2
Service name	Elderly Care Home
Service provider	St. Elisabeth Elderly Home of Árpád House / Árpád-házi Szent Erzsébet Idősek Otthona
Website	http://www.szterzsebetotthon.hu/
Goal	The Home aims to help the inhabitants to live a tolerable life in a physical and spiritual sense.
Special conditions	Cleaning, maintenance as needed, renovation Washing, ironing and repair of clothing, other textiles physical activities - joint gymnastics, individual physiotherapy, walking, intellectual and entertaining activities - watching TV, listening to music, presentations, reading, quiz, card and board games, handicrafts, cultural activities - celebrations, theater, concert tours, exhibitions, excursions 24-hour nurse service. Regular medical supervision. Daily 24-hour service, professional care, and care for skilled workers

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	Provision of health and medical care: regular medical supervision ensures the continuous monitoring of the health status of the persons provided and, if necessary, the organization of specialist medical and hospital care. Three meals a day are provided. Diet as needed
Datasets	

Service ID	HU-3
Service name	Elderly Care Home
Service provider	John Calvin Reformed Elderly Home / Kálvin János Református Idősek Otthona
Website	http://kalvinotthon.hu/
Goal	• full service • regular medical care and care • nursing, physiotherapy, mental hygiene, patient transport • Laundry • 3x meal • care tasks • group programs, excursions, events, exhibitions visiting
Datasets	

Service ID	HU-4
Service name	Social Home Service
Service provider	Urban Human Service and Social Services Nursing Home / Városi Humánsegítő és Szociális Szolgálat Idősek Otthona
Website	http://human.mezobereny.hu/IdosekOtthona
Goal	three meals a day regular medical care care - care Providing medicine and medical aids the possibility of practicing religion Useful and cultured spending of leisure time Mental care advocacy

Service ID	HU-5
Service name	Social Home

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Service provider	Social Home of Ruzsa
Website	http://nolak.hu/
Goal	Complete care • 24-hour monitoring • Medical care • Mental health care and employment. • Disabled access areas • Buffet • Hairdressing salon

3.3.2 List of third-party data sources

Static datasets are valuable in that they offer snapshots of the healthcare situation for the elderly. The Open Data portal from the City of Tampere provides valuable data sources as well as social media feeds from various platforms and active organisations.

Source ID	HU-S1
Dataset name	Survey about general practitioners and elderly care
Data source	Semmelweis University, Faculty of Public Health, Institute of Mental Health, Budapest
Website	https://akademiai.com/doi/pdf/10.1556/650.2018.30959
Added value	Research about long-term care systems, their sustainability, and the difficulties of aging societies.
File format	PDF

Source ID	HU-S2
Dataset name	Central Statistics Office / Központi Statisztikai Hivatal
Data source	Population by age group
Website	http://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_wdsd004b.html
Added value	Data on the number of Hungarian population by age groups
File format	XLS

Source ID	HU-S3

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

Dataset name	Yearbook of Welfare Statistics
Data source	Central Statistics Office / Központi Statisztikai Hivatal
Website	http://www.ksh.hu/docs/hun/xftp/idoszaki/evkonyv/szocialis_evkonyv_2016.pdf
Added value	• Age distribution of persons in care • Assistance for people over 65 years of age • Distribution of social homes
File format	PDF

3.4 THE FINNISH PILOT SITE - CENTRAL TAMPERE AREA

3.4.1 List of long-term care services

A shortlist of long-term care service providers has been identified for the Central area of Tampere City, which will be stored within the knowledge base under the list of services already available.

Service ID	FI-1
Service name	Kotitori - Home care service integrator
Service provider	Luona Oy Ltd, purchased by the City of Tampere
Website	https://ekotitori.tampereenkotitori.fi/palvelut/palvelutuotekuvaukset
Goal	Kotitori aims to assist and support people to remain at home and support informal carers: ● Innovative home care service integration solution for ageing people ● Services provided to elderly people living at home, both public and private ● Information office, one-stop shop, for elderly people and their relatives where one can find help from how to get cleaning services to how to apply to sheltered housing
Special conditions	The service providers must tender to join the portal, and the City of Tampere, as the purchaser, monitors regularly the quality of the services via digital feedback sheets available in every service included in Kotitori.
Datasets	There are 550 service providers listed in 16 different categories (links below): ● Apteekkipalvelut - pharmacy services (29 service providers) ● Asumispalvelut - housing services (13) ● Ateriapalvelut - meal services (22) ● Henkilökohtaisen hyvinvoinnin palvelut - individual well-being services (43) ● Hyvinvointeknologiapalvelut - wellbeing technology services (5) ● Kauppapalvelut - shopping services (29) ● Koti- ja ympäristöpalvelut - home and environment services (53)

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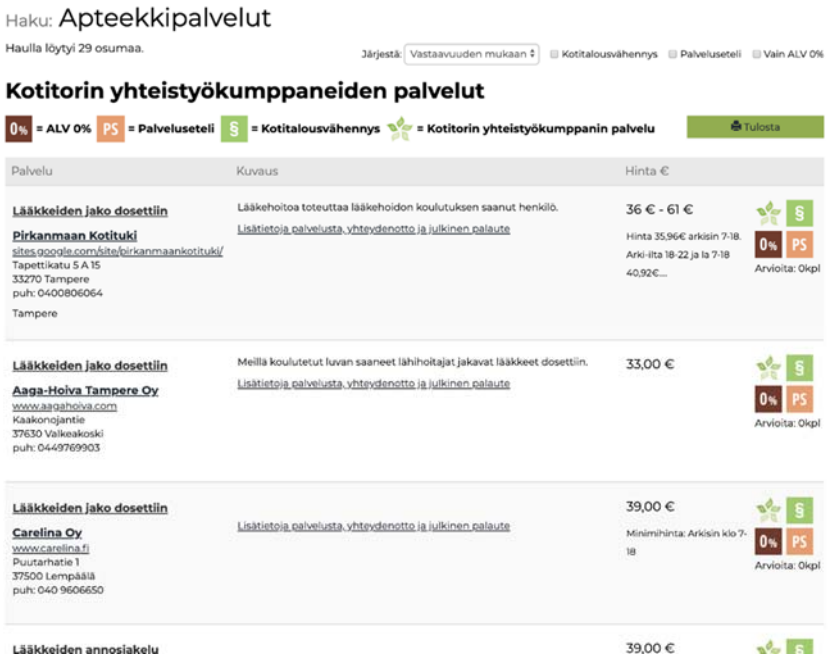
	• Kotihoito-palvelut - housekeeping services (122) • Kuntoutuspalvelut - rehabilitation services (37) • Muut palvelut - other services (3) • Saattoapupalvelut - escorting services (68) • Siivouspalvelut - cleaning services (103) • Suun terveydenhuollon palvelut - oral care services (0) • Terveyden- ja sairaanhoitopalvelut - health and medical care services (12) • Turvapalvelut - safety services (9) • Vaihtoehtohoitopalvelut - alternative treatment services (2) For example, the page listing the pharmacies in the Tampere area reports the address and a description of each provider. 

Service ID	FI-2
Service name	Service centre
Service provider	The City of Tampere
Website	Tampere City's five Service Centers https://www.tampere.fi/sosiaali-ja-terveyspalvelut/ikaihmisten-palvelut/virkistystoiminta/palvelukeskukset/omat.html Contracted Service Centers https://www.tampere.fi/sosiaali-ja-terveyspalvelut/ikaihmisten-palvelut/virkistystoiminta/palvelukeskukset/sopimussuhteiset.html
Goal	• Service Centers are open to all older people in Tampere. In the Service Center you can

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	• participate in diverse recreational activities and groups and meet other people. There is • a lunch restaurant and café in every Service Center.
Special conditions	
Datasets	

Service ID	FI-3
Service name	Home care
Service provider	The City of Tampere
Website	https://www.tampere.fi/sosiaali-ja-terveyspalvelut/ikaihmisten-palvelut/kotona-asuvalle/kotihoito.html
Goal	Help provided to older people to live safely and comfort in their own homes
Special conditions	
Datasets	

Service ID	FI-4
Service name	Arkeen Voimaa - Chronic Disease Self-Management Program (CDSMP) - Study groups
Service provider	The City of Tampere
Website	http://www.arkeenvoimaa.fi/ (national) https://www.tampere.fi/sosiaali-ja-terveyspalvelut/terveyspalvelut/omahoito-ja-terveysneuvonta/ryhmaneuvonta/arkeen-voimaa.html (municipal)
Goal	Arkeen Voimaa – study groups support people with long term conditions (fatigue, weariness, loneliness, chronic diseases…) in the challenges of everyday life.
Special conditions	The group leaders are volunteers: no resources of nurses will be needed.
Datasets	

3.4.2 List of third-party data sources

Static datasets are valuable in that they offer snapshots of the healthcare situation for the elderly. The Open Data portal from the City of Tampere provides valuable data sources as well as social media feeds from various platforms and active organisations.

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Source ID	FI-S1
Dataset name	Public health centres in Tampere
Data source	City of Tampere's open data portal
Website	https://data.tampere.fi/data/en_GB/dataset/tampereen-kaupungin-terveysasemat
Added value	Identification of potential gaps in the coverage of ageing population with public health centres
File format	CSV, WFS, GeoJSON, ShapeFile
License	Creative Commons Attribution 4.0

Source ID	FI-S2
Dataset name	Statistics on elderly care and a comparison between the six largest cities
Data source	City of Tampere's open data portal
Website	https://data.tampere.fi/data/en_GB/dataset/kuuden-suurimman-kaupungin-vanhustenpalvelujen-vertailu-vuonna-2011
Added value	Identification whether Tampere represents the general situation in Finland in respect to the ageing population
File format	Excel
License	Creative Commons Attribution 4.0

Source ID	FI-S3
Dataset name	Statistical information on welfare and health in Finland
Data source	Sotkanet
Website	https://sotkanet.fi/sotkanet/en/data/indicators
Added value	Over 2000 indicators on health, welfare and functioning of the service-system in Finland. Also a lot of international comparisons are available.
File format	REST API for Open Data https://yhteistyotilat.fi/wiki08/pages/viewpage.action?pageId=27557907
License	

Real-time data sources, such as Twitter or Facebook feeds, are also important to collect trending topics on important healthcare matters.

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Feed ID	FI-F1
Feed URL	https://www.facebook.com/Kotitori/
Feed info	Official Facebook site of Kotitori
Feed examples	

3.4.3 National/EU level insights

Ideation on innovative long-term care services at national or EU level requires different datasets that allow the platform to put a global context around a given co-creation exercise on a specific topic. Local statistics or services are not immediately relevant, unless they are representative of the county as a whole. One needs to see the full picture as to what a country has to offer in terms of health services, what the status quo is compared to other countries to identify lack of resources, challenges and other opportunities to do things better and more efficiently.

A number of well-known databases exist to provide insights and indicators as to what each EU country can offer in relation to health services for the elderly. A sample is given below, with some examples of the kind of data that is publicly available that the knowledge base can ingest to produce recommendations and context to ongoing discussions on the co-creation platform.

Source ID	GS-1
Source name	The OECD database
Service provider	The Organisation for Economic Co-operation and Development (OECD)
Website	https://data.oecd.org
Added value	The OECD's goal is to stimulate economic progress and world trade by comparing policy experiences, seeking answers to common problems, and by identifying good practices and coordinating domestic and international policies of its members. The OECD database allows anyone to find, compare and share the latest OECD data: charts, maps, tables and related publications. This is of utter value for the SoCaTel

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	knowledge base as it provides national level indicators that will provide factual data on matters such as number of hospital beds and radiotherapy equipment per country. This will allow the end-users to contextualise their ideation process around the opportunities and problems identified.
Datasets example	More than 800 datasets related to health matters affecting the elderly in EU countries, such as data on health expectancy, health spending, nurses and doctors head counts, etc.  Showing 831 results for "health old" Health TOPIC Alcohol consumption INDICATOR in Health risks Life expectancy at 65 INDICATOR in Health status Overweight or obese population INDICATOR in Health risks Health spending INDICATOR in Health resources Doctors INDICATOR in Health resources Life expectancy at birth INDICATOR in Health status Medical graduates INDICATOR in Health resources Nurses INDICATOR in Health resources Pharmaceutical spending INDICATOR in Health resources A specific example of dataset that will be included in the knowledge base is the number of hospital beds per 1000 inhabitants in each country, with major discrepancies that can showcase current issues. For example, Ireland has a major issue with patients staying overnight in temporary beds located in corridors, due to the lack of hospital beds. This issue deters older persons to travel to the hospital and potential solutions can be thought of once all stakeholders are in the same "virtual" room.

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	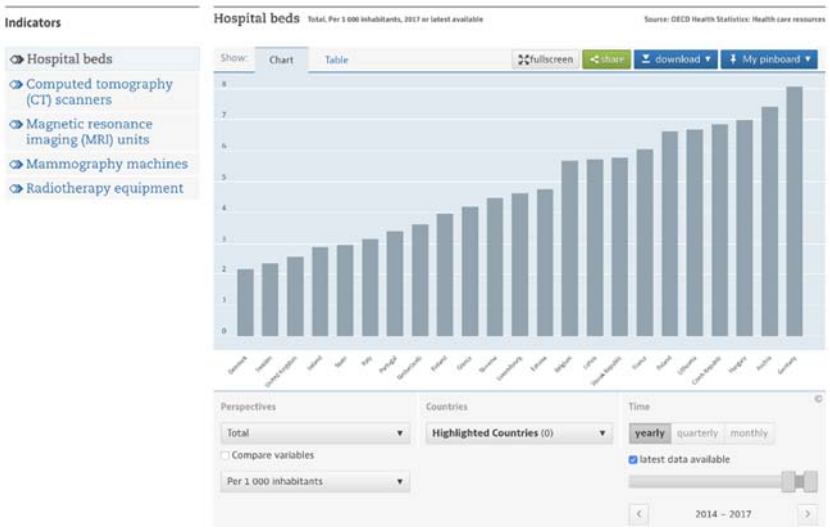 Most OECD datasets can be manually exported in .csv file format, or via the OECD's application programming interfaces (APIs) providing datasets in JSON and XML formats: https://data.oecd.org/api/ The exact list of datasets that will be imported in the knowledge base is not yet defined, but adaptation to the OECD's API will allow us to seamlessly add new insights valuable for the co-creation platform.
Licensing	The OECD's terms and conditions state that the reproduction and translation of the Material is authorised for commercial and non-commercial purposes within established limits. In particular, one can extract from, download, copy, share and embed Data for any purpose, even for commercial use. One must give appropriate credit to the OECD by using the citation associated with the relevant Data, or, if no specific citation is available, one must cite the source information using the following format: OECD (year), (dataset name),(data source) DOI or URL (accessed on (date)).

Source ID	GS-2
Source name	The WorldBank Open Data portal
Service provider	The WorldBank
Website	https://data.worldbank.org/ https://datacatalog.worldbank.org/
Added value	The WorldBank's goal is to end extreme poverty and promote shared prosperity in a sustainable way. Their data platform helps engage the development community with real-world statistics, so actions can take place based on factual data. The data portals provide general statistics and trends about global development, and valuable datasets can be extracted to support the ideation process on long term care services.
Datasets example	A specific example of dataset that will be included in the knowledge base are statistics about health nutrition, which can provide insights relevant to the quality of nutrition in a

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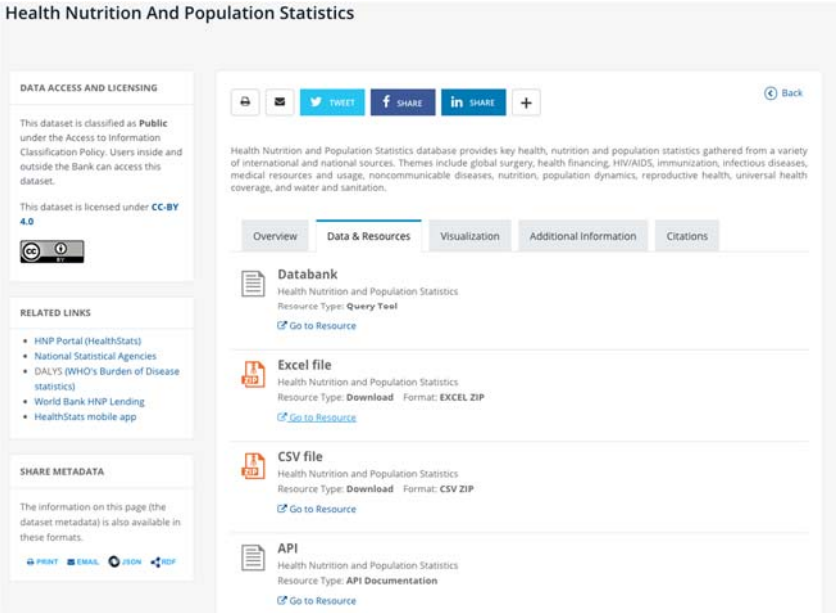
	country, and help devise schemes that can improve nutrition quality for the elderly.  Other datasets will be integrated as needed. WorldBank datasets can be exported in various file formats, such as .csv or Excel, but also via the WorldBank's application programming interfaces (APIs): http://data.worldbank.org/developers
Licensing	The World Bank Group makes data publicly available according to open data standards and licenses datasets under the Creative Commons Attribution 4.0 International license (CC-BY 4.0). Many datasets are available under other licenses. They are labeled accordingly, and when they are accessed by users, users agree to comply with all of the terms of the respective licenses. https://datacatalog.worldbank.org/public-licenses

Source ID	GS-3
Source name	The EuroStat database
Service provider	Eurostat
Website	https://ec.europa.eu/eurostat/data/database
Added value	Eurostat is the statistical office of the European Union whose mission is to provide general statistics and trends about global development, that enable comparisons between countries and regions.

