Project Acronym:	**VICINITY**
Project Full Title:	**Open virtual neighbourhood network to connect intelligent buildings and smart objects**
Grant Agreement:	**688467**
Project Duration:	**48 months (01/01/2016 - 31/12/2019)**

Deliverable D1.3

Report on Pilot sites and Operational Requirements

Work Package:	**WP1 – Sites Survey, Requirements**
Task(s):	**T1.2 – VICINITY**
Lead Beneficiaries:	**ENERC, HITS, BVR**
Due Date:	**31 December 2016 (M12)**
Submission Date:	**23 January 2017 (M13)**
Deliverable Status:	**Final**
Deliverable Type:	**R**
Dissemination Level:	**PU**
File Name:	**VICINITY_D1.3 Report on Pilot sites and Operational Requirements_FINAL.docx**

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Revision Control

Version	Date	Status	Modifications made by
0.1	24 June 2016 (M6)	Initial Draft, Use cases template	Hovstø, Asbjørn (HITS)
0.2	28 June 2016	First Draft formatted with contributions received	Viktor Oravec (BVR), Sveen Flemming (HITS), Samovich Natalie (ENERC)
0.3	8 August 2016	3rd review by partners of Use cases	Hovstø, Asbjørn (HITS)
0.4	September October November	Consolidation of use cases; Overview of Site visits; Operational Requirements	Natalie Samovich (ENERC) Joao Oliveira (ENERC) Joao Santos (ENERC) Rolv Nilsen (TINYM) Athanasios Tryferidis (CERTH)
0.5	8 December 2016	Re Draft formatted with contributions received	Natalie Samovich (ENERC)
0.6	14 December 2016	Deliverable version for final review by partners	Natalie Samovich (ENERC)
0.7	20 December 2016	Deliverable version uploaded for Quality Check	
0.8	21 December 2016	Quality Check	
0.9	24 December 2016	Final Draft reviewed	
1.0		Submission to the EC	

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List of Abbreviations and Definitions

Abbreviation	Definition
AIOTI	Alliance for Internet of Things Innovation
AMI	Advanced Metering Infrastructure
API	Application Programming Interface
CO_2	Carbon Dioxide
DER	Distributed Energy Resources

DNI	Direct Normal Irradiance
DSO	Distribution System Operators
EC	European Commission
EU	European Union
EV	Electric Vehicle
HVAC	Heating, ventilation and air conditioning
ICT	Information and Communications Technology
IEQ	Indoor Environmental Quality
IoT	Internet of Things
IaaS	Infrastructure as a Service
IP	Internet Protocol
NZEB	Near Zero Energy Building
OREEC	Oslo Renewable Energy and Environment Cluster
PaaS	Platform as a Service
PV	Photovoltaic
RES	Renewable Energy Systems
RES	Renewable Energy Sources
SaaS	Software as a Service
SotA	State of the Art
SysML	System Modelling Language
VPP	Virtual Power Plant

WP	Work Package
WP1	Requirements capture Framework
WP2	Standardisation Analysis and VICINITY platform conformity
WP10	Project Management

1. Executive Summary

The aim of this report is to present results of visits to the four pilot sites, selected by VICINITY partners, and to provide details of the operational requirements for the demonstrations at each site as the result of discussions with key stakeholders. Operational requirements focus on how the users will operate the system, including interfaces and interoperability with other systems. The four trials are in the domains: energy, building, healthcare and transport. By having a bottom-up build across four domains, VICINITY has the rare opportunity to identify and exploit cross-domain efficiencies, which would not become apparent with conventional single-domain solutions. By establishing operational requirements at the outset, the project may now progress to the system design stage allowing cross-domain synergies to be exploited. The double diamond model, as proposed by the British Council in 2005, has been adopted by the project as the methodology to be used. This allows for two stages of divergence and convergence over four phases of a design project: Discover, Define, Develop and Deliver. This report focuses on the first phase-Discover.

This report organizes and presents the outcomes of the VICINITY project task T1.2 Pilot Sites Surveys and extraction of Use Case requirements, which were performed during the course of 2016. The conducted work is presented along with analysis of consolidation of four survey reports accompanied by ENERC in cooperation with each pilot responsible (MPC, TINM and HITS) and reflecting the related activities. A comprehensive list of operational requirements is presented along with the interoperability challenges. Task 1.2 focused on the definition of high level user requirements for IoT interoperability, ubiquitous applications, services and other smart objects based on results of task 1.1.