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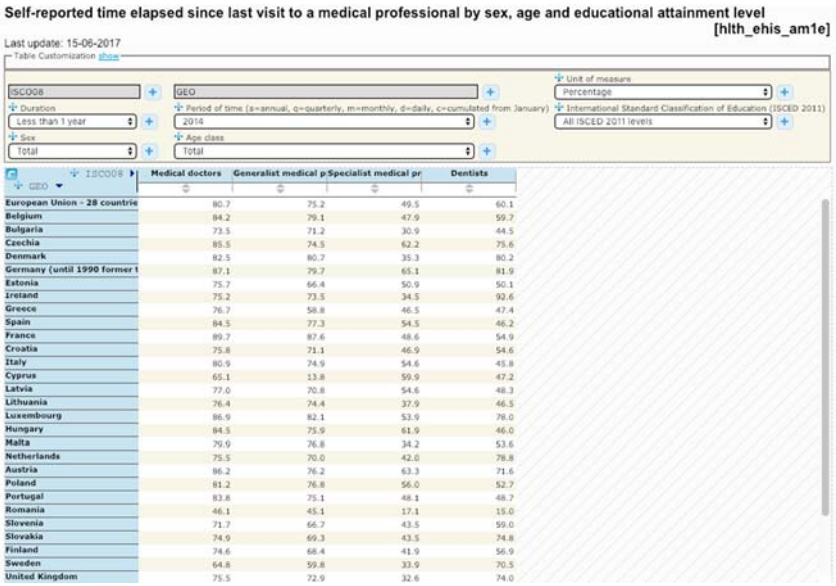
	The EuroStat database contains many datasets related to health and healthcare services, which can provide factual data to motivate changes or the introduction to new long term care services.
Datasets example	A specific example of dataset that will be included in the knowledge base is the self-reported time elapsed since last visit to a medical professional by sex, age and educational attainment level.  **Self-reported time elapsed since last visit to a medical professional by sex, age and educational attainment level [hlth_ehis_am1e]** Last update: 15-06-2017 Table Customization show ISCO08 · GEO · Unit of measure: Percentage · Duration: Less than 1 year · Period of time (a=annual, q=quarterly, m=monthly, d=daily, c=cumulated from January): 2014 · International Standard Classification of Education (ISCED 2011): All ISCED 2011 levels · Sex: Total · Age class: Total ISCO08 / GEO · Medical doctors · Generalist medical p · Specialist medical pr · Dentists European Union - 28 countrie 80.7 75.2 49.5 60.1 Belgium 84.2 79.1 47.9 59.7 Bulgaria 73.5 71.2 30.9 44.5 Czechia 85.5 74.5 62.2 75.6 Denmark 82.5 80.7 35.3 80.2 Germany (until 1990 former t 87.1 79.7 65.1 81.9 Estonia 75.7 66.4 50.9 50.1 Ireland 75.2 73.5 34.5 92.6 Greece 76.7 58.8 46.5 47.4 Spain 84.5 77.3 54.5 46.2 France 89.7 87.6 48.6 54.9 Croatia 75.8 71.1 46.9 54.6 Italy 80.9 74.9 54.6 45.8 Cyprus 65.1 13.8 59.9 47.2 Latvia 77.0 70.8 54.6 48.3 Lithuania 76.4 74.4 37.9 46.5 Luxembourg 86.9 82.1 53.9 78.0 Hungary 84.5 75.9 61.9 46.0 Malta 79.9 76.8 34.2 53.6 Netherlands 75.5 70.0 42.0 78.8 Austria 86.2 76.2 63.3 71.6 Poland 81.2 76.8 56.0 52.7 Portugal 83.8 75.1 48.1 48.7 Romania 46.1 45.1 17.1 15.0 Slovenia 71.7 66.7 43.5 59.0 Slovakia 74.9 69.3 43.5 74.8 Finland 74.6 68.4 41.9 56.9 Sweden 64.8 59.8 33.9 70.5 United Kingdom 75.5 72.9 32.6 74.0 Such a dataset can illustrate that a country has a problem with older persons not visiting professionals as regularly as they should, and this could motivate ideation on why this is happening and how to remediate. Eurostat datasets can be exported in various file formats, such as .csv or Excel, but also via the Eurostat's application programming interfaces (APIs): https://ec.europa.eu/eurostat/web/json-and-unicode-web-services
Licensing	Eurostat has a policy of encouraging free re-use of its data, both for non-commercial and commercial purposes. All statistical data, metadata, content of web pages or other dissemination tools, official publications and other documents published on its website, with the exceptions listed below, can be reused without any payment or written License provided that: ● the source is indicated as Eurostat; ● when re-use involves modifications to the data or text, this must be stated clearly to the end user of the information. https://ec.europa.eu/eurostat/about/policies/copyright

Source ID	GS-4
Source name	PubMed MeSH database
Service provider	US National Library of Medicine National Institutes of Health

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Website	https://www.ncbi.nlm.nih.gov/pubmed/
Added value	PubMed is a free resource that is developed and maintained by the National Center for Biotechnology Information (NCBI), at the U.S. National Library of Medicine (NLM), located at the National Institutes of Health (NIH). PubMed comprises more than 29 million citations for biomedical literature from MEDLINE, life science journals, and online books. Their MeSH (Medical Subject Headings) database is the NLM controlled vocabulary thesaurus used for indexing articles for PubMed. https://meshb.nlm.nih.gov/search The MeSH vocabulary thesaurus is valuable for SoCaTel in that it provides a very detailed taxonomy of health related illnesses, and any other topic related to health. This data can allow the SoCaTel platform to automatically suggest or clarify what end-users are talking about, to ensure discussions and co-creation is precise and uses the correct idioms.
Datasets example	A snapshot of the vocabulary thesaurus is given below, showing the wealth of information that will can be inserted into the knowledge base. The snapshot shows how mental disorders are categorised in the medical field, so when someone discusses mental disorders within a discussion topic the knowledge base will be able to provide such taxonomy to clarify the type of mental disorders that exist to try to focus on the exact issue being discussed.

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	Anatomy [A] Organisms [B] Diseases [C] Chemicals and Drugs [D] Analytical, Diagnostic and Therapeutic Techniques, and Equipment [E] Psychiatry and Psychology [F] Behavior and Behavior Mechanisms [F01] Psychological Phenomena [F02] Mental Disorders [F03] Anxiety Disorders [F03.080] Bipolar and Related Disorders [F03.084] Disruptive, Impulse Control, and Conduct Disorders [F03.250] Dissociative Disorders [F03.300] Elimination Disorders [F03.388] Feeding and Eating Disorders [F03.400] Mood Disorders [F03.600] Depressive Disorder [F03.600.300] Cyclothymic Disorder [F03.600.500] Motor Disorders [F03.608] Neurocognitive Disorders [F03.615] Neurodevelopmental Disorders [F03.625] Neurotic Disorders [F03.650] Paraphilic Disorders [F03.657] Personality Disorders [F03.675] Schizophrenia Spectrum and Other Psychotic Disorders [F03.700] Sexual Dysfunctions, Psychological [F03.835] Sleep Wake Disorders [F03.870] Somatoform Disorders [F03.875] Substance-Related Disorders [F03.900] Trauma and Stressor Related Disorders [F03.950] Behavioral Disciplines and Activities [F04] Phenomena and Processes [G] Disciplines and Occupations [H] Anthropology, Education, Sociology, and Social Phenomena [I] Technology, Industry, and Agriculture [J] Humanities [K] Information Science [L] NLM produces Medical Subject Headings XML, ASCII, MARC 21 and RDF formats, which can be download in bulk downloads: https://www.nlm.nih.gov/databases/download/mesh.html MeSH data in RDF format is also available from their E-utilities API, through SPARQL and URI Requests: https://hhs.github.io/meshrdf/sparql-and-uri-requests
Licensing	NLM freely provides MeSH data.

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	Users of the data agree to: ● acknowledge NLM as the source of the data in a clear and conspicuous manner, ● properly use registration and/or trademark symbols when referring to NLM products, and ● not indicate or imply that NLM has endorsed its products/services/applications. Users who republish or redistribute the data (services, products or raw data) agree to: ● maintain the most current version of all distributed data, or ● make known in a clear and conspicuous manner that the products/services/applications do not reflect the most current/accurate data available from NLM and/or identify the version of MeSH being used.

4. THE CREATION OF A UNIFIED DATA MODEL

A unified data model is proposed to store and link all data collected from external data sources, as presented in section 2 and 3, for use as the data repository component of the knowledge base in support of the co-creation process within the SoCaTel platform.

Promoted by the Semantic Web initiatives, such as the 5 stars initiative for Open Data, the use of ontologies to define a conceptual and shared data representation is considered as putting in place a universal vocabulary that enables the highest level of data interoperability.

In the Deliverable D3.2 “SoCaTel Platform Concrete Architecture Design”, a first draft of the conceptual framework was defined. The conceptual framework is the ontology network that defines all the different entities of the SoCaTel “data ecosystem” (domain knowledge, co-creation and co-design activities, insightful datasets collected from external data sources). The conceptual framework is composed by two different kinds of ontologies:

- A core ontology: which is an ontology that consists only of the core entities (the key entity / minimal concept of the data model) and the relationships required to understand the behaviour with other concepts. This is the most generic layer of the conceptual framework to describe SoCaTel data and from which all the entities are connected and defined;

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- The entity specific ontologies: This kind of ontology is specific for each entity. If the core ontology defines how the main concepts/entities are defined and related, the specific entity ontology defines all the characteristics of one entity, the definition of the class itself independently of the other ontologies.

The methodologies that are followed to design and develop the SoCaTel ontologies are two:

- MOTPlus[1], a methodology developed by Montreal University (UQAM/LICEF) for knowledge representation. It provides a graphical and semi-formal language that permits to define concepts, procedures, principles and their relations. MOT was used to design the high-level conceptual data model.
- The Methodontology,[2] one of the most comprehensive ontology engineering methodologies as it is one for building ontologies either from scratch, reusing other ontologies as they are, or by a process of re-engineering them. This methodology is used to define in more detail all the different entities and develop in an iterative way the ontologies.

For the SoCaTel conceptual data model two important kinds of ontologies are required:

- The co-creation ontologies to represent all the co-creation activities performed within the co-creation platform. It is mainly focused on the activities (4 phases), entities (main concepts) and the thematic description (semantic annotation). This model is used to instantiate all the user activities and to link them with the knowledge that is collected in the knowledge base.
- The healthcare domain ontology: it is the thematic ontology that will permit to describe all the topics related to the health domain and that could be used to semantically annotate the content that will be managed within the SoCaTel co-creation platform.

[1] https://fr.wikipedia.org/wiki/Mod%C3%A9lisation_par_objets_typ%C3%A9s
[2] http://oa.upm.es/5484/

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4.1 CO-CREATION ONTOLOGIES

The core ontology was introduced in deliverable D3.2 with all the main entities of the SoCaTel ecosystem. This high-level conceptual data model defined the important concepts that has to be represented for each co-creation phase.

For this updated version of the conceptual framework, four important aspects have been considered in order to refine and improve the logical coherence and the expressiveness of the model:

- Functional requirements (D3.2 section 3.2): all the platform functionalities and the data they will process refer to a semantic representation in the data model.

- Technical requirements (D3.2 section 3.3): the heterogeneity of the knowledge that is managed by the platform should be easily organized and tracked in order to facilitate the evolution and the maintenance of the knowledge base. Temporal and multilingual aspects are crucial for the maintenance.

- Also, even if the design of the platform frontend, reflects most of the functional and technical requirements, some adaptation was done in order to provide a consistent user experience. For instance, it offers a global view of all functionalities and required data which imply more detailed and concrete requirements regarding the ontology's definition. It also permits to verify the global consistency of the data model and its relation with the user activities and the data processed by the platform.

- Existing data sources: as the knowledge base will be generated from different data sources, it is important to control the provenance of the data to avoid duplicates and evaluate the reliability of the data over the time

In the next sections, the consolidated results of the ontologies are presented.

4.1.1 Co-creation core ontology

The design of the ontologies is a long process as it requires several iterations where functional requirements and platform development are constantly improved.

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Based on the mentioned considerations, the conceptual data model was fully refined by performing the following activities:

- Refinement and consolidation of the Core ontology: what are the new, modified and removed concepts;
- Definition of the specific entity ontologies: detailed description of all the entities defined in the core ontology;
- Implementation of the conceptual data model in OWL format: all the concepts, properties, relation (cardinalities, data types, etc.) are specified in OWL format and released as a first implementation of the data model.

The ontologies should consider all the entities and activities involved in the co-creation activities. First, the general ontology is introduced to present all the main entities required during the whole process. Below is a basic definition for all the main concepts and later, they will be presented for every step of the process:

- Needs: are all the issues or specific needs that users identified and want to solve through a co-creation process.
- Users: are all the members of the SoCaTel platform that are involved in one or several steps of the co-creation process. The users are the participants (registered users and organizations), the moderators of the groups and the parties involved in the development of the LTC services.
- Group: is the set of users that are involved to discuss about an issue and define an idea through a co-creation process.
- Idea: is the result of the co-creation activities performed by a group about issue/needs.
- Topic: is the theme that is related to an issue, a group, or a service.
- Facts: is all the information that is structured in the semantic formats and stored in the knowledge base. Facts can be collected from external data sources and comes directly from the activities performed in the SoCaTel platform.
- Co-creation activity: is any kind of activity performed by the member of the group within or outside the platform (physical co-creation sessions).

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- Specification: is the formal description of the idea that is submitted by the co-creation group within the platform. The specification is usually defined and validated by the moderator of the group and it can contain the list of LTC features and the work plan.
- Prototype: is the basic implementation of the specification developed by an organization (third parties) in order to prove the concept of the idea defined by the co-creation group.
- Service: is the complete development of the specification. Once the service is tested and validated, it is published in the catalogue of available LTC services within the Ozwillo platform and also in the "success stories" section of Socatel platform.
- Work plan: is the schedule with the tasks list to be performed to develop the services features and the related deadlines.
- Software Publisher: is the organization that declared its interest to develop a LTC service. When selected, the organization will propose a work plan and execute the service development.
- Feedback: is the list of comments or ratings that are provided by the users of the platform. The feedback can be provided for different assets of the platform (e.g. idea, specification, prototype, LTC service, etc.).
- Evaluation criteria: are a list of predefined values used to comment or rate the different assets of the platform.

Below, the main entities are described in more details for each step of the co-creation process. As the first steps of the process are more developed at this stage, mainly the *ideation* and the *collaboration* phases, this has an impact on the related ontologies and it will be reflected in the following section. After the development iteration and the improvement of the other phases, the ontologies will be reviewed and enriched with the new requirements.

As introduction to the ontology definition per phase, we can summarise the entry point (input) and the expected results (output) of every phase. The important entities involved in the process are listed in Table 1 below:

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Table 1: The entry point (input) and the expected results (output) of every phase of the end-users co-creation activities on the SoCaTel platform

	Contribution phase	Ideation phase	Collaboration phase	Co-Production phase
Input	User needs	(Initial) idea	Solution	Service specification
Important entities involved in the process	Users of the Group provide their Contribution to elaborate an (or several) Idea of the solution	Users performs Co-creation activities to formalise the Idea as a formalised Solution	The Service Providers and users co-design Service specification by defining the features, work plan and the business model.	The Service Provider develop the LTC service that is tested by the users.
Output	(Initial) idea	Solution (basic specification)	Service specification (Co-designed solution)	LTC service

Each phase is described below in greater details.

1. Contribution phase

Typical users (health care professional and elder people) come on the Socatel platform with special needs and for this reason, they are looking for specific solutions or groups that have the similar need. So, the first phase of the co-creation process is the contribution phase which is focused on the topics/group's exploration. The exploration activities are filtered by the location and/or language preference of the user and the subject of its needs.

The central entity to be considered in this phase is the group which is created around a specific need to be discussed and solved. In the Socatel context, the definition of the group is related to the topic to be discussed, members that joined, their location (and the corresponding language), members contributions and related resources (such as potential solutions, relevant information previously collected, etc.).

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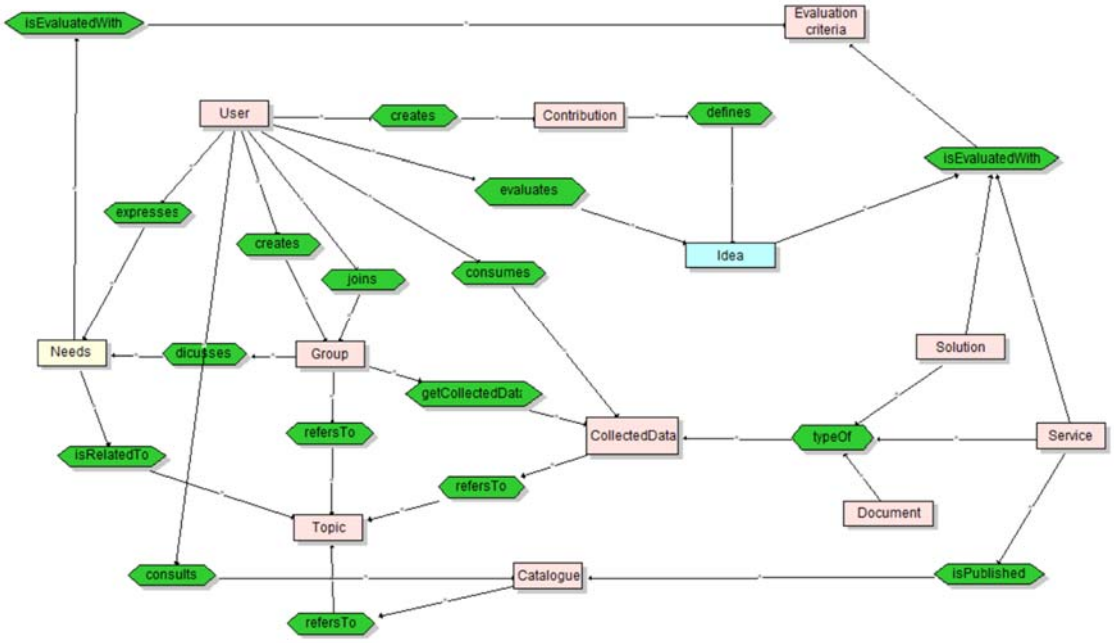

Figure 1: Ontology for the contribution phase

2. Ideation phase

Once the group is joined or created, the objective is to consolidate the idea until having a potential solution. For this, group members will discuss and contribute with some new ideas. Their ideas could be tagged by type (fact, personal experience, constraint, and solution). This permits to organise the content during the ideation process and thanks to the evaluation scores, this will help the moderator to produce the summary of the contributions. The contributions summary is pushed as the idea description to the next phase (Collaboration phase).