ENERC led the survey of pilot sites and the definition of requirements for the Energy, Building, Transport and parking and Ehealth at Home domains related use cases. VICINITY's IoT interoperability goals were the guiding approach to the surveys and to the contextual requirements extraction.

This report is the outcome of consolidation of four survey reports conducted by ENERC in cooperation with the organisation responsible for each pilot (TINYM, HITS, MPC). This report presents requirements for Energy, Building, Health and Parking domains, the analysis of contingencies and the expected results of the use cases. The report summarises specifications of the installed systems and equipment per demo site, and provides overviews of the technical systems and devices.

A gap analysis is presented in order to identify operational, technical and organisational prerequisites for development of the VICINITY solution at DEMO sites. A matrix consolidating information gathered during DEMO sites survey was developed and presented further. Common categories were identified in attempt to make responses to what, where and how the DEMO sites would demonstrate the VICINITY solution.

The report presents the following research activities outcomes:

1. Overview of the four Demonstration site visits to Martim Longo site in Portugal, Oslo and Tromso in Norway and Pilea-Hortiatis in Greece;
2. Demonstration sites Survey results; Comparative requirements' matrix for future replicable package creation of optimized sites surveys for operational requirements and contingencies;
3. VICINITY Operational requirements list;
4. VICINITY ready operational and risk mitigation requirements per site based on the site surveys;
5. Outcomes of the stakeholder interviews focused on operational requirements solicitation by attribute per domain: ENERGY; BUILDING; TRANSPORT and HEALTHCARE;
6. Demonstration sites context for use cases and use cases overview;
7. Demonstration sites Gap Analysis matrix for operational management of sites and preparations management;
8. Detailed description of the Installed systems and corresponding functionalities and features based on adapted use cases template in Annex 2;
9. Municipal and site-specific context of each Demonstration site, In Annex 1;
10. Knowledge management cross DEMO exchange method adapted, including stakeholder's engagement method. The report on VICINITY operational requirements in this task synthesises stakeholders' expectations as to what the system should facilitate, how it should perform and what concerns they have as to its critical performance.

This report incorporates knowledge obtained from use-cases definitions with the stakeholders and within the VICINITY consortium along with the tasks performed leading towards the D1.1 and D1.2 deliverables. Outcomes of preceding tasks are summarised and consolidated on many levels as presented in Tables 8 to 13 (Uses cases site context and Operations Planning) in this deliverable as well as in D1.4 and further on in D1.5 with different focus of analysis. A combination of all WP1 deliverables based on the VICINITY bottom-up methodology, which is presented in Table 11, aims at building VICINITY architecture.

The VICINITY Platform operational features were assessed in T1.2 and described in D 1.3. They will be verified in T6.4 and reported in D6.4. Hence, the results presented in this document are considered to be dynamically developing through the course of the project leading towards the final conclusions in D 6.4.

The detailed overview of important security and privacy issues of the operational requirements of VICINITY are part of D1.5 document. However the operational requirements are listed in this Deliverable (D1.3) along with interoperability-specific requirements.

It was observed during the site visits and stakeholders interviews that Internet of Things enabled solutions which are novel to the user and operator communities across all the domains and are not fully understood by them. These systems and solutions involve multiple stakeholders, which are defined as 'ecosystems of stakeholders'.

Understanding stakeholders' real needs, perceived needs and expressed needs is challenging in the cross-domain environments, where benefits of an overall system are distributed across the ecosystem. The ecosystem approach is one of the methods adopted to facilitate the operational requirements solicitation and use cases definition for IoT driven projects. The artefacts showcasing wider ecosystem opportunities, identified during this process, is expected to contribute to the architecture definition of the VICINITY solution.

Knowledge management across stakeholders of the DEMO sites was an important method to elicit operational requirements and define use cases.

Complementary to this report is the report on VICINITY Business Requirements, which are consolidated in D1.4 and are analysed from the standpoint of stakeholders' business expectations.

2. Introduction

The aim of this report is to present results of visits to the four pilot (DEMO) sites, selected by VICINITY partners, and to provide details of the operational requirements for the demonstrations at each site as the result of discussions with key stakeholders. Operational requirements focus on how the users will operate the system, including interfaces and interoperability with other systems. The four trials are in the domains: energy, building, healthcare and transport. By having a bottom-up build across four domains, VICINITY has the rare opportunity to identify and exploit cross-domain efficiencies, which would not become apparent with conventional single-domain solutions. By establishing operational requirements at the outset, the project may now progress to the system design stage allowing cross-domain synergies to be exploited. The double diamond model, as proposed by the British Council in 2005, has been adopted by the project as the methodology to be used. This allows for two stages of divergence and convergence over four phases of a design project: Discover, Define, Develop and Deliver. This report focuses on the first phase-Discover.

This document summarises and presents the outcomes of the executed Tasks of WP 1 related to stakeholder's operational requirements elicitation. It also introduces methods of visualising the outcomes in a concise way, allowing for cross-comparison and easy information analysis of the results from four DEMO locations in Martim Longo in Portugal; Oslo and Tromso in Norway and Pilea-Hortiatis in Greece. All DEMO sites have high replication potential, municipal scale relevance and involve wide stakeholder groups.

The site surveys adopted a common knowledge-management approach across all pilot locations, identified similarities in interoperability challenges, allowed workshops to be conducted to further define use cases and to facilitate prioritisation of business and operational requirements for the VICINITY solution.

Visual inspection of the premises and their context along with interactions with on- site operations teams facilitated cross-domain information flow, allowed the creation of visual materials and other artefacts to be used at various stages of the project. The exercise was complementary to the stakeholders' interviews and to the DEMO site partners' activities.

The outcomes of this deliverable serve as input to the following deliverables: D1.4 and D1.5 and take into consideration methodologies described in D1.1 and the analysis presented on barriers and opportunities in D1.2.

Pilot locations selection

The VICINITY pilot locations or DEMO sites were selected to test, demonstrate and refine VICINITY solution capabilities within energy, building, healthcare and transport domains. The DEMO sites context aims to demonstrate cross-domain interoperability enablement that would be facilitated by the VICINITY.

Service rollouts provided by public entities encounter long implementation timeframes and demand for such services naturally lags behind. Shared economies and new ways to deliver services could be enabled by the VICINITY solution in order to speed up the rollout of services as well as shorten implementation times. For example, the VICINITY consortium aims to demonstrate an extendable service for sharing available parking space through use cases set for DEMO site 1.2 in Tromsø, Norway.

While buildings are perhaps the objects that society spends most of its critical resources on, such as energy and capital. There are ways that could be facilitated by the VICINITY solution to cut such costs and enable better operations and management of these facilities, while involving end users.

At the DEMO site 1.1. In Norway at Oslo Science Park, we will test use cases that harvest and combine information from the interior of the facility, energy systems and smart parking to find new and better approaches to solve some of these issues through the interoperable approach VICINITY would provide.

The DEMO 2 in Martim Longo, Portugal is focused on transversal energy domain and municipal buildings management. Energy generating and energy consuming components could potentially form a municipal-scale smart-grid enabled by VICINITY. It aims to demonstrate value added services that could be enabled through the VICINITY framework based on renewable energy generation infrastructure. The aim is to cross leverage and create value through community-scale VICINITY enabled interoperability.

Caring for an aging population is one of the major challenges for future healthcare. An important step is the need to move from institutional care to assisted living at home, in particular for elderly people living alone and people with long-term needs and chronic illness (such as people with hypertension, dementia, and obesity). Electronic medical care services enable these people to obtain a better quality and independent life. In DEMO site 3 in the municipality of Pilea-Hortiatis such services are expected to be enabled through VICINITY interoperability solution.

The scale and cross-domain relevance of the pilots set them apart from other trials for VICINITY demonstration purposes. More detail on each pilot is presented further in the Chapter on Site Surveys and in the Use Case Introductions.