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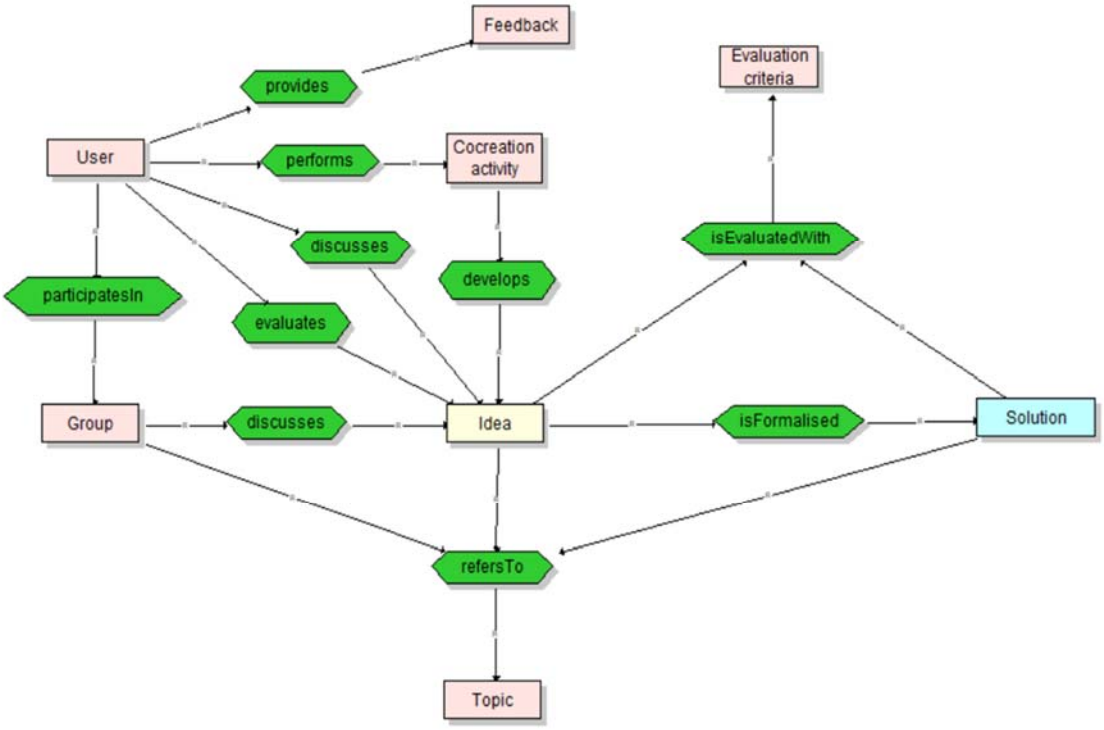

Figure 2: Ontology for the ideation phase

3. Collaboration phase

Once the potential solution (basic specification) is released from the ideation phase, it is published in the list of potential solutions pending of development. Then, the community can rate them and provide feedback. This list of potential services and the corresponding information and community evaluation will permit the third parties (Service Provider) to evaluate the relevance of the idea for a certain audience and let them express their interest to develop it.

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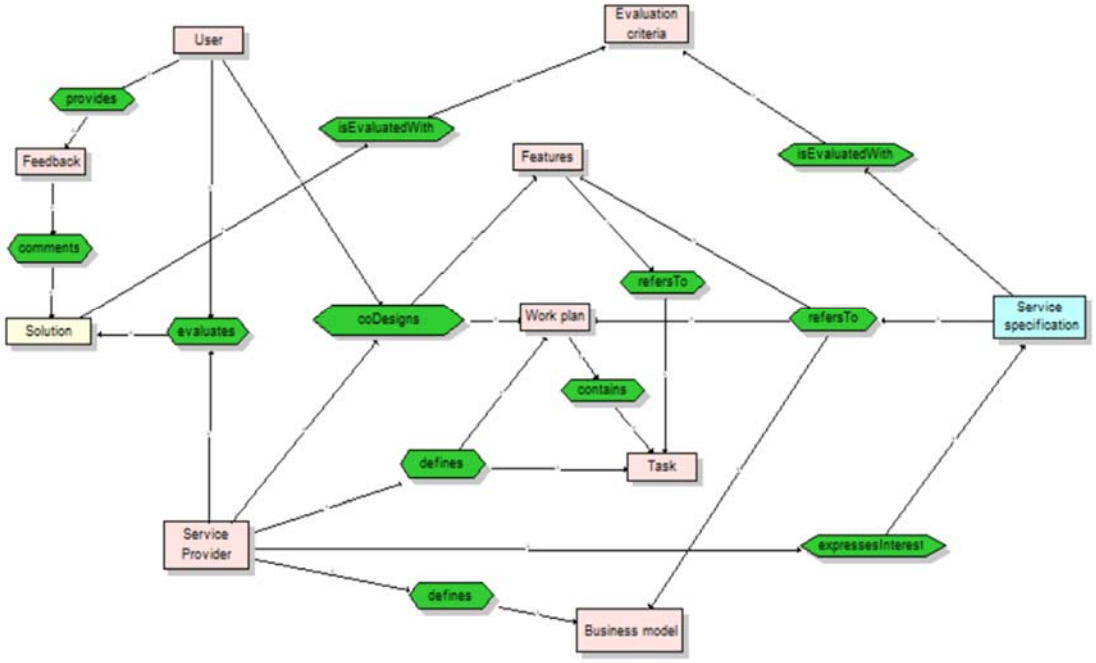

Figure 3: Ontology for the collaboration phase

4. Co-production phase

The last phase consists in the development of the co-designed solution. Using the specification defined previously (called the co-designed solution), the Service Provider that is in charge of the solution development will initiate the process. For this, the work plan has to be clearly defined and the different version of the LTC service as well.

When the different versions of the LTC service will be released, the users will be notified and they will be able to test, evaluate and suggest potential improvements. Based on this feedback the software publisher will adapt the service until reaching a stable and satisfied version. Once the service development is complete, the LTC service is published within the Ozwillo's catalogue of services.

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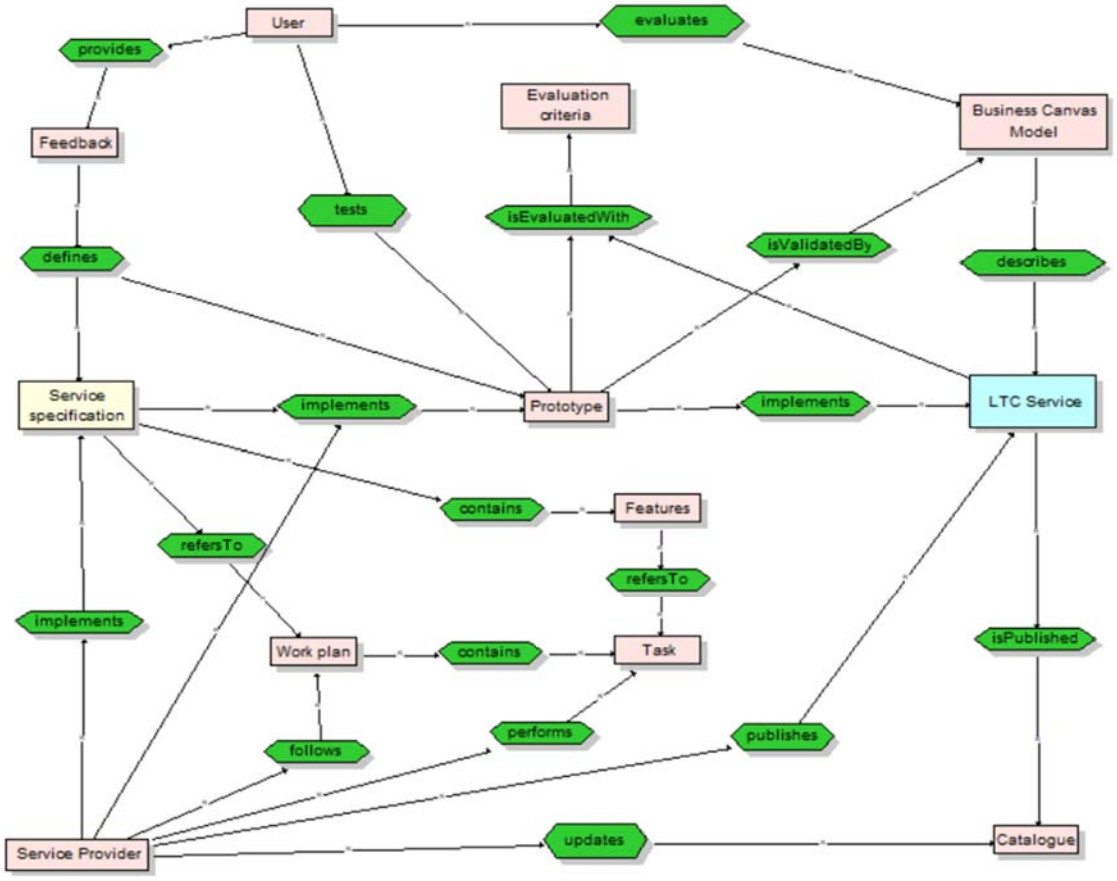

Figure 4: Ontology for the co-production phase

Obviously, all the data that is produced within the platform will be formatted according to the SoCaTel ontologies. Also, most of the data that are originally collected from external data sources will be transformed as much as possible to follow the conceptual data model and increase the semantic interoperability of the data stored in the knowledge base.

4.1.2 **Entity specific ontologies**

The main entities are defined into details in Table 2 with their attributes and properties. Only the main entities are defined here as an example. The rest of the entities will be defined directly in the ontology.

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Table 2: Definition of the main SoCaTel entities with their attributes and properties

Socatel Entities (Classes)	Attributes	Description	Data Type
Group foaf:Group	dc:title	Title of the group	xsd:string
	dc:subject	Subject	xsd:string
	soca:members	List of the members	Element list <soca:User>
	soca:creationDate	Creation date	xsd:dateTime
User foaf:Person	foaf:name	Name	xsd:string
	foaf:givenname	Given name	xsd:string
	foaf:family_name	Family name	xsd:string
	foaf:gender	Gender	xsd:string
	foaf:title	Social title (Mr. / Mrs.)	xsd:string
	foaf:mbox	Email address	xsd:string
	foaf:homepage	Home page	foaf:document
	foaf:nick	Nickname	xsd:string
	soca:role	User role (participant, developer)	xsd:string
	foaf:interest	Topics of interest	Element List <soca:Topic>
Topic	foaf:title	Title of topic	xsd:string
	dc:subject	Subject of the topic	xsd:string
	soca:description	Description of the topic	xsd:string

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Needs	foaf:title	Title of the need	xsd:string
	foaf:description	Description of the need	xsd:string
Idea	foaf:title	Title of the idea	xsd:string
	foaf:description	Description of the idea	xsd:string
	foaf:topic	Topic of the idea	xsd:string
	soca:creationDate	Creation date	xsd:dateTime
Fact	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:source	Source of the fact (external, activity, etc)	xsd:string
	soca:creationDate	Creation date	xsd:dateTime
Co-Creation Activity	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:creationDate	Date the activity took place	xsd:dateTime
	soca:activityType	Online, physical, etc	xsd:string
	soca:numberOfParticipants	Number of participants in activity	xsd:integer
Specification	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:status	Submitted, validated, approved	xsd:string
	soca:attachedFile	File containing additional information	xsd:string

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Prototype	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:status	In development, ready, deployed	xsd:string
	soca:startDate	Start date of implementation	xsd:dateTime
	soca:deliveryDate	Estimated date of deployment	xsd:dateTime
	soca:toolsList	List of tools used during development	Element list <xsd:string>
Service	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:status	Pending, tested, validated, published	xsd:string
	foaf:homepage	Link to service's page on Ozwillo	xsd:string
	soca:startDate	Start date of implementation	xsd:dateTime
	soca:deliveryDate	Estimated date of deployment	xsd:dateTime
Work Plan	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:startDate	Start date of implementation	xsd:dateTime
	soca:deliveryDate	Estimated date of deployment	xsd:dateTime
	soca:status	On time, delayed	xsd:string
	foaf:name	Name	xsd:string

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Software Publisher	foaf:description	Description	xsd:string
	foaf:homepage	Link to publisher's page	foaf:document
	foaf:mbox	Contact email address	xsd:string
	soca:pubType	Publisher type	xsd:string
	soca:softwareLicense	License under which software will be published	xsd:string
Feedback	foaf:title	Title of feedback	xsd:string
	foaf:description	Feedback text	xsd:string
	soca:rating	Feedback rating (1 à 5)	xsd:integer
	soca:feedbackDate	Feedback date	xsd:dateTime
Evaluation Criteria	foaf:title	Title	xsd:string
	foaf:description	Description	xsd:string
	soca:evalType	Rating, Yes/No, Open	xsd:string
	soca:evalDomain	Technical, Design, Business	xsd:string

Another important dimension of the ontologies are the relations between the concepts, illustrated in Table 3. For this, the different properties per concept are introduced. They also define which concept it is applied to and in some case the possible reverse property.

Table 3: Relation between the SoCaTel concepts

Domain Class	Range Class	Property	Special Property (inverse)
User	Group	creates, joins, participatesIn	isCreatedBy, isJoined, contains
User	Needs	expresses	expressedBy

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User	Catalogue	consults	isConsultedBy
User	Contribution	creates	isCreatedBy
User	Idea	evaluates, discusses	isEvaluatedBy, isDiscussedBy
Group	Needs	discusses	isDiscussedBy
Group	Topic	refersTo	describes
Needs	Evaluation Criteria	isEvaluatedWith	characterises
Needs	Topic	isRelatedTo	
User	Co-Creation Activity	Performs	isPerformedBy
User	Feedback	Provides	isProvidedBy
Solution	Evaluation Criteria	isEvaluatedWith	characterises
Idea	Topic	refersTo	describes
Feedback	Solution	comments	isCommentedBy
User, Service Provider	Work Plan, Feature	coDesigns	isCodesignedBy
Service Provider	Work Plan, Task	defines	isDefinedBy
Service Provider	Service Specification	expressesInterest, implements	isInterestingFor, isImplementedBy
Service Provider	Business Model	defines	isDefinedBy
Feature	Task	refersTo	describes
Work Plan	Task	contains	describes
Prototype	LTC Service	implements	isImplementedBy
Service Provider	Prototype	implements	isImplementedBy
Service Provider	Work Plan	follows	isFollowedBy
Service Provider	Task	performs	isPerformedBy
User	Prototype	tests	isTestBy

Moreover, the concepts and properties definition, another important aspect of the ontology are the taxonomies, which is the hierarchical relations between the

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different concepts. Below are presented the most important taxonomies and all the others will be defined in the OWL ontology:

- ArtefactType:
  - Idea
  - Solution
  - Prototype
  - Service
- ActivityType:
  - Contribution
  - Evaluation
  - Negotiation
  - Software development:
    - Analysis and design
    - Business modeling
    - Configuration and change
    - Deployment
    - Environment
    - Implementation
    - Project management
    - Requirements
    - Test
- ContributionTypes:
  - Fact
  - Personal experience
  - Constraint
  - Solution
- RoleTypes:
  - Group member
    - Older persons
    - Family/friends
    - Care assistants
    - Healthcare specialists
    - Policy makers
    - Service providers
  - Group moderator
  - Software Provider
  - Testers

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Even if this version of the ontologies is consistent enough to imitate the development of the semantic pre-processing tools, iterative improvements will be performed all along the development process.

4.1.3 Other conceptual considerations

Moreover, the conceptual entities that has to be represented in the ontologies, other dimensions have to be defined in the conceptual framework. For instance, if the data population of the knowledge base is quite simple when the data models are correctly defined and the handlers performs correctly, it can be complex to maintain a semantic repository that grows every day. Semantic and logical inconsistencies can appear. In order to mitigate this issue, the conceptual data model should consider important aspects that will facilitate the evolution and maintenance of the knowledge base over the time.

Here a list of the main dimensions to be considered at this stage:

- Localisation and multilingual aspects: according to the location and language preferences of the users, the display of the information will be adapted. Also, the data collection services will gather data in different languages. For both processes, the languages should be correctly specified for the knowledge production in order to facilitate the content translation (only based on existing vocabularies) and the multilingual access.
- Temporal aspects: temporal description of the content is crucial to establish historic relation between the different triples stored in the knowledge base. Indeed, in order to differentiate versions of collected data, timestamp is necessary to tag the different version of the content.
- Versioning aspects: during the project, some data sources or vocabularies (e.g. the SoCaTel ontologies themselves) will be used. These data sources can evolve and to maintain the compliance with the existing data, the control of the different version is highly recommended.
- Provenance: as the knowledge base production is also based on the data collection from several data sources, similar data can be collected. Controlling the provenance of the data can facilitate to determine level of trust for the reuse according to the origin.