The following graphic visually summarises the cross-domain bottom-up interoperability approach in VICINITY. The non-technical challenges identified by the stakeholders along with the interoperability issues expressed during the sites visits and the related workshops is shown in the Figure below and in the following section:

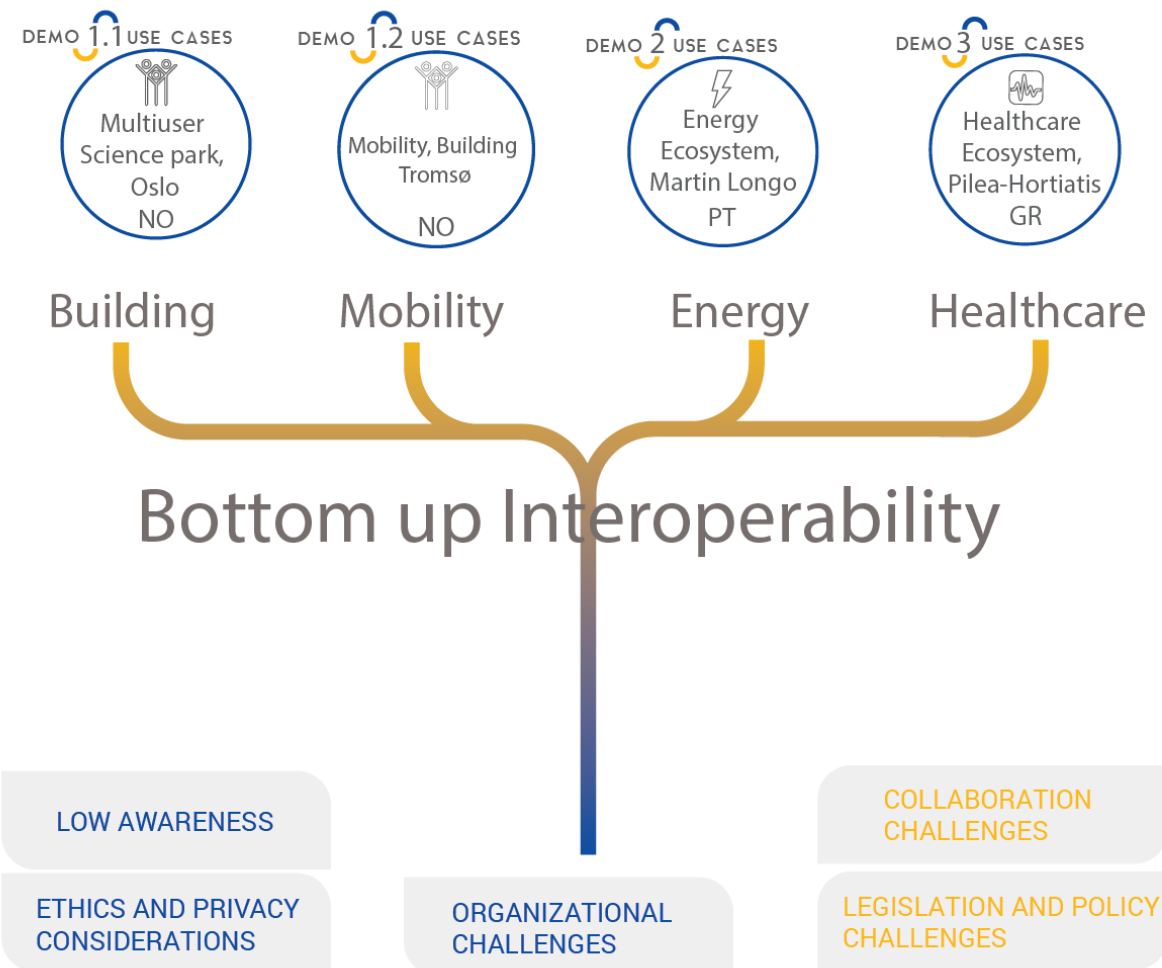

Figure 1 - Ecosystem Bottom up Interoperability

Operational requirements approach

Operational requirements presented in the document reflect the collaboration challenges, organisational challenges, ethics and privacy considerations and internal requirements, which aim to address new legislation and perception challenges.

Operational requirements form a foundation of VICINITY system. The user-centric and bottom-up approach adopted in VICINITY through requirements elicitation during sites visits, workshops and interviews allowed necessary interactions to take place in order to understand domain-specific requirements and identify cross-domain interoperability constraints and possibilities.

These live interactions also allowed cross-domain VICINITY relevance to be identified along with business priorities at the DEMO sites. The approach facilitated identification of the anticipated impact and stakeholders' expectations management towards IoT driven initiatives and the role of the VICINITY solution in it. Collaboration challenges, organisational challenges, ethics and privacy considerations and complex internal requirements are reflected in the operational requirements presented in the document.

For example, a cross energy, transport and building domains requirement listed in Table 17 demonstrates these complexities. The requirement to develop capacity to aggregate energy consumption patterns of various types of equipment in multi functional use buildings aims at understanding and managing the impact of EV charging services. An ultimate goal is to minimise peaks in energy consumption. To achieve this harmonisation and collaboration is needed both at technical and organisational levels.

It could be stated that most cross-domain use cases operational requirements identified in VICINITY demonstrate such challenges. IoT enabled interoperable automation could potentially facilitate the resolution to these collaboration challenges, while delivering a simple way to enable these services.

The detailed sites surveys are presented in the form of standard use case template. A non-public Annex to this document includes privacy and security considerations by the site operators towards users.

Joint DEMO site visits were made by BVR, ENERC, TINYM and HITS. These were hosted by: MPC partners of the Municipality of Alcoutim, PT; Municipality of

Pilea-Hortiatis in Greece; and Gnomon and Regional/Municipality Projects management teams in Tromsø, Norway.

Among the activities fulfilled were the organisation of workshops, the execution of stakeholder interviews and the internal consortium workshops aimed at processing and analysis of gathered information. Inputs were received from the site visits as well as leads from other VICINITY Work packages.

In addition, the lead beneficiaries of VICINITY WP1 have agreed to work on Deliverables D1.3, D1.4 and D1.5 in order to ensure that these deliverables are consistent and build insights and greater understanding of contribution of each document.

Weekly meetings in July, August, October, November and December followed by post sites visit during the months of Augusts, September and December took place regularly and ensured progress and synchronised actions between WP 1 contributors.

The document presents new methods towards site surveys, and a prioritisation of IoT enabled initiatives approach and a comprehensive list of operational requirements.

The other tasks related to this deliverable are listed below:

- T 1.1 – Elicitation of user requirements and barriers related to IoT interoperability;
- T 1.2 – Pilot sites survey and extraction off use case Requirements;
- T 1.3 – VICINITY Platform User and Business Requirement Definition (This task);
- T 1.4 – Functional & Technical Specification, Architectural Design.

Thus, it is suggested that the readers of this document should become with and have access to the following other deliverables:

- D 1.1 – VICINITY requirement capture framework;
- D 1.2 – Report on business drivers and barriers of IoT interoperability and value added services;
- D 1.4 – Report on VICINITY business requirements;
- D 1.5 – VICINITY technical requirements specification.

Information solicitation through DEMO site visits:

The Demonstration site location in Portugal in the Municipality of Alcoutim was visited by the consortium in August, the demonstration site in Norway in Oslo was visited in August and the Demonstration site in the Municipality of Pilea-Horatis was visited in September. The last location visit to the demonstration site in Norway in Tromsø took place at the beginning of December.

The site visits included: tours of the sites facilities considered for demonstration purposes in the use cases; internal and external team workshops aimed at business and operational requirements extractions and introductions to the VICINITY concept. These introductions made stakeholders more aware of IoT developments and how it may impact stakeholder activities. IoT EPI was introduced and the upcoming open calls were discussed.

On average two full day visits to the Demo location sites took place.

Use cases template definition:

In order to organise information for future distribution, dissemination and unification a standard ISO/IEC IoT template of the detailed use cases overview was adapted, which was modified to reflect the VICINITY project needs and priorities.

During the course of sites surveys and workshops a number of methods were used to extract operational requirements and prioritize the site-relevant and tailor the use-case to specific needs of the stakeholders. The results are detailed later.