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4.2 CONCEPTUAL MAPPINGS TO INCREASE THE SEMANTIC INTEROPERABILITY

Following the best practice defined by the Linked Open Data initiative, it is important to reuse the existing ontologies. For this reason, after the domain analysis that permits to identify the main entities, an investigation is required to identify the existing ontology that already defined the important concept. When the relevant ontologies are identified, the similar concepts are mapped using the logical mechanism offered by OWL formalism. Indeed, the property owl:sameAs can be used to conceptually link two similar concepts. For example, the concept User is already defined in different ontologies (e.g. FOAF, Schema.org, etc.).

Thanks to the mapping mechanism defined at the level of the conceptual model, all the data that will be instantiated with the mentioned concept will be compliant with any other data that was instantiated with one of the mapped ontologies. In addition, this mechanism allows extend by default the mapped concepts with all the other relationships of the reused ontologies. This way the interoperability of the data model is optimised.

4.3 EXTERNAL DATA SOURCES ONTOLOGIES

Publicly available ontologies can be used to build the SoCaTel knowledge graph. Examples of ontologies are people, hospital organisations, illnesses, etc.

There exist countless ontologies resources online, such as Schema.org and the DBpedia Ontology. These vocabularies are independent of each other, and the one that fits better the SoCaTel needs will be chosen.

Based on the mechanism of conceptual mapping, all the different data sources will have to be mapped with the SoCaTel ontologies in order to populate the knowledge base in a harmonised way. As such, it is important to identify which ontologies already exist for connexion to the unified data model of SoCaTel.

Table 4 is an initial review of the ontologies relevant to the SoCaTel context, and their relative concepts to be mapped with the SoCaTel concepts in order to reach the most universal data model. Additional ontologies will be investigated and included during the implementation of the knowledge base.

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Table 4: Review of the ontologies relevant to the SoCaTel context, and their relative concepts to be mapped with the SoCaTel concepts

Category	Ontologies	Mapped concepts	Impact
General ontology	FOAF	Person, Group	The modelling of end-users of the platform.
	DC	Subject, Date	
	schema.org	Person, Group, Project, etc.	
Long term care ontology	https://health-lifesci.schema.org/MedicalCondition	Medical condition	Will allow us to model any condition of the human body that affects the normal functioning of a person, whether physically or mentally.
	https://health-lifesci.schema.org/Patient	Patient	The modelling of any person recipient of long term care services.
	https://health-lifesci.schema.org/PrimaryCare	Primary care	The modelling of the medical care by a physician, or other health-care professional, who is the patient's first contact with the health-care system and who may recommend a specialist if necessary.
	https://schema.org/MedicalOrganization	Medical Organization	The modelling of a medical organisation (physical or not), such as hospital, institution or clinic.
	https://health-lifesci.schema.org/LifestyleModification	Lifestyle Modification	The modelling of the process of care involving exercise, changes to diet, fitness routines, and other lifestyle changes aimed at improving a health condition.
	https://health-lifesci.schema.org/PhysicalActivity	Physical activity	The modelling of any bodily activity that enhances or maintains physical fitness and overall health and wellness.
	https://health-lifesci.schema.org/PhysicalActivityCategory	Physical Activity Category	The modelling of categories of physical activity, organized by physiologic classification.
	https://health-lifesci.schema.org/Nursing	Nursing	The modelling of a health profession of a person formally educated and trained in the care of the sick or infirm person.

The interoperability aspects will be improved iteration after iteration by identifying more and more relevant ontologies to describe the SoCaTel ecosystem.

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5. COLLECTING DATA FROM EXTERNAL DATA SOURCES VIA THE DATA ACQUISITION LAYER

Collecting data from external data sources is done via the Data Acquisition layer, a language-agnostic component with handlers containers designed to connect to and collect datasets.

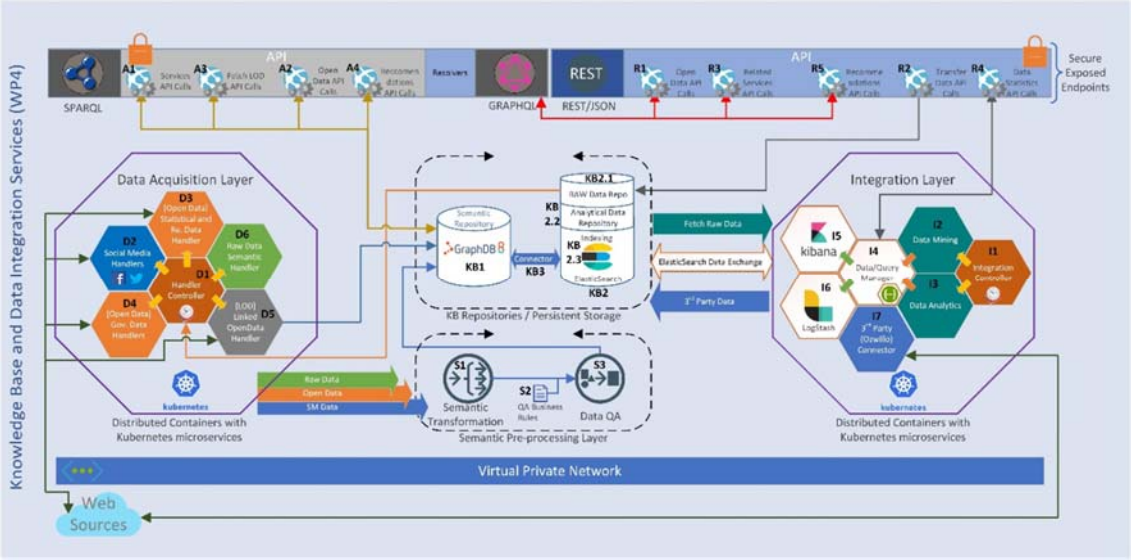

Figure 5: The SoCaTel Knowledge Base Software Architecture

The SoCaTel Software Architecture presented in Figure 5 illustrates the various components that compose the entire WP4 Knowledge Base infrastructure. The architecture was defined in Deliverable D3.2. The underlying infrastructure includes components used for *i) Data Acquisition, (ii) Semantic Pre-processing, (iii) Persistent Storage, (iv) Integration with Data mining and Analysis and (v) SPARQL/JSON endpoints* that the SoCaTel portal (front-end) uses for communicating with the Knowledgebase (KB).

A core module of WP4 is the *Data Acquisition Layer*. This module is responsible for connecting to identified data sources from the internet and collect insightful datasets. If the datasets are semantically ready, they can be stored directly in the Knowledge base data repository, otherwise they must pass through the Semantic Pre-processing Layer to be semantically annotated. In general terms, and what we apply as a rule, Linked Open Data (LOD) are already semantically processed whereas everything else needs further processing.

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The following sections describe extensively how the data acquisition layer works, and which processes are followed for each specific data acquisition handler.

All the information and data used in the present document is either anonymized or used under a pseudonym, making sure that all regulations on private information are followed as described under GDPR.

5.1 DATA COLLECTION FROM EXTERNAL DATA SOURCES - METHODOLOGY

Data collection is an essential part of the Data Acquisition Layer as it transforms data originating from i) *Social Media Platforms*, ii) *Statistical and Research Data*, iii) *Governmental Data*, iv) *Linked Open Data and v) SoCaTel Platform Data* into meaningful information.

As outlined in D3.2, the Data Acquisition Layer acts as a self-sufficient component of the Knowledgebase (KB) infrastructural architecture design which then supports the SoCaTel platform. The Data Acquisition Layer interacts with the various aforementioned sources to collect data and then interacts with the Semantic pre-processing layer (if necessary) to semantically annotate data from external data sources into meaningful, queryable, streamlined, inter-connected and semantically-annotated information. Information is then used by the Integration Layer to perform analytics, extract statistics and produce resource and statistical recommendations to the platform. As mentioned previously, in the case of Linked Open Data, the data is semantically ready and is stored in the Semantic Repository directly.

The Data Acquisition Layer, as shown in Figure 6, consists of multiple handlers that consume data from Web data sources and a *Handler Controller (D1).* The handler controller *acts as an orchestration medium for the multiple data collection handlers*. It spawns itself after a specific time interval and it *i) performs administration and validation checks on the handlers' orchestration infrastructure and ii) then spawns the handler data collectors to start consuming data*.

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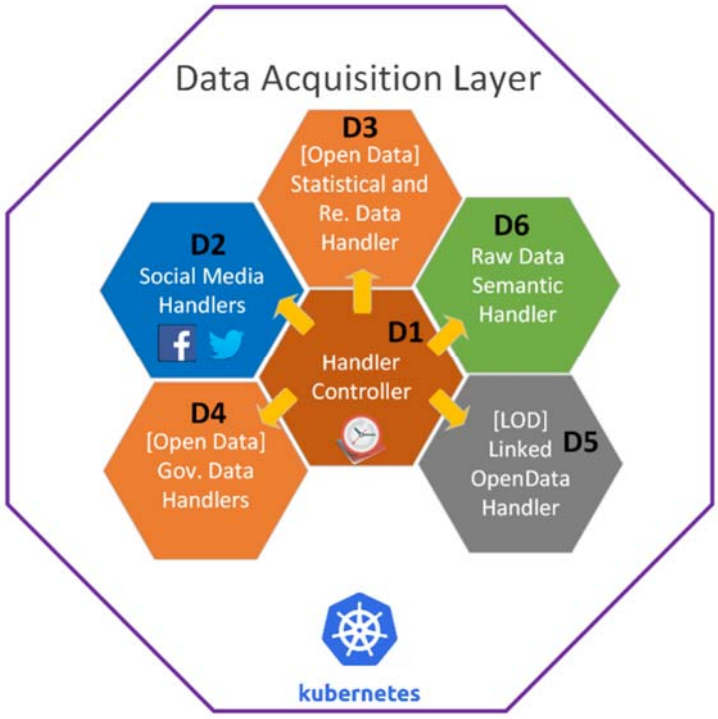

Figure 6: The Data Acquisition Layer

The Data Acquisition Layer introduces the following data collection handlers which are then split into specific containers:

1. Social Media Handlers (D2)
   a. Twitter Handler Containers (D2.1)
   b. Facebook Handler Containers (D2.2)
2. Open Data Handlers
   a. Statistical and Research Data Handler Containers (D3)
   b. Governmental Data Handler Containers (D4)
3. Linked Open Data Handler Containers (D5)
4. Raw Data Semantic Handler Containers (D6)

All Handlers communicate with the KB Repositories (as Figure 5 displays) to obtain all necessary data that are needed for initiating the data acquisition's multiple mechanisms. In other words, any configuration data necessary for the data acquisition individual handlers to start collecting data is stored in the KB repositories. For example, in the case of unstructured data such as Social Media (SM) data, the appropriate containers will have to be aware of the group names, twitter screen names, etc, to query appropriately the SM platforms and obtain

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data. The same applies to every container, meaning that, they will also interact with the KB Repositories to obtain the input required and use it to store the output as well.

The rest of this section described how Handlers are constructed in a higher level of abstraction using the term *container* as a packaging mechanism that describes a handler that is run on the Kubernetes infrastructure that hosts these containers.

The entire Kubernetes infrastructure and how containers are constructed, maintained and run upon the infrastructure, is explained in D4.2 “Data infrastructure and storage”. The following sections will focus on the data input, output and the purpose of each handler by presenting the obtained data from the various handlers such as SM Handlers, Open and Linked Open Data and Raw Data from the platform.

5.2 Social Media (SM) Handlers

We target Long Term Care (LTC) related groups that have their own Facebook Pages, Facebook Groups and Twitter pages. Part of the commissioning process is the social media services registration. The administrator of these pages will preferably register on the SoCaTel platform the various Facebook Pages, Facebook Groups and Twitter accounts that they own by giving authorisation to the platform to collect and use the data. This step is necessary to gather better information more often, as the authorisation provides us access to all content datasets and removes the API hits limit. We also have the ability to mine social media for publicly published data related to LTC without authorisation.

The social media data collected will be pre-processed through Natural Language Processing to identify the sentiment of the service users, as well as to identify context (language and location identification, part-of-speech and entity recognition etc.). All these will be utilized by the Data Integration Layer to provide the context aware recommendations and insights that will assist the co-creation groups in new service creation or improvement of existing services. Data will be collected with the multiple SM handler containers that are introduced in the following sections.

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5.2.1 Twitter

Twitter accounts are registered to the platform by the administrator. He/She will declare to the platform all necessary information and metadata information for a specific LTC related account. In particular, and more specific for Twitter, the following needs to be declared per LTC related account:

1. ***Screen Name*** of Twitter account for a specific Service.
2. ***Access Tokens*** of Twitter account for a specific Service. Access Tokens are automatically provided and registered to the platform when the administrator authorizes the SoCaTel TwitterHandler twitter application of SoCaTel. These tokens are then being used to retrieve and store tweets from the timeline of the LTC service.

The handler containers use the Screen Name and the Access Tokens to collect data which are retrieved from KB2.1 in a metadata form.

Twitter Handler consists of two separate core containers that collect data from Twitter which are described as follows:

1. Twitter Feed (D2.1.1)

- Purpose: Collects *User Timeline* for a Twitter account. Twitter Timeline are published tweets that a specific Twitter account produces over time. Tweets are then crawled using the Twitter API[3].
- Input from KB2.1: *Screen Name* and *Access Tokens (+* ***optional*** *latest known tweet) for fetching the latest unknown tweets and avoiding hitting the Twitter limits)*

2. Twitter Replies (D2.1.2)

- Purpose: Collects *Tweet Replies* that are addressed for a specific tweet. Tweet that has triggered the interest of users gets replies by other users. It is important for the platform to collect these reactions for sentiment and opinion analysis. This will act as an indication to which services are underutilised, need further improvement, etc.

[3] https://developer.twitter.com/

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- Input from KB2.1: *Screen Name* and *Access Tokens (+* ***optional*** *latest known tweet for fetching the latest unknown tweets and avoiding hitting the Twitter limits)*

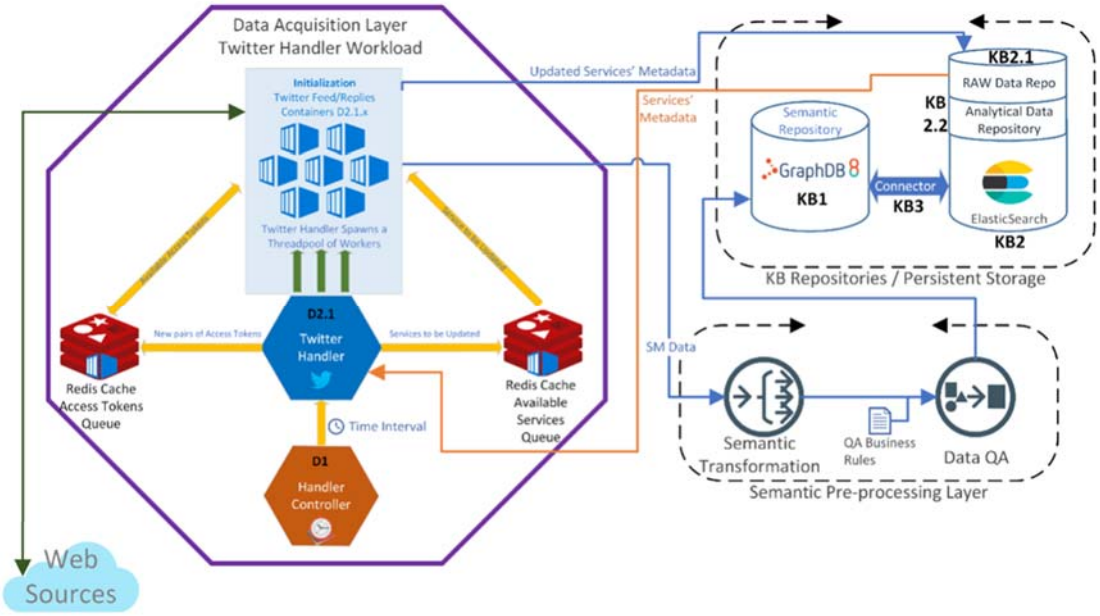

Figure 7: Twitter Handler Workload

Figure 7 above displays the Twitter Handler process of acquiring Twitter data. Periodically, the Handler Controller (D1) is being spawned to start in turn the data acquisition handlers, which in this case is the Twitter Handler (D2.1). The Twitter Handler will then communicate and obtain all the declared Services' metadata which are registered in the Raw Data Repository (KB2.1) and were not updated during the previous data collection (based on an internal time interval). The Twitter Handler then updates the Redis Cache Queues (in-memory FIFO Queues that store keys and tokens that are used by handlers for retrieval of data) that are used by the *threadpool of workers*. Finally, the threadpool of workers informs and updates the Raw Data Repository (KB2.1) on which services were updated using a timestamp and it also sends the obtained Twitter Data Structure (Table 5) to the Semantic Pre-processing Layer for semantic annotation.