Cross dissemination of Use cases with stakeholders in Demo sites:

Cross-domain leverage and dissemination of all the use-cases envisioned in VICINITY for all Demo sites has been facilitated and the stakeholders in the four locations were introduced to the VICINITY use-cases in the other sites. This activity increased stakeholder engagement and opened a channel for further information exchange, deeper engagement with the project and identification of additional synergies for cross-domain value-added-services. This process facilitated operational requirements gathering and contributions from the stakeholders on the activities.

This Deliverable builds on the Task 1.1 and Deliverable 1.2 in WP1 and incorporates their results as well as shaping additional knowledge obtained during the course of the past 12 months of the project activities. The consortium undertook an effort to standardise the presentation and methodology of the above tasks for future reuse in IoT research-driven projects.

2.1 Methodology

INTEROPERABILITY, European Context. [1]

> ***"Machines and devices using new technologies create great opportunities for businesses to provide new services. However, these machines and devices need to be interoperable, or there will be barriers to cross-border business. Such interoperability will also allow businesses to mix and change suppliers and thus have more choice. Standardisation in key areas would greatly help this interoperability, without reducing innovation."***

On 6 May 2015, the European Commission adopted an ambitious strategy to complete the Digital Single Market

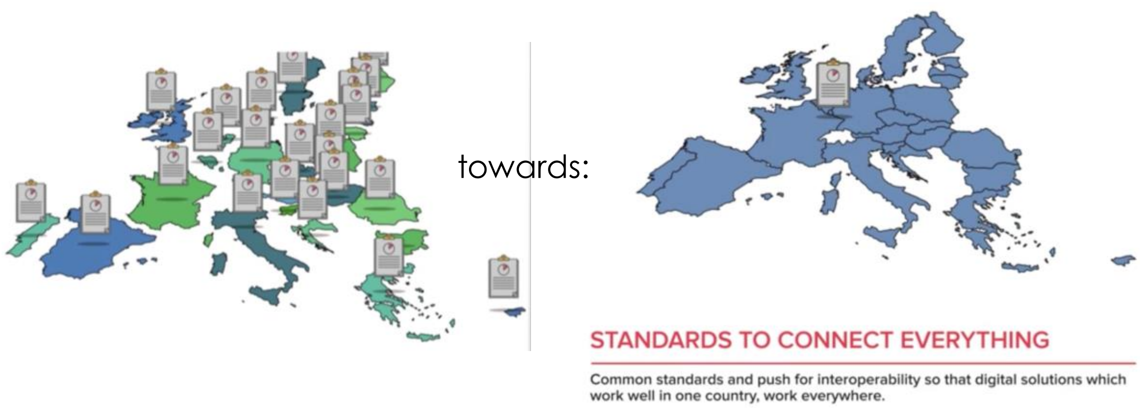

Figure 2 - Cross Countries Digital Single Market Interoperability Standards

Interoperability within VICINITY context is understood as *"the ability of two or more systems or elements to exchange information and to use the information that has been exchanged"*[2] in the broad sense of the definition, allowing for

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[1] https://ec.europa.eu/digital-single-market/en

[2] Institute of Electrical and Electronics Engineers, IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries, New York, NY: 1990

seamless recognition of IoT objects (as defined at D1.5), based on trust and full control of data by the generator of data. Cross domain internal requirements are presented in the table below:

INTEROPERABILITY INTERNAL REQUIREMENTS	
BUILDING and SMART PARKING DOMAIN	- An extensible core information model, i.e. core ontology, should be used for all information elements to be interpreted, being agnostic of their specific contexts and communication standards.
	- Domain-specific information elements have to be interpreted using specific model extensions of the core model.
	- All information elements should have enough associated metadata to become properly annotated and understood using the corresponding information models.
	- All APIs should provide semantic descriptors of all information elements they expose by leveraging their own metadata.
ENERGY DOMAIN	Components of Energy systems generation providers open APIs to service providers
	Equipment self discovery, software stack layer communications protocols and APIs
	Development frameworks between heterogeneous device-specific operating systems and apps
	Data governance systems, company-specific, product-specific, and even individual consumer-specific
SMART PARKING/ TRANSPORT	Interoperability with other smart parking sites for shared parking space in a city-wide IoT infrastructure
	Interoperability on access control to shared parking space in a city-wide IoT infrastructure
	Smart parking interoperability between city-like IoT infrastructures
	Smart lightning interoperable digital signs for visualization of way in to allocated shared parking space
	Booking app interoperable with city-like IoT infrastructures

Table 1 - Interoperability Internal Requirements

OPERATIONAL REQUIREMENTS in VICINITY: INTEROPERABILITY							
type	Operational Requirement	Function - Feature	Use-cases facilities	Domains			
#				E	B	H	T
ORIO_001	Provide distributed energy generation and consumption domain focused solution to obtain aggregated insights that could be shared with third parties within value chain	IaaS	Cross Facilities	✔	✔	✔	✔
ORIO_002	Facilitate self-discovery of any given device introduced into energy, building and parking ecosystem	IaaS	Cross Facilities	✓	✓	✓	✓
ORIO_003	Provide ways to reduce theft of equipment through tracking or other methods	IaaS	Cross Facilities	✓	✓	✓	✓
ORIO_004	Provide interoperability with city domain infrastructures	IaaS	Cross Facilities	✓	✓	✓	✓
ORIO_005	Provide interoperability with domain-specific apps in city	IaaS	Cross Facilities	✓	✓	✓	✓

Table 2 - Operational Requirements: Interoperability

TABLE FIELD	DESCRIPTION
TYPE	Operational requirements for VICINITY system as communicated by selected stakeholders during interviews, workshops, site visits
#	Number of requirement
Operational Requirement	An expectation towards system ability to deliver solve or influence business process stated in natural language ready for further processing towards business and functional requirements
Function-Feature	Device, facility or service centred for existing or new models of operations
Use-cases facilities	Physical locations of use cases in VICINITY DEMO sites
Domains	Vertically integrated field of operations chosen for VICINITY capacity demonstration
Energy	Electricity and other resources driven environment cantered both on generation and consumption side. Involves systems, flows and equipment

Building	Represented by in VICINITY through Residential, Commercial, Municipal and research Lab facilities ranging from 100-300 sqm to 55,000 sqm in total space.
Health	Represented by in VICINITY through Municipal services network, related facilities, health care at home and wearable devices managed by network of specialised service providers.
Parking	Represented by in VICINITY through Underground Parking Facility with automated access through electrically operable door, built in into the facility, part of managed infrastructure with paid and by residents only access management models.
Implicit	Operational Requirements derived from best practices, consortium partner's knowledge and inferred to during stakeholders discussion, but not clearly stated.
Explicit	Operational Requirements explicitly stated, and discussed during stakeholders interviews, site visits and extended stakeholders interactions

Table 3 - Operational Requirements: Definitions

There were expected and anticipated changes according to the methodology. Fine-tuning was needed of use-cases and possible extensions that were identified in WP1 and specifically during the DEMO site visits and stakeholders workshops.

As these possibilities became known, we dynamically attempt to incorporate such changes into the final DEMO priorities and align these with established VICINITY goals. There will then be a joint decision between the project and the current demo owner to align new with existing requirements and agreed priorities established by the consortium partners.

In order to highlight the evolving process of use-case development Figure 18 shows the initial demo descriptions in M2 and Figure 19 as they were in M4.

Figure 3 – Initial General Description use cases before stakeholder interview. M2