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Table 5: The Twitter Data Structure

Twitter Data Structure


```
{
 "created_at": "Thu Apr 06 15:28:43 +0000 2017",
 "id": 850007368138018817,
 "id_str": "850007368138018817",
 "text": "RT @TwitterDev: 1/ Today we're sharing our vision for the future of the Twitter API platform!nhttps://t.co/XweGngmxlP",
 "truncated": false,
 "entities": {
  "hashtags": [],
  "symbols": [],
  "user_mentions": [
       {
     "screen_name": "TwitterDev",
     "name": "TwitterDev",
     "id": 2244994945,
     "id_str": "2244994945",
     "indices": [
      3,
      14
      ]
      }
      ],
  "urls": [
       {
     "url": "https://t.co/XweGngmxlP",
     "expanded_url": "https://cards.twitter.com/cards/18ce53wgo4h/3xo1c",
     "display_url": "cards.twitter.com/cards/18ce53wg…",
```


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5.2.2 Facebook

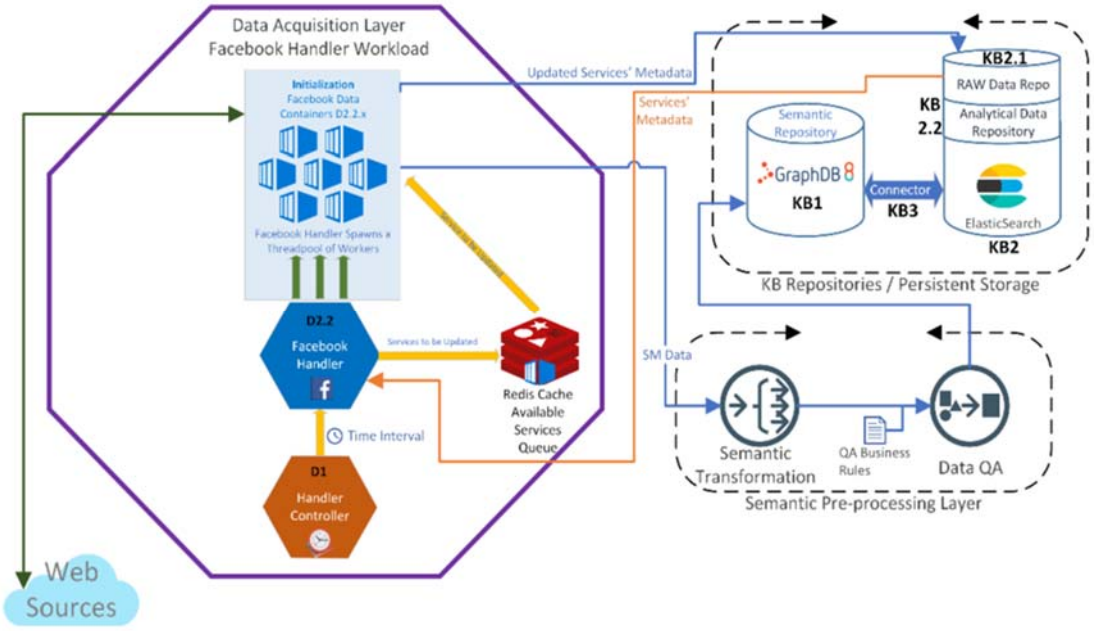

Figure 8: Facebook Handler Workload

The Facebook handler enables the retrieval of data from the popular social media platform, using their official tool called GraphAPI. GraphAPI is an HTTP-based API which can be used by apps to programmatically query Facebook data; this is unrelated to the GraphDB tools included in the Semantic Repository. The use of the GraphAPI requires the creation of a Facebook application which the users have to “install” in their personal pages. The same stands for the Facebook pages and groups administrators, who also need to install the application in their page or group. Once the application is in place, the API calls can start retrieving data such as:

- Posts
- Comments
- Reactions (likes, angry, love etc)
- Tags
- Shared location including date and time. (only after explicit consent from the user)
- Public information like age, email, place of living, provided these are set as public. (only after explicit consent from the user)

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The Facebook handler is composed of two separate but similar core containers that collect the required Facebook data. One container will be responsible for handling Facebook Pages and the other the Facebook Groups. While the data acquisition process is almost identical, the steps for acquiring access tokens and permissions are different. Therefore, it was considered best practice to separate these two accordingly:

1. Facebook Page Harvester:

- Purpose: Collects page's and user's activities (Posts, comments, reactions) from a public Facebook Page.
- Input: The Facebook Page Id and admin's page access permission *(+* ***optional*** *latest known post for fetching the latest unknown activities and avoiding hitting the Facebook limits)*

2. Facebook Group Harvester:

- Purpose: Collects group user's activities (Posts, comments, reactions) from a group that installed the Facebook application.
- Input: The Facebook Group Id and admin's group access permission *(+* ***optional*** *latest known post for fetching the latest unknown activities and avoiding hitting the Facebook limits)*

Figure 8 above displays the Facebook Handler process of acquiring Facebook data, a process very similar to the process for acquiring Twitter data. After a fixed time, the Handler Controller (D1) initiates an awakening of the data acquisition handlers, which in this case is the Facebook Handler (D2.2). The Facebook Handler will request all the declared services metadata from the Raw Data Repository (KB2.1) that were not updated during the previous data collection (based on an internal time interval). The Facebook Handler then updates the Redis Cache Queues that are used by the *threadpool of workers*. Lastly, the threadpool of workers informs and updates the Raw Data Repository (KB2.1) on which services were updated using a timestamp and it also sends the obtained Facebook Data Structure (Table 1) to the Semantic Pre-processing Layer for semantic annotation.

In the following tables, we can see the data acquired from an example page.

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For the purpose of creating a realistic example, a Facebook Page was created. In this example, a visitor makes a post (visitor post), which is then commented and reacted by the page and other users of the page.

Table 6 shows the results of an API call, requesting the posts made in the “App page” (our example page). In these results we can see two different posts. The “json” file presents the dates the posts were made, the message each post shows and the “post id”.

Table 6: Facebook Page Posts

Facebook Page Posts {GET Page posts}


```
{
 "posts": {
  "data": [
   {
     "created_time":"2019-02-05T08:23:00+0000",
     "message":"Welcome to our page ! Feel free to post and communicate with the other members",
     "id":"2184505761816952_2184506168483578"
    }
  ],
  "paging": {
   "cursors": {
     "before":
"Q2c4U1pXNTBYM0YxWlhKNVgzTjBiM0o1WDJsa0R5UXlNVGcwTlRBMU56WXhPREUyT1RVeU9qRXhORE
F4TURNNE5UQXlOekl4TVRnd05UWVBER0ZA3YVY5emRHOXllVjlwWkE4aE1qRTRORFV3TlRjMk1UZA3hO
amsxTWw4eU1UZAzBOVEEyTVRZANE5EZA3pOVGM0RHdSMGFXMWxCbHhaUitRQgZDZD",
     "after":
"Q2c4U1pXNTBYM0YxWlhKNVgzTjBiM0o1WDJsa0R5UXlNVGcwTlRBMU56WXhPREUyT1RVeU9qRXhORE
F4TURNNE5UQXlOekl4TVRnd05UWVBER0ZA3YVY5emRHOXllVjlwWkE4aE1qRTRORFV3TlRjMk1UZA3hO
amsxTWw4eU1UZAzBOVEEyTVRZANE5EZA3pOVGM0RHdSMGFXMWxCbHhaUitRQgZDZD"
    }
   }
 },
 "visitor_posts": {
  "data": [
   {
     "created_time": "2019-02-06T08:01:56+0000",
     "message": "The weather is very rainy today",
     "id": "2184505761816952_2185168505084011"
    }
  ],
  "paging": {
   "cursors": {
     "before":
"Q2c4U1pXNTBYM0YxWlhKNVgzTjBiM0o1WDJsa0R4MDFPVGN6TkRFME5UUTdNakU0TlRFMk9EVXdOVE
E0TkRBeE1UczdOQThNWVhCcFgzTjBiM0o1WDJsa0R4bzFPVGN6TkRFME5UUmZANakU0TlRFMk9EVXdO
VEE0TkRBeE1ROEVkR2x0WlFaY1dwUjBBUT09",
     "after":
"Q2c4U1pXNTBYM0YxWlhKNVgzTjBiM0o1WDJsa0R4MDFPVGN6TkRFME5UUTdNakU0TlRFMk9EVXdOVE
```


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```
E0TkRBeE1UczdOQThNWVhCcFgzTjBiM0o1WDJsa0R4bzFPVGN6TkRFME5UUmZANakU0TlRFMk9EVXdO
VEE0TkRBeE1ROEVkR2x0WlFaY1dwUjBBUT09"
    }
   }
  },
  "id":"2184505761816952"
}
```


Table 7 shows more detailed information, regarding a specific post. Using a "post id" acquired from the previous table, we can get a more post specific response that contains comments, replies and reactions on that post.

Table 7: Facebook Page Post Activities

Facebook Page Post Activities {GET post's activities}


```
{
  "from": {
    "name": "Rafa Lopez",
    "id": "1986916064738608"
  },
  "message": "The weather is very rainy today",
  "reactions": {
    "data": [
      {
        "name": "Johny Farmerson",
        "id": "1543199735782339",
        "type": "WOW"
      },
      {
        "name": "App Page",
        "id": "2184505761816952",
        "type": "LIKE"
      }
    ],
    "paging": {
      "cursors": {
        "before":
"QVFIUmJUeW9rMXQyeHRuMEJ6STNaMHBwcGx4bExweVBMcTZAySlVRZA2djeEN1U0RhejM3LWZADX1
VmYWtES08yWHZAndW0ZD",
        "after":
"QVFIUm13NVJEUi1OYXdGMk0yQmtRSGFoNXB1RmRuMlFNTlI2WVVxUTY0djRUR3NwbTJvZA2ZAVOGR
NcE1rTm9zLTFFYllya3NJUDJid2c2YVF3blBCWWVTR3Rn"
      }
    }
  },
  "comments": {
    "data": [
      {
```


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```
      "message": "Yes ! Lets hope the roads won't flood !",
      "reactions": {
       "data": [
        {
         "name": "Johny Farmerson",
         "id": "1543199735782339",
         "type": "LOVE"
        },
        {
         "name": "Rafa Lopez",
         "id": "1986916064738608",
         "type": "WOW"
        }
       ],
       "paging": {
        "cursors": {
         "before":
"QVFIUnFPVTN2dWNlWk9ucVRrSnVwem80SnJOVWpSWU1XVDIxR0I1eldvSTUyNEN2bWJLLWFUT1RDN
UF1TmhTWlhYYTcZD",
         "after":
"QVFIUjBvaWxiaFNuaEZAiblRWVWQzMUg4TDF1YmZAUS2tLRkNkNWNSMk81WlVydWJwOUNWUGljZAl8
0cjhhYkJGUWhsa3cZD"
        }
       }
      },
      "from": {
       "name": "App Page",
       "id": "2184505761816952"
      },
      "id": "2185168505084011_2185241391743389"
     },
     {
      "message": "Let us stay inside for the rest of the day!! □□□",
      "reactions": {
       "data": [
        {
         "name": "App Page",
         "id": "2184505761816952",
         "type": "WOW"
        }
       ],
       "paging": {
        "cursors": {
         "before":
"QVFIUmJNMWpGLUpLeUhYejhlRXVjQVJHRmpOcVRuQmd0Rm40RnEwNVk2NERqdU5rdlc4MHhKb1EzW
mNjajlRWDFSR1VRMFJzcUtnYnluNTJqSFM5eVl1enJB",
         "after":
"QVFIUmJNMWpGLUpLeUhYejhlRXVjQVJHRmpOcVRuQmd0Rm40RnEwNVk2NERqdU5rdlc4MHhKb1EzW
mNjajlRWDFSR1VRMFJzcUtnYnluNTJqSFM5eVl1enJB"
        }
       }
      },
      "from": {
       "name": "Rafa Lopez",
       "id": "1986916064738608"
```


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```
      },
      "id": "2185168505084011_2185243128409882"
     },
     {
      "message": "That is not the usual Cyprus weather :(  I am used to bright sun and warm weather
□□□",
      "reactions": {
       "data": [
        {
         "name": "App Page",
         "id": "2184505761816952",
         "type": "SAD"
        }
       ],
       "paging": {
        "cursors": {
         "before":
"QVFIUndFS21td1NzSV91WnRUWWdRNUNlZAVE4bWJVX0NFbzY1VkdSV1JaNGtLMGhKdkxDYkdoQUJmTjAyR3hDbzdQYUIzT0pfQ1liRG9mX0tOdERUYnJjcUt3",
         "after":
"QVFIUndFS21td1NzSV91WnRUWWdRNUNlZAVE4bWJVX0NFbzY1VkdSV1JaNGtLMGhKdkxDYkdoQUJmTjAyR3hDbzdQYUIzT0pfQ1liRG9mX0tOdERUYnJjcUt3"
        }
       }
      },
      "from": {
       "name": "Johny Farmerson",
       "id": "1543199735782339"
      },
      "id": "2185168505084011_2185243171743211"
     }
    ],
    "paging": {
     "cursors": {
      "before":
"WTI5dGJXVnVkRjlqZAFhKemIzSTZANakU0TlRJME1UTTVNVGMwTXpNNE9Ub3hOVFE1TkRRNU9UZAzQZD",
      "after":
"WTI5dGJXVnVkRjlqZAFhKemIzSTZANakU0TlRJME16RTNNVGMwTXpJeE1Ub3hOVFE1TkRVd01qRXcZD"
     }
    }
   },
   "id": "2184505761816952_2185168505084011"
}
```


5.3 Open and Statistical Research Data Handlers

The Open and Statistical Research Data Handler, as the name implies, manages the import of Open and Statistical Research Data either through existing open data platforms (D4) or other statistical research data (D3). This is achieved

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through a user interface (web form), exposed to the SoCaTel user through the SoCaTel Platform, and an Open Data Handler, residing in the Data Acquisition Layer. For clarity and completeness both components and the data flow between them are explained in this section and depicted in Figure 9.

The supported file types for the data sources are the following:

- CSV (Comma-Separated Values)
- XLS/XLSX (Microsoft Excel Spreadsheet)
- JSON (JavaScript Object Notation)
- XML (eXtensible Markup Language)

Additionally, each file that is uploaded needs to be accompanied by specific metadata. The metadata associated with the open data resources included in the page, are acquired automatically when a file is selected. External data resources' metadata requires manual insertion from the administrator. Metadata is extra data with information which helps summarise and describe the actual data.

Some examples of metadata to be used, amongst others, are:

- Title
- Author
- Release Date
- Updated Date
- Language
- Location
- Subject
- Tags

A SoCaTel user, with appropriate privileges, can use the Open Data declaration form to easily import open data from:

- A catalogue of open data providers already integrated with the knowledge base. An initial step could be that the administrator requests a new open data portal to be integrated before datasets are imported. The administrator (or a user with similar authority) can then choose any dataset available as long as the file type and format is supported.

- Any external data source on the condition that:

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- The data file can be processed by the platform
  - Compatibility is bounded and defined by the metadata described above. More specific, the administrator must provide a file of the supported file types and all metadata listed above.
- The URL of the data file is a compatible file download link
  - Mandatory for fetching the actual resource. As above, compatibility is again obligatory.

- For both Open Data and Statistical Research Data, the file and metadata will be sent to the Open Data Handler for retrieval and storage. To assist the Data Integration Layer on understanding the usefulness of the data and presenting them when relative to the co-creation groups, the administrator will be given the option to select specific columns and fields of the dataset along with a set of platforms defined visualization options which will provide value to the discussion.

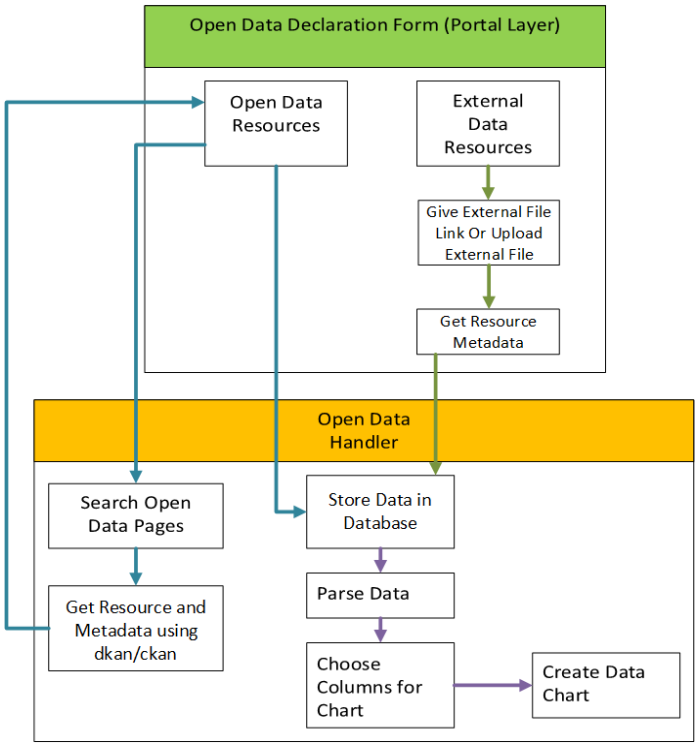

Figure 9: Open Data Handler Process

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5.3.1 Open Data

The platform will contain a list of Open Data website sources, from which the Web Form user will be able to perform a search and find a specific dataset. The list of website sources was chosen taking into consideration the project partners and the piloting countries. Nevertheless, more websites that follow the same standards can be easily added in the future.

The open data handler will be implemented with focus on retrieving data from the two main Open Data Portal frameworks, namely CKAN and DKAN, using the APIs provided by them. A more detail description regarding the tools:

- **CKAN:** The initials stand for Comprehensive Knowledge Archive Network and is an open-source management system designed to manage and distribute open data. The back-end is written mainly in python and in the front end is mostly Javascript. For database it uses a PostgreSQL. CKAN is maintained by Open Knowledge International and it is vastly used by many different countries as government data catalogues.

- **DKAN:** DKAN is an open data platform running on Drupal php framework. It is based on CKAN and its an open source open data portal platform. The codebase is maintained by “CivicActions”.

An extensive study of the open data portals available by SoCaTel partner countries showed that the aforementioned frameworks are the only ones used, see Table 8. For this reason, we consider that the focusing on these two platforms and incorporating their APIs in the SoCaTel Open Data Handler to be more than sufficient for the project. The Open Data Handler will use the provided endpoints (APIs) to retrieve information (i.e. metadata and data location) about the data source provided by the users and periodically check for updates of the data. Thus, the Open Data Handler will be able to assist users of the platform for identifying open data resources relevant to their interests and the co-creation groups they are participating in.

It is important to note that by incorporating in the platform the APIs the two most widely used Open Data Frameworks, not only allows to support additional Open Data Platforms build using these frameworks but also makes the Open Data Collection process language agnostic, since any communication with these platforms will be made in the language of the deployment country.

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Table 8: Review of Open Data technology frameworks

#	Open Data Portal	Pilot	Partner	CKAN	DKAN	Country/City
1	**Opendata.hu**	**X**	**X**	**X**		**Hungary**
2	**Data.gov.ie**	**X**	**X**	**X**		**Ireland**
3	**Data.tampere.fi**	**X**	**X**	**X**		**Tampere (Finland)**
4	**Datos.gob.es**	**X**	**X**	**X**		**Spain**
5	**data.overheid.nl**		**X**	**X**		**Netherland**
6	**data.gouv.fr**		**X**	**X**		**France**
7	**Data.gov.cy**		**X**		**X**	**Cyprus**

The following tables present a step-by-step example of Open Data acquisition from one of the pilot sites:

1. The need is for identifying open data relevant to “Disabled Parking”. The search keywords are: “Disabled Parking”. The search keyword can originate either from a user explicitly trying to suggest an open data dataset to be included in the knowledge base or the data mining process of the Data Integration Layer that may identify the keyword in the co-creation group discussions. A search through the data.gov.ie website returns a JSON file, as shown in Table 9:

Table 9: Open Data portal search result example

Search result example


```
{
   "help": "https://data.gov.ie/api/3/action/help_show?name=package_search",
   "result": {
      "count": 2,
      "facets": {},
      "results": [
         {…
         }
         {…
         }
      ],
      "search_facets": {},
      "sort": "score desc, metadata_modified desc"
   },
   "success": true
}
```


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From the search result we can see that this search returned two results ("count": 2). Investigating the search result further we can see that both results are also returned (cropped here for ease of reading).

2. All the data results are returned as part of an array in the JSON file ("results":[{…}{ …}]). Exploring fully a result we can get all the necessary metadata regarding the associated resource:

Table 10: Expansion of the first result on the Open Data portal

Search result example


```
{
        "author": "Not supplied",
        "author_email": "data@smartdublin.ie",
        "conforms_to": "DUBLinked Metadata Standard",
                "creator_user_id": "ef08264c-676d-48c5-aaad-6ce8aa18d521",
        "extras": […
        ],
        "frequency": "Annual",
        "groups": [],
        "id": "7f6b18d1-207f-40e6-89cc-333b680b2ccf",
        "isopen": true,
        "issued": "2011-12-07",
        "language": "en",
        "license_id": "CC-BY-4.0",
        "license_title": "Creative Commons Attribution 4.0",
        "license_url": "https://creativecommons.org/licenses/by/4.0/",
        "maintainer": "Not supplied",
        "maintainer_email": "data@smartdublin.ie",
        "metadata_created": "2015-09-13T15:40:47.164949",
        "metadata_modified": "2018-03-05T15:52:46.597230",
        "name": "disabled-parking-spaces",
        "notes": "Location of Disabled Car Parking spaces known to Fingal County Council\nThis dataset outlines the disabled parking bays on streets and roads with the Fingal County Council administrative area.  Fields include id Area Description ROADNAME Area Total Spaces Dipped footpath Park Sign Road Marking Occupied Lat Long'Spatial Projection: WGS84",
        "num_resources": 3,
        "num_tags": 7,
        "organization": {…
        },
        "owner_org": "fingal-county-council",
        "private": false,
          "relationships_as_object": [],
          "relationships_as_subject": [],
        "resources": […
        ],
        "revision_id": "4c4b74fd-e92c-40d1-b33f-c69063aee9f5",
        "rights": "PSI License: http://data.fingal.ie/License/License.pdf",
        "spatial_other": "Fingal",
```


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```
            "srs": [
                    "epsg:4326"
            ],
            "state": "active",
            "tags": [...
            ],
            "temporal": "2011-09-01 to 2011-09-01",
            "theme": "Transport",
            "title": "Disabled Parking Spaces",
            "type": "dataset",
            "updated": "2010-11-12",
            "url": "https://data.smartdublin.ie/dataset/disabled-parking-spaces",
            "version": "1.0"
                },
```


Part of the metadata returned is also specific metadata regarding the resource file. Table 11 presents the resources ("resources":[..]) array expanded:

Table 11: Resources Array from the first result of the Open Data portal

Search result example


```
"resources": [
                {
                "api_access_url": "",
                "api_response_formats": [],
                "api_type": "",
                "cache_last_updated": null,
                "cache_url": null,
                "created": "2016-01-22T11:41:44.171726",
                "datastore_active": false,
                "date": "2018-07-18",
                "description": "",
                "format": "CSV",
                "hash": "",
                "id": "7c100c63-d099-4a47-9e3d-c34683919d15",
                "last_modified": "2016-01-22T11:41:44.116320",
                "mimetype": null,
                "mimetype_inner": null,
                "name": "FCC_DisabledParking Bay_P20111013-2046.csv",
                "package_id": "7f6b18d1-207f-40e6-89cc-333b680b2ccf",
                "position": 0,
                "resource_type": null,
                "revision_id": "4c4b74fd-e92c-40d1-b33f-c69063aee9f5",
                "size": null,
                "state": "active",
                "url":              "https://data.smartdublin.ie/dataset/7f6b18d1-207f-40e6-89cc-
333b680b2ccf/resource/7c100c63-d099-4a47-9e3d-c34683919d15/download/fccdisabledparking-
bayp20111013-2046.csv",
              "url_type": null
                },
...]
```


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Table 7 - Resources Array Expanded

The uniform resource location (url) for accessing the actual dataset can be found in the metadata of the result

(*"url"*:https://data.smartdublin.ie/dataset/7f6b18d1-207f-40e6-89cc-333b680b2ccf/resource/7c100c63-d099-4a47-9e3d-c34683919d15/download/fccdisabledparking-bayp20111013-2046.csv).

Thenceforth, by using a simple GET request on that URL we can get the CSV file.

```
ID,AREA_DESC,ROADNAME,Area,TOTAL_SPACES,DIPPED_FOOTPATH,PARK_SIGN,ROAD_MARKING,OCCUPIED,Adjacent_Services,LAT,LONG
1,Chapel Street,Chapel Street,,2,TRUE, ,TRUE, ,Hairdressers,53.61029459,-6.186854504
2,Chapel Street,Chapel Street,,2, , ,TRUE, ,Hairdressers,53.6103352,-6.186735289
3,Clonard Road,Clonard Road,,1, , ,TRUE, ,Housing,53.60824911,-6.187719696
4,Carpark at New Savoy Cinema Complex,Carpark at New Savoy Cinema Complex,,1, , ,TRUE, ,"Cinema, Cafe",53.61014397,-6.182680715
5,High Street,High Street,,3, , ,TRUE, ,Housing,53.60930241,-6.181617976
6,High Street,High Street,,3, , ,TRUE,TRUE,Housing,53.60917483,-6.18166914
7,High Street,High Street,,3, , ,TRUE, ,Library,53.60894594,-6.181744886
8,St. Paul's Cresent,St. Paul's Cresent,,1, , ,TRUE,TRUE,Sports Club,53.60481942,-6.183291529
9,St. Paul's Cresent,St. Paul's Cresent,,1,TRUE, ,TRUE, ,"Housing, Cricket Club",53.60494254,-6.183861682
10,Quay Street Outside Nav 1,Quay Street,,1, , ,TRUE,TRUE,Housing,53.58124882,-6.111724109
11,Quay Street,Quay Street,,1, , ,TRUE, ,Housing,53.5811463,-6.110918226
12,Quay Street,Quay Street,,1, , ,TRUE,TRUE,Housing,53.58112319,-6.109863343
13,Quay Street,Quay Street,,1, , ,TRUE,TRUE,Housing,53.58137367,-6.109044226
14,Quay Street,Quay Street,,1, , ,TRUE,TRUE,Housing,53.58134265,-6.108917836
15,Strand Street,Strand Street,,1, , ,TRUE,TRUE,Housing,53.58139744,-6.107341521
16,Little Strand Street,Little Strand Street,,1, , ,TRUE,TRUE,Housing,53.57936961,-6.107731607
17,Church Street,Church Street,,1, , ,TRUE,TRUE,Housing,53.57936672,-6.108813584
18,Beau Piers,Beau Piers,,1, , ,TRUE,TRUE,Housing,53.57838661,-6.110941775
19,Railway Avenue,Railway Avenue,,1, , ,TRUE, ,"GP, Credit Union",53.45119867,-6.155679413
20,Church Road,Church Road,,1,TRUE, ,TRUE, ,Church,53.44791492,-6.153061522
21,St. Margarets Park,St. Margarets Park,,1,TRUE, ,TRUE, ,Housing,53.4468714,-6.153982847
22,Morton Stadium,Morton Stadium,,4, , ,TRUE, ,Sports Club,53.40082427,-6.246489708
23,Morton Stadium,Morton Stadium,,4, , ,TRUE, ,Sports Club,53.40085397,-6.246463191
24,Morton Stadium,Morton Stadium,,4, , ,TRUE, ,Sports Club,53.40088364,-6.246438523
25,Morton Stadium,Morton Stadium,,4, , ,TRUE, ,Sports Club,53.4009048,-6.246420524
26,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,"Supermarket, Library",53.46196786,-6.229922981
27,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,"Supermarket, Library",53.46198821,-6.229964581
28,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,Library,53.46208053,-6.230157855
29,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,"Supermarket, Library",53.46209471,-6.230198929
30,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,"Supermarket, Library",53.46215973,-6.230320707
31,Dunnes Stores/ Public Library,RATHBEALE ROAD,,2, , ,TRUE, ,"Supermarket, Library",53.46217323,-6.23036062
32,Dunnes Stores/ Public Library,ACCESS TO SHOPPING CENTRE,,2, , ,TRUE, ,Library,53.46226613,-6.230543209
33,Dunnes Stores/ Public Library,ACCESS TO SHOPPING CENTRE,,2, , ,TRUE, ,"Supermarket, Library",53.462283,-6.230583463
34,Airside Reid's furniture,AIRSIDE RETAIL PARK,,2, , ,TRUE, ,Retail Park,53.44585464,-6.227307107
35,Airside Reid's furniture,AIRSIDE RETAIL PARK,,2, , ,TRUE, ,Retail Park,53.44581241,-6.227289705
36,Airside Reid's furniture,AIRSIDE RETAIL PARK,,2, , ,TRUE, ,Retail Park,53.44599927,-6.227603863
37,Airside Reid's furniture,AIRSIDE RETAIL PARK,,2, , ,TRUE, ,Retail Park,53.44599643,-6.227552804
38,Airside Homestore and More,AIRSIDE RETAIL PARK,,4, , ,TRUE, ,Retail Park,53.44714411,-6.2231136
39,Airside Homestore and More,AIRSIDE RETAIL PARK,,4, , ,TRUE, ,Retail Park,53.44717178,-6.223135216
```

Figure 10: Sample of the CSV file exported from the Open Data portal

From there, and as described from Error! No s'ha trobat l'origen de la referència., the file is going to be saved in the knowledge base along with everything as described in the introduction of this section.

5.3.2 Statistical Research Data

We define as Statistical research data, data and information that present the results of research efforts, either academic or census. As such we require from

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the user to provide the Data Acquisition Layer with either upload a file or a URL for direct download, along with appropriate metadata that describe the research and its main insights.

Table 12: Statistical Research Data Metadata and Link

Statistical Research Data	
Metadata	Value
Title	World - Old age dependency ratio
URL	https://www.dropbox.com/s/akzhlwgkptqth1j/Old_age_dependency_ratio.xlsx?dl=1
Author	United Nations Human Settlement Programmes, Global Urban Observatory
Release Date	Dec 31, 2000
Updated Date	Dec 31, 2014
Language	English
Location	World
Subject	Elderly
Tags	World, Elderly, Age, etc.
Etc...	

Table 12 summarises the metadata and the URL of the Statistical Research data should be provided to the Statistical Research Data Handler. With this information the handler is able to store the data to the Knowledge Based with sufficient information for the Data Integration Layer to use them towards assisting the co-creation process.

5.4 Linked Open Data Handler Containers

Linked Open Data Handler Containers (D5) is the component that is in charge of the collection of the Linked Open Data, this means the semantic data available in online LOD repositories. The most relevant and stable LOD repositories are:

- DBpedia:
  - URL: https://wiki.dbpedia.org/
  - SPARQL endpoint: http://dbpedia.org/sparql

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    - Description: DBpedia is a project aiming to extract structured content from the information created in the Wikipedia project. This information is made available on the Web. DBpedia allows users to semantically query relationships and properties of Wikipedia resources, including links to other related datasets. Tim Berners-Lee described DBpedia as one of the most important parts of the decentralized Linked Data effort.
- EuroStat:
    - URL: https://ec.europa.eu/eurostat/data/database
    - SPARQL endpoint: http://data.europa.eu/euodp/en/linked-data
    - Description: EuroStat is the data portal of the European Commission that provides the statistical data for most of the domains (economy, population, transport, energy, science, etc.). Some data are available through the Open Data Portal and other datasets are downloadable in semantic format (SDMX).
- WorldBank:
    - URL: https://data.worldbank.org/
    - SPARQL endpoint: https://datacatalog.worldbank.org/
    - Description: WorldBank provides a list of datasets that contains several world developments indicators, financial data and projects. For example, they provide data about the efficiency of public spending in Education, health and infrastructure

All of them, as compliant with the Linked Open Data principles (5 stars of the linked data initiative), offer a SPARQL endpoint in order to directly query the semantic data. Different kinds of query are possible according to the 4 forms to use in the query header and that will retrieve either result sets or RDF graphs:

- SELECT: Returns all, or a subset of, the variables bound in a query pattern match
- CONSTRUCT: Returns an RDF graph constructed by substituting variables in a set of triple templates
- ASK: Returns a Boolean indicating whether a query pattern matches or not
- DESCRIBE: Returns an RDF graph that describes the resources found

In order to collect and reuse the relevant data, two approaches are possible. The first approach consists to download available datasets in semantic format (RDF) and upload them in the local semantic repository. All the data are then available

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to be reused but, in this case, if a new version is released, the new dataset will have to be downloaded again. This way the synchronisation of the data is not optimal. The second approach can be used when data provider shares the data through a SPARQL endpoint. In this situation, the data are accessible directly through SPARQL queries. With this approach we always collect the last version of the data, and we can filter only on the relevant data for Socatel platform. The second option is more flexible and more precise.

For this reason, a LOD crawler will be implemented in order to collect automatically semantic data from identified data sources. The LOD crawler will be configurable with the list of data sources (SPARQL endpoints and Linked Web pages) and some contextual information (important concepts, domains, languages, etc.) in order to identify and extract only the relevant RDF data.
Then, it saves the extracted data into a triple store and navigates users to define and target data sources to extract the most relevant data, filtered by the context. The LOD crawler combines different techniques and researches in one component, to offer the best functionalities and the more precise results.

Below is available the architecture of the LOD crawler that will be integrated in the SoCaTel platform. It contains three important components:

- A **Controller** will receive the seed list. It will hold the in-memory FIFO queue of URIs to be crawled and communicate with the data storage of crawled URIs. After receiving URIs from Worker, it will check if those links were crawled before during the task. Links that are not crawled before are put into Crawled URIs database and also put into the FIFO queue for further crawling.

- A **Worker** will receive the URI from Controller and crawl the URI, it will also send SPARQL queries to the endpoints to receive related data and with this data it will create triples. Crawled and created triples will be inserted into Triple Store's Task Graph for each task and if they pass the Store Filter, they will be inserted into the Process Graph. If a Crawl Filter is defined, filtering will be applied on the new found URIs. New URIs will be sent to Controller to be filtered for further crawling.

- Finally, Controller and Workers will be communicating through a **message broker**.

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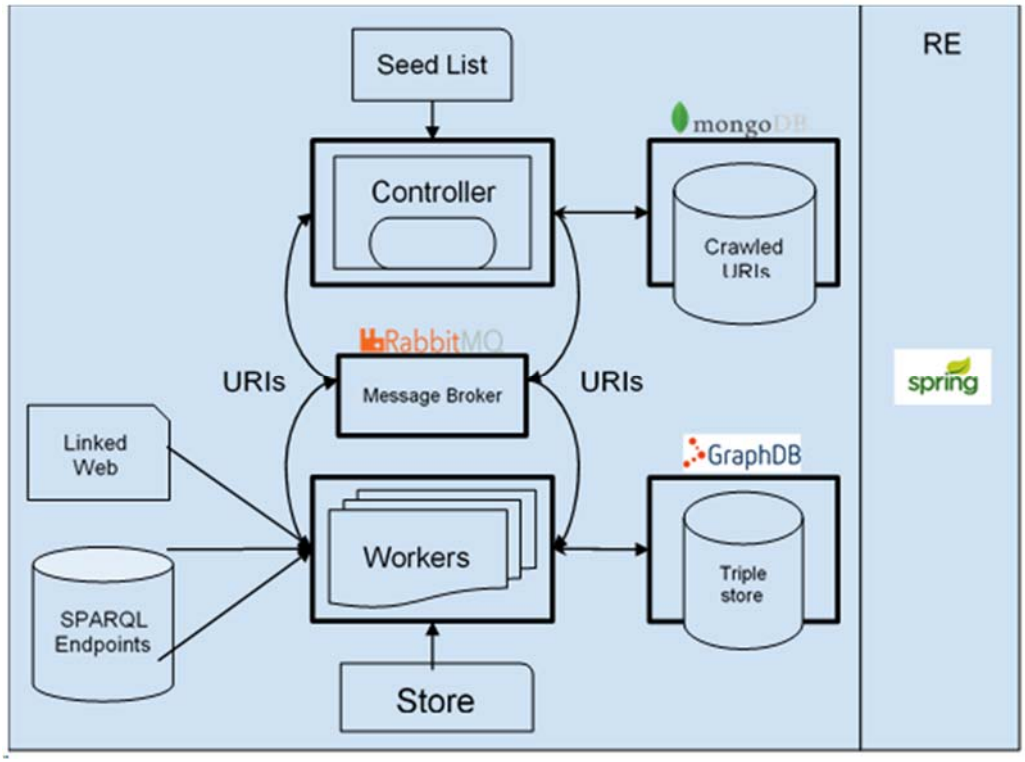

Figure 11: The LOD Crawler architecture

5.5 Raw Data Semantic Handler

The Raw Data repository will be populated on a regular basis (upon specific change events and also on a time basis). The data in the Raw Data Repository will be sourced from the SoCaTel Portal as a result of a Push action from the Portal over the knowledge base REST API. The data stored will be:

1. Pseudonymised, processed prior to being pushed. This applies to data that is necessary to provide SoCaTel Platform user specific recommendations i.e. recommend co-creation groups to join

2. Anonymised, processed prior to being pushed. This applies data derived from activities in the platform i.e. activities in groups sent over anonymised for statistical analysis, demographics against participation etc.

The Raw Data Semantic Handler (D6) is responsible for:

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1. Obtaining raw data that reside on the Raw Data Repository in ElasticSearch
2. Applying filtering / alteration / annotation / transformation / etc.
3. Send these obtained raw data to the Semantic Transformation Layer for semantic annotation.

All consumed data by the Raw Data Semantic Handler have already being anonymised/pseudonymised by the portal layer prior being sent to the Raw Data Repository (KB2.1). In detail, the portal raw data are being populated to the Raw Data Repository by a process initiated by the portal. This is handled by the Transfer Data API calls (R2). This process makes the Knowledge Base completely decoupled from any privacy concerns and increases its modularity and portability.

After the population of the Raw Data Repository, the Handler Controller gets notified that new raw data had been inserted to the repository. The Handler Controller then enables the Raw Data Semantic Handler to fetch the new raw data in order to apply the process explained above. The Raw Data Semantic Handler, after the semantic transformation, updates the raw data with a flag that indicates their semantic transformation completion.

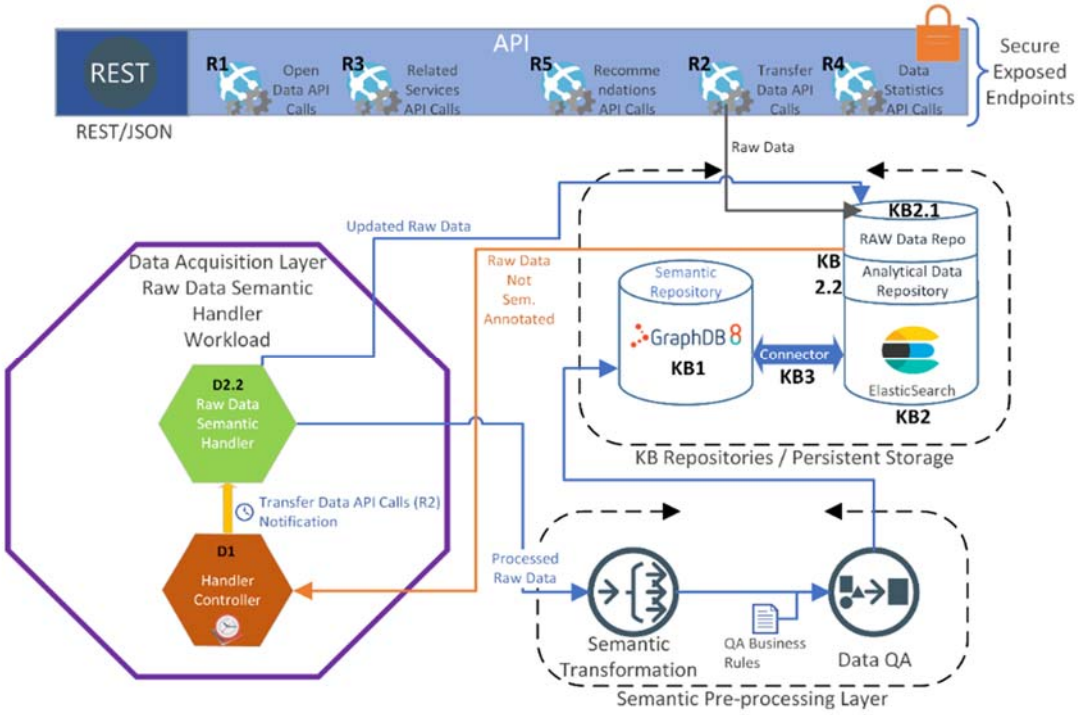

Figure 12: Raw Data Semantic Handler Workload

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Figure 12 displays the process described above. It is worth noting that any applied filtering / alteration / annotation / transformation / etc outcome is being used by the Integration Layer as an input for generating statistics and recommendations.

6. SEMANTIC PRE-PROCESSING LAYER

The semantic pre-processing layer is in charge of the conversion of all the data collected by the Data Handlers. From the handlers, even if an important heterogeneity of the data is expected, a minimal structure will be available.

The semantic pre-processing layer aims to automatically map the structure of the incoming data with the SoCaTel conceptual data model. Based on this mapping, the data will be converted in RDF in order to be stored in the knowledge base.

This is the typical problematic of the Extraction, Transformation, Load (ETL) that provides a technical workflow where the different steps of the data transformation are considered:

1. **Extraction:** is the step of the data extraction from different sources that exists in different formats (e.g. text, CSV, XLS, etc.)

2. **Transformation:** corresponds to the cleansing of the data. In order to manage the diversity of the data, several operations to clean the data can be applied:
    a. Typical transformation activities;
    b. Data normalisation;
    c. Removing duplicates;
    d. Checking the integrity constraints violation;
    e. Filtering data;
    f. Sorting and grouping;
    g. etc.

3. **Loading:** is the last step focused on the data propagation. Once the data are cleaned and harmonised (cf. the data model mappings), they can be converted in semantic format (RDF):
    a. Semantisation of the data
    b. Production of the LOD

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4. **Storing** in the knowledge base, which is the final step to load the obtained semantic data in the semantic repository.

According to the level of data structuration, the process of the data semantisation is more or less complex. The more complex scenario is when the data are totally unstructured such as text because no mapping can be easily performed. By contrary, the easiest scenario is when the collected data are from LOD repository, they have very high level of structuration and the concept mappings are already considered within the SPARQL queries.

For this reason, we differentiate the three following scenarios:

1. From unstructured to structured data: the lack of structuration increase the complexity to map specific entities of the data model directly with the content. Techniques for automatic mapping are required to identify the minimal structure elements and how they can automatically be mapped with the SoCaTel ontologies.
2. From semi-structured to structured data: in this case, all the structural elements are extracted and mapped automatically with the SoCaTel ontology.
3. From structured to structured data: this is the easiest scenario that consists in LOD consumption. For this, SPARQL queries are triggered to collect RDF data or directly semantic sub-graphs. The mapping is explicitly defined within the query and for this reason, this operation does not require complex transformation. The collected data can be reused as it is.

In the two first scenario (unstructured and semi-structured), human validation of the automatic mappings is required to ensure the semantic validity and the appropriate semantisation of the content.

Figure 13 shows the specification of the ETL workflow for the semantic pre-processing layer in the knowledge base.

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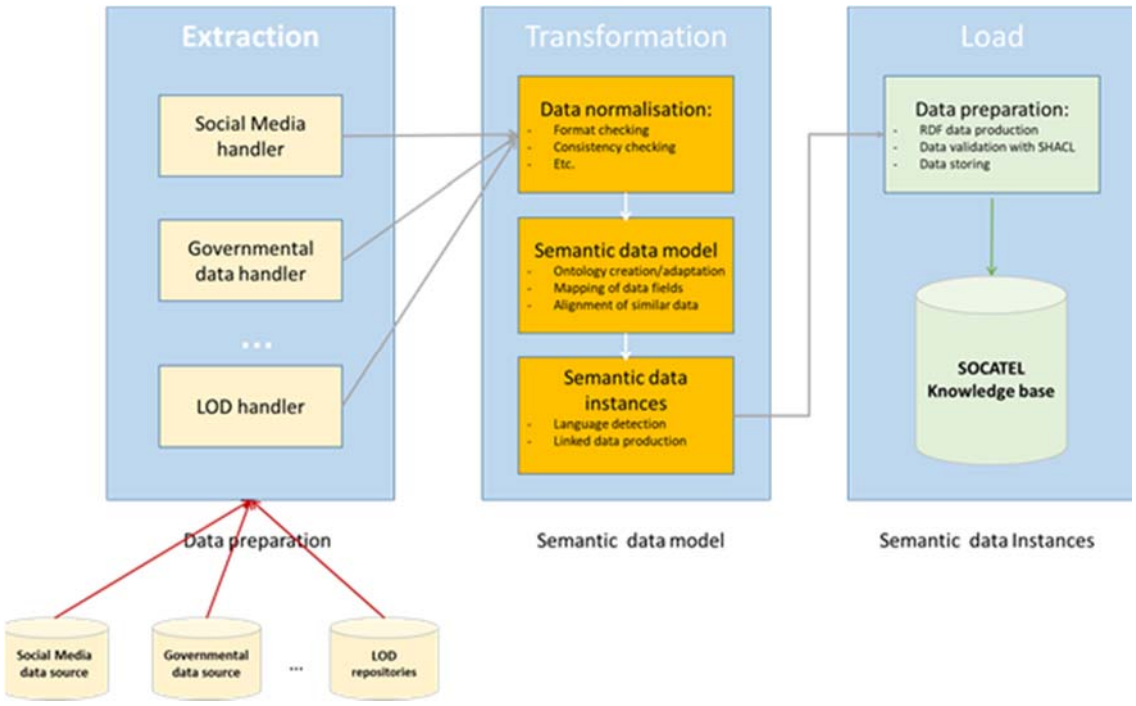

Figure 13: ETL workflow of the semantic pre-processing layer

Below is the specification of the ETL workflow for the semantic pre-processing in SoCaTel. As explained previously, the ETL workflow for the semantic pre-processing layer is composed of three main components:

- Data extraction: this phase aims to extract the data from the different handlers and prepare them in order to be transformed in the semantic format. According to their origin and the level of content structuration, more or less extraction operations will be required. Technical operations will be realised by the specific handlers developed in the project.
- Data transformation: consists of all the operations required to properly generate the collected data in the semantic format. The required operations applied in SoCaTel are the following ones:
    - Data normalisation: the initial operations performs a set of data verification in order to normalise the content and facilitate the automation of the data transformation (format checking, consistency checking, etc.)
    - Semantic data model: once the data are normalised, the content structure is automatically analysed in order to map it with the predefined ontologies (Ontology creation/adaptation). At the beginning, the mapping will be performed manually but will be

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progressively automated (e.g. mapping of data fields, ontology alignment, etc.)

- Semantic data instances: once the mappings are correctly defined and manually validated, the data conversion can be initiated. During this phase, conceptual requirements can be considered in order to enrich the content. For example, a service of language detection can be used to detect the content language and when it if is identified, the content will be automatically annotated with the language metadata. This way the linked data will be produced and available in semantic and multilingual format (e.g. inked data production).

- Data loading: this phase will be in charge of the control of the data format and logical coherence in order to store in the knowledge base only the relevant and reusable information.
- To conclude on the semantic pre-processing layer, the full workflow is quite complex. In order to develop it progressively and ensure the validity of the linked data production, we have to adopt a pragmatic strategy that follows these basic principles:
- Priority of content type processing will be focused on well-structured content first. This will permit to generate quickly relevant data.
- Small datasets will be processed first and the stored data in the knowledge base will be tested from the beginning in order to ensure the quality of the linked data. For this, scenario with SPARQL queries will be implemented to focus on frontend and pilots' requirements.
- Tools to generate the semantic data will not use at the beginning all the concepts of the ontologies but the most important ones (main entities, multilingual, origin, etc.). Once quality of the produced data to feed the knowledge base will be verified, other levels of complexity will be introduced step by step.

7. CONCLUSION

The deliverable has presented the concept of insightful datasets in the context of SoCaTel. They are datasets that contain pieces of information that will facilitate decision making within the co-creation platform. For example, information about existing long-term care service providers, statistical studies, census reports, local events, fresh news on topical issues and other relevant content help contextualise a topic under discussion, and will prevent a discussion to be based

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on unknowns, incorrect statements or not reflecting the reality. It also prevents end-users from reinventing the wheel.

A methodology was introduced to coordinate how organisations commissioning the platform in a target territory should proceed to identify such datasets. For reasons ranging from language issues to poor knowledge of the local community, the entity commercialising or promoting SoCaTel globally cannot run the commissioning process independently. A coordinated effort is necessary with the right balance between what each party should deliver. The methodology has been tested and validated at the 4 pilot sites in Ireland, Spain, Finland and Hungary, and a sample of the datasets collected have been included.

The deliverable has further described the methodology and implementation of the Data Acquisition and Semantic Pre-Processing layers of the knowledge base, responsible for connecting to online data sources to collect insightful datasets, and then processing them to enrich them and transform them in a machine-readable format, so that valuable information can be pushed to the SoCaTel co-creation platform during discussions. Great details were presented as to the mechanisms put in place to connect and parse data files from heterogeneous data sources, such as from Open Data portals, Twitter and Facebook social media platforms.

Finally, the management of multilingual content is a complex matter that has been identified and discussed throughout the document. Mechanisms will be implemented, specifically at the Semantic Pre-Processing layer, and presented in greater details in next deliverables.

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8. APPENDIX 1

The list of long-term care service providers in Ireland and the Dublin area with the description of the services and information provided to the population.

Agency	Available at / Link to	Purpose
Irish Government Open Data	https://data.gov.ie/ https://www.gov.ie/en/campaigns/slaintecare-implementation-strategy/	Open source data available by government. Link to the new health strategy Slaintecare for implementation over next 10 years and investment in ehealth.
Department of Health (DOH)	https://health.gov.ie/wp-content/uploads/2018/06/Homecare-Consultation-Report.pdf	DOH provides information on legislation, policy and statistics. Publications available concerning policy development in home care

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Health Service Executive (HSE) HSE -ICPOP HSE -Health Atlas HSE Digital Team HSE - Ehealth Ireland Strategy HSE - Understand Together HSE Open Source Policy HSE-NCPOP	1)https://www.hse.ie/eng/services/list/4/olderpeople/ https://www.hse.ie/eng/home-support-services/home-support-services-information-booklet.pdf 2)https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/positive-ageing/ 3)https://www.hse.ie/eng/services/publications/kpis/2017-older-persons-services-kpi-metadata-.pdf 4)https://www.hse.ie/eng/services/publications/corporate/personsatriskofabuse.pdf 5)https://www.hse.ie/eng/about/who/cspd/icp/older-persons/ 6)https://www.healthatlasireland.ie/ 7)https://www.hse.ie/eng/about/who/communications/digital/ 8)http://www.ehealthireland.ie/Knowledge-Information-Plan/eHealth-Strategy-for-Ireland.pdf 9)http://www.understandtogether.ie/ 10)http://www.ehealthireland.ie/Library/Document-Library/Open%20Data/Open-Data-Policy.pdf 11)https://www.hse.ie/eng/services/news/media/pressrel/mpower-project-commences-in-cho-1.html 12)http://www.ncpop.ie/	HSE charged with providing public health services nationally; 1)Information on services for older people including information on home support services 2)The Healthy and Positive Ageing Initiative (HaPAI) is a collaborative partnership involving the HSE Health and Wellbeing, Dept of Health, Atlantic Philanthropies and Age Friendly Ireland. 3) Social Care Division Older Persons Services Key Performance Indicator Data 2017 4) Safeguarding services for persons at risk of abuse 5) Integrated care for older persons (Nora's story video) 6) Map resource for citizens to find information on local services 7)The Digital team responsible for delivering the online user experience for the HSE 8) Shows plans for EHR with patient portal to be implemented. 9)Understand Together - a public support, awareness and information campaign led by HSE, working with The Alzheimer Society of Ireland and Genio campaign 10) HSE commitment to open source data 11) HSE supported EU Interreg VA funded project mPower includes social prescribing, to signpost and connect people to local activities and services. Technology solutions to include home and mobile health monitoring devices/solutions, Apps and using video for clinical consultations. https://mpowerhealth.eu/ 12) National Centre for the Protection of Older People undertaking research into elder abuse in Ireland

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Dept of Communications, Climate Action and Environment (DCCAE)	1)https://www.dccae.gov.ie/en-ie/communications/topics/Digital-Strategy/Pages/default.aspx 2)https://www.dccae.gov.ie/en-ie/communications/topics/Internet-Policy/internet-governance/Pages/Internet-Governance.aspx	1) The National Digital Strategy sets out a vision and a number of practical actions and steps to encourage and assist more citizens to get on line. 2) Internet Governance
Dublin City Council (DCC)	1)http://www.dublincity.ie/housing-and-community 2)http://www.dublincity.ie/main-menu-your-council-your-area-north-west-area-north-west-area-committee/older-persons-unit 3)http://www.dublincity.ie/library-eresources	1)DCC for public housing and community information. 2)DCC for older persons sheltered accommodation 3)Link to library e-resources
An Garda Siochana	https://www.garda.ie/en/Crime-Prevention/Community-engagement/Community-Policing.html	Community engagement and policing to protect older adults
Institute of Public Health (IPH)	http://healthinequalities.publichealthwell.ie/?source=hometabs	The Public Health Well is an all-island (Ireland and Northern Ireland) health information website making evidence available.
Health Information & Quality Authority (HIQA)	https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf	HIQA provides guidance for health information standards. HIQA also monitors, inspects and registers designated centres for older people, such as nursing homes.
Nursing Board (NMBI)	https://www.nmbi.ie/Standards-Guidance/Code	NMBI statutory organisation which regulates the nursing and midwifery professions to enhance patient safety and patient care.

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Irish College of General Practitioners (ICGP)	https://www.icgp.ie/go/library/notice_board/3265C61F-B1F7-3409-1442031E3A3CC866.html	The ICGP is the professional body for general practice in Ireland. The College's primary aim is to serve the patient and the general practitioner by encouraging and maintaining the highest standards of general medical practice
Irish Association of Social Workers	https://www.iasw.ie/social-worker-ageing-older-persons	The IASW Special Interest Group on Ageing (SIGA) is a group of social workers who wish to pursue the best interests of older persons and promote professional development of practice.
Central Statistics Office (CSO)	https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics/	National Census Data; Demographic information (including disability) at small areas for Census 2016
Pobal	www.pobal.ie	Pobal works on behalf of Government to support communities and local agencies toward achieving social inclusion and development. Tools such as Pobal Maps and the Pobal HP Deprivation Index are made freely available to allow policy makers and communities respond to needs identified.
Irish Platform for Patient Orgs, Science and Industry (IPPOSI)	http://www.ipposi.ie/about-us/who-we-are/	IPPOSI is a patient-led organisation that works with patients, government, industry, science and academia to put patients at the heart of health innovation.

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The Irish Longitudinal Study on Ageing (TILDA)	www.tilda.ie	The Irish Longitudinal Study on Ageing (TILDA) is a large-scale, nationally representative, longitudinal study on ageing in Ireland.
Centre for Ageing Research and Development in Ireland (CARDI)	http://www.cardi.ie/theme/health-well-being	Centre for Ageing Research and Development in Ireland (CARDI) committed to building a strong and lasting community of researchers in ageing in Ireland, North and South.
Citizens Information	http://centres.citizensinformation.ie/centre.php?cic=Ballymun+CIC+	National portal for accessing citizens information (link shown to Ballymun in the Socatel catchment)
Care Folk	www.carefolk.com	An Irish platform for carers which provides tools for carers to use and which hosts online communities
The Wheel	https://www.wheel.ie/about-us	National association of community and voluntary organisations, charities and social enterprises. We are a registered charity in Ireland and are unique in our role as a 'one-stop-shop' for anything related to the charity and non-profit sector.
ALONE	www.alone.ie	ALONE is a national organisation that supports older people to age at home. Alone offers a range of services including: Befriending, Housing with Support, Support Coordination, Technology, and Campaigns for Change.

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Thirdage	www.thirdage.ie http://www.thirdageireland.ie/whats-on/summerhill-services (link to find computer skills classes for older persons)	Third Age is a national voluntary organisation celebrating the third age in life. Third Age recognises and celebrates the fact that older people are a diverse group with different needs, abilities, backgrounds and experiences.
Sage Advocacy	www.sageadvocacy.ie	Sage Advocacy which is a support and advocacy service for vulnerable adults, older people and healthcare patients.
Activelink	https://www.activelink.ie/content/irish-links/older-people	An online network for Irish non-profit organisations
Care Alliance Ireland	www.carealliance.ie	Provides information and supports to Family Carers and opportunities to collaborate on initiatives including National Carers Week, Family Carer Research Group & policy submissions
Crosscare	www.crosscare.ie	Crosscare is the Social Support Agency of the Catholic Archdiocese of Dublin and provides a range of social care, community services across to people affected by poverty.
Dementia Services Information and Development Centre (DSIDC)	www.dementia.ie	DSIDC is a National Centre for excellence in dementia offering three core professional services; Education and Training, Information and Consultancy, Research

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Friends of the Elderly	https://friendsoftheelderly.ie/about/	Provides social engagement programmes such as Home Visitation, Friendly Call Service, Social Club and Social Events.
The Irish Hospice Foundation	http://hospicefoundation.ie/wp-content/uploads/2013/04/End-OfLife-care-for-older-people-in-acute-and-long-stay-care-settings-in-Ireland.pdf	Providing end of life care to older people in acute and community settings
Sample of websites for private homecare agencies	www.bluebirdcare.ie www.comfortkeepers.ie www.homeinstead.ie www.privatehomecare.ie www.myhomecare.ie www.careworld.ie www.mindme.ie www.libertyhomecare.ie www.iniscare.ie	Provide private and HSE commissioned home support services to older adults
Migrant Rights Centre Ireland MRCI	https://www.mrci.ie/resources/all-work-and-low-pay-the-experience-of-migrants-working-in-ireland/	Support association for migrant home care workers
Age Action	1)https://www.ageaction.ie/sites/default/files/aa2c_asi2c_iasw_final_research_report-a4-report_lr_for_web_2.pdf 2)https://www.ageaction.ie/how-we-can-help/getting-started-computer-training/getting-started-tutor-and-learner-resources-0	1)Our mission is to: *'To achieve fundamental change in the lives of all older people by empowering them to live full lives as actively engaged citizens and to secure their rights'* 2)Computer training courses for older persons
The Alzheimer Society of Ireland	http://www.alzheimer.ie/about-us.aspx	A national non-profit organisation, The Alzheimer Society of Ireland is person centred, rights-based and grassroots led with the voice of the person with dementia and their carer at its core.

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Senior Care	https://www.seniorcare.ie/listing-categories/home-care-home-help/	Online resource for finding helping agencies in Ireland
Kare Social Services	http://www.karesocialservices.ie/about.php?pid=2	KARE's main function is to provide home help, meals on wheels, citizens information for citizens living in Artane, Killester, Raheny,Kilbarrack, Clontarf, Edenmore, Balgriffin, Marino and Dollymount.
Fold Ireland	https://www.foldireland.ie/telecare	FOLD TeleCare provide a range of telecare solutions to FOLD Ireland's tenants and residents who can access help and support 24 hours a day by linking them directly to a member of staff or by contacting FOLD TeleCare's 24 hour Response Centre.
Dublin City University (DCU)	https://www.dcu.ie/agefriendly/initiatives.shtml	The increased demand for the medical exercise and fitness programme MedEx and Active for Life programme aimed at older people demonstrates DCU's commitment to support active and healthy ageing.
Active Retirement Ireland (ARI)	https://activeirl.ie/ari-mission/	ARI is a voluntary organisation for older people with a national membership ranging in age from 50 -100+ years and cover a range of socio-economic backgrounds.

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Age and Opportunity	http://ageandopportunity.ie/what-we-do/education-training	Age & Opportunity is the national organisation the goal of which is to turn the period from age 50 onwards into one of the most satisfying times in people's lives working with public and private partners to deliver established innovative programmes like the Bealtaine arts festival.
National Adult Literacy Agency (NALA)	1)https://www.nala.ie/literacy/nala-research/older-people 2)http://www.writeon.ie/nala/home/home.jsf?1545231616668	1)Factors that could affect older people's decisions about learning new skills in later life (including technology) and about what role learning plays in their life as they grow older. 2) Online course to help citizens with reading and writing skills and technology
Making Ireland Click (RTE programme)	http://www.makingirelandclick.ie/episode-1/	With the assistance of David Puttnam, Ireland's Digital Champion, we meet some of the 300,000 (older) people who are missing out, and those who have recently got to grips with using the internet
1)Yourlocal 2)Parish website	1)http://www.yourlocal.ie/company/495654307553280 2)http://www.donnycarneyparish.ie/groups.html 3)http://www.whitehall.dublindiocese.ie/_webedit/uploaded-files/All%20Files/20th%20May%202018.pdf	1) Links to local services that do not have a website. The service identified is a day care centre providing services within the Irish Socatel catchment. 2&3) Many older persons' services (which may not have their own website) are listed on local parish websites

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Le Cheile Donnycarney	https://dcyc.ie/about/	We are a community facilities and services provider our purpose is to provide recreational, social and educational space and activities for people of all ages, including young people at risk in Dublin 5 and neighbouring areas of Artane, Killester, Beaumont and Marino.
Age Friendly Ireland	http://agefriendlyireland.ie/wp-content/uploads/2015/03/EastWall_AFT-Final-Report-03.03.15.pdf	The Age Friendly Cities and Counties Programme (AFCCP) is an in initiative of the Age Friendly Ireland and is aligned to WHO Age Friendly Cities Programme. This Age Friendly strategy for East Wall was prepared by Age Friendly Ireland (a non-profit organisation) on behalf of the older people in East Wall.
Vantastic	https://vantastic.ie/health-route/	Low cost fully accessible Door-to-Door transport service for the over 65's living in specific areas in Dublin.
Mens Sheds	http://menssheds.ie/about-us/	A Men's Shed is any community-based, non-commercial organisation which is open to all men where the primary activity is the provision of a safe, friendly and inclusive environment where the men are able to gather and/or work on meaningful projects at their own pace, in their own time and in the company of other men and where the primary objective is to advance the health and well- being of the participating men.

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Mental Health Ireland (MHI)	https://www.mentalhealthireland.ie/what-we-do/	Mental Health Ireland is a national voluntary organisation which aims to promote positive mental health and wellbeing to all individuals and communities in Ireland. Our Mental Health Associations fundraise to organise outings and events for those struggling with mental health in their communities.
Family Carers Ireland	https://familycarers.ie/home-care-services/training/digital-skills-for-citizens-initiative-free-online-training/	Family Carers Ireland is a registered charity and a company limited by guarantee. They provide training for carers; home care services; information on carers' Rights and Entitlements; free legal advice; and both one-to-one counselling and personal advocacy services. They also provide personal alarms to seniors as part of the Senior Alert Scheme. Family Carers Ireland also maintains a nationwide network of Carer Groups and operate a confidential Freephone Careline, which offers advice and support to family carers.
Respond	https://www.respond.ie/ireland-interactive-map/resident-support/older-persons/	Respond Housing Association aims to provide the highest quality housing for older people in sustainable thriving communities. We encourage an environment that is informed by a positive ageing ethos. We aim to facilitate independent living by enabling and empowering older residents to develop and maintain participation and activation within their families, communities and wider society.

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Lifeline24	https://www.lifeline24.ie/?gclid=EAIaIQobChMIxISg_Z2s3wIVg_hRCh3M9wNHEAMYASAAEgItT_D_BwE	Lifeline 24 is a dedicated national Telecare provider that provides a low cost Telecare personal alarm service for anyone that is frail, elderly or disabled living in the Republic of Ireland.
Siel Bleu Ireland	http://www.sielbleu.ie/home/programmes/community/	A not for profit organisation provides life enhancing exercise programmes to older adults. Siel Bleu Ireland is the first specific effort to promote exercise among older adults and patient groups in Ireland, with the aim of improving overall wellbeing.
St. Vincent de Paul	https://www.svp.ie/home.aspx	The Society of St. Vincent de Paul (SVP) is the largest voluntary charitable organisation in Ireland. Our goal is to fight poverty in all its forms through the practical assistance to people in need.
Enable Ireland	https://www.enableireland.ie/resources/publications/discussion-paper-assistive-technology-people-disabilities-and-older-people	Assistive Technology For People with Disabilities and Older People.
Assist Ireland	http://www.assistireland.ie/eng/	Assistireland.ie contains information on daily living aids, mobility aids and assistive technology. Assistireland.ie is provided by the Citizens Information Board.

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Focus Ireland	https://www.focusireland.ie/	Recent Department of Housing statistics show that in February 2018 there were 119 people aged over 65 living in emergency homeless accommodation, up over 40% in just two years. Focus Ireland reported up to 10 older people who are vulnerable to sleeping rough, many of them with serious health issues.
NetwellCasala	https://www.netwellcasala.org/about/	NetwellCASALA is a joint venture between DIT, the HSE and Louth County Council. Links with a global network of stakeholders at the forefront of understanding of ageing and age-friendliness. We also work with industry to achieve product innovation, business competitiveness, and market leadership in the emerging ambient assisted living (AAL) sector.
The Arts Council	http://www.artscouncil.ie/Arts-in-Ireland/Arts-participation/Arts-and-older-people/	The Arts Council recognises the important and valuable contribution made by older people in the arts as artists, audience members, critics, arts workers and board members. The Arts Council offers a wide range of financial supports across artforms and arts practices, including arts and older people.
TESCO	https://www.checkout.ie/tesco-announce-free-deliveries-65s-shop-online/65540	Tesco Ireland has launched a free deliveries programme for over-65s when they shop online which seeks to support the full and effective participation of older persons in the community.

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Silver Surfers Senior Forums Dementia Forum	https://www.silversurfers.com/best-of-the-web/technology-best-of-the-web/best-senior-chat-rooms-sites-for-over-50s-60s/ http://www.seniorforums.com/ https://www.dementiaforum.org/	Chat rooms for older adults and carers
The Home Share	https://homeshare.org/programmes-worldwide/ireland-republic-of/	Organisation which matches householders with homesharers who support older people. Householders have a home that they are willing to share and need some companionship or would like some support with household tasks.

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9. APPENDIX 2

A list of Twitter and Facebook feeds for Older Persons Services in Ireland.

Organisation	Twitter	Facebook
HSE	@HSELive @PeopleofHSE @eHealthIreland @CCIO_IRL	www.facebook.com/HSELive
Department of Health	@roinnslainte @Slaintecare @HealthyIreland	
Dublin City Council www.dcc.ie www.homeless.ie	@DubCityCouncil @eventsDCC @housingdcc @dccsportsrec @HomelessDublin	www.facebook.com/DublinCityCouncil
Dept. of Employment Affairs & Social Protection www.welfare.ie/en/Pages/Retired-and-older-people_holder.aspx	@welfare_ie	
Department of Communication, Climate Action & Environment	@Dept_ccae	
Health Information & Quality Authority HIQA	@HIQAIreland	www.facebook.com/HIQAIreland
Research Hug www.researchhug.com My Patient Space www.mypatientspace.com	@ResearchHug	

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Central Statistics Office	@CSOIreland	www.facebook.com/CSOIreland
Pobal www.pobal.ie https://www.pobal.ie/programmes/seniors-alert-scheme-sas/	@pobal	
IPPOSI	@IPPOSI	www.facebook.com/patientsplatformireland
Citizens Information Centre	@citizensinfo	
Carefolk	@carefolkteam	www.facebook.com/carefolkteam
The Wheel (vol. organisations)	@The_Wheel_Irl	www.facebook.com/TheWheelIreland
ALONE	@ALONE_IRELAND	www.facebook.com/ALONEIreland
Third Age Ireland	@ThirdAgeIreland	www.facebook.com/thirdageireland
Age Action	@AgeAction	www.facebook.com/AgeActionIreland
Sage Advocacy	@SageAdvocacy	www.facebook.com/SageAdvocacy
Family Carers	@familycarers	www.facebook.com/familycarers
Care Alliance Ireland	@CareAllianceIrl	

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Crosscare	@Crosscare1	www.facebook.com/Crosscare1
Dementia Ireland	@dementiaireland	
Alzheimers Society Ireland	@alzheimersocirl	
Friends of the Elderly	@FriendofElderly	www.facebook.com/friendsoftheelderly
North Dublin Home Care	@NorthDublinHomeCare	www.facebook.com/NorthDublinHomeCare
Bluebird Care	@BluebirdCareDublinNorth	www.facebook.com/BluebirdCareDublinNorth
Mens Sheds	@irishmensshedsassociation	www.facebook.com/ irishmensshedsassociation
St. Vincent dePaul	@SVP_Ireland	www.facebook.com/SVPIreland
Home Instead	@HomeInsteadIrl	www.facebook.com/homeinsteadireland
Comfort Keepers Ireland	@ComfortKeepersIreland	www.facebook.com/ComfortKeepersIreland
My Home Care	@myhomecare_ie	www.facebook.com/myhomecare
Private Home Care	@PHCLucan	www.facebook.com/PHCLucan

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Liberty Home Care & Hospice Services	@libertyhomecare	www.facebook.com/libertyhomecare
St. Mary's Campus http://www.nursinginthepark.com		
Irish Senior Citizens Parliament www.seniors.ie	@seniorsparl	
Institute of Public Health IPH www.publichealth.ie www.agestats.ie	@publichealthie	
Economic & Social Research Institute www.esri.ie	@ESRIDublin	
Irish Human Rights & Equality Division www.ihrec.ie	@IHREC	
National Council for the Blind in Ireland http://www.ncbi.ie/technology/ Irish Deaf Society www.irishdeafsociety.ie	@NCBI_sightloss	
Cerner www.cerner.com/ie/	@Cerner	www.facebook.com/Cerner/
www.Mpowerhealth.eu NetwellCasala	@mPower_health @CASALATWEET	

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement Nº 769975.

www.tcd.ie/research/btr/ageing/ http://www.ucd.ie/issda Irish Social Science Data Archive ISSDA	@tcddublin @issda	
Irish Nursing Homes www.nhi.ie http://www.irishnursinghomes.eu/?display=21		
Parkinsons Association of Ireland www.parkinsons.ie	@Parkinsonsirl	www.facebook.com/parkinsons.ireland
Diabetes Ireland www.diabetes.ie	@Diabetes_ie	www.facebook.com/DiabetesIreland/
National Disability Authority www.nda.ie www.enableireland.ie	@EnableIreland	
www.mentalhealthireland.ie www.aware.ie	@MentalHealthIrl @Aware	www.facebook.com/Mental.Health.Ireland www.facebook.com/AwareIreland

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