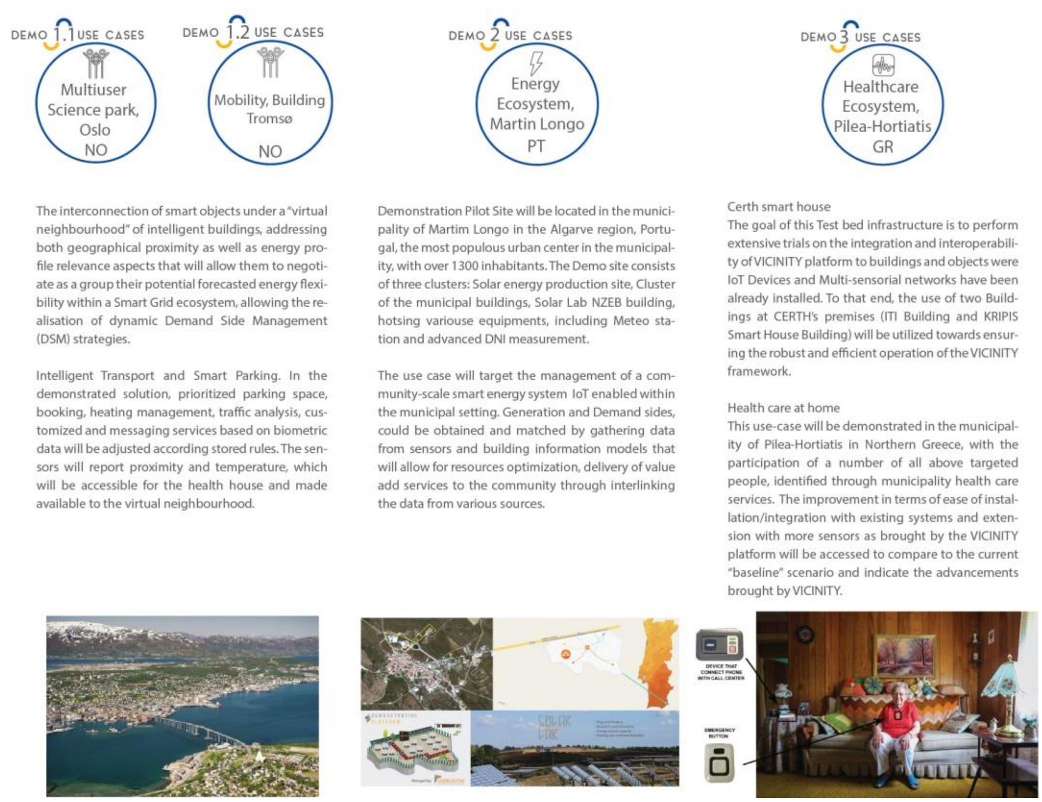

Figure 4 – Initial General Description Pilot Locations prior to stakeholder's interviews, M4

The use cases in VICINITY relate to four domains: ENERGY; BUILDING; TRANSPORT and HEALTHCARE as represented in the figure 2 below. The Municipal scale approach and relevance is chosen for the use cases along with cross-domain applicability. Public and private sectors are represented within the project use cases. Further overview of the VICINITY DEMO sites stakeholders Ecosystem approach is presented in Chapter 3.

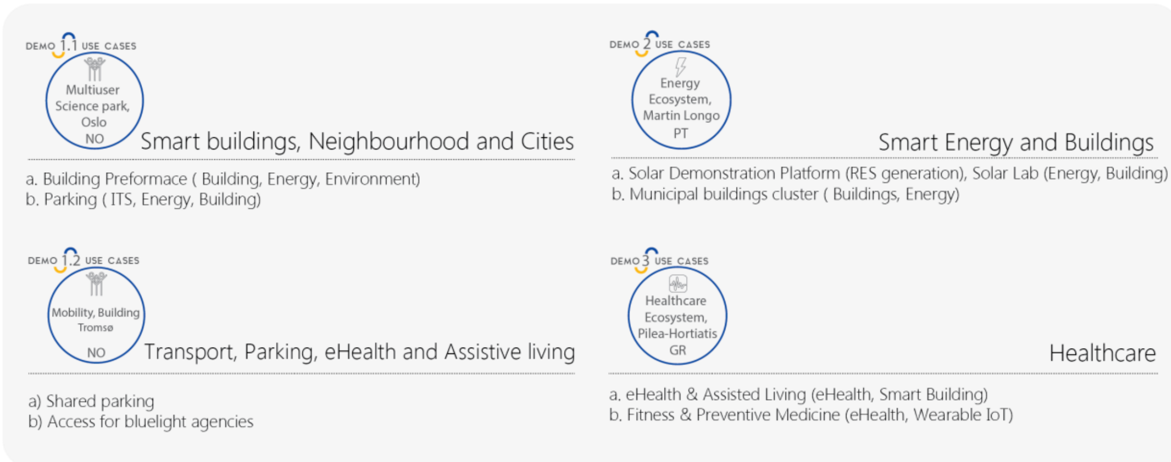

Figure 5 – VICINITY Use cases and Domains

As concluded in D1.2 "Report on business drivers and barriers of IoT interoperability and value added services", the main challenge of moving from plan- and frequency-based working methods in public and private environments towards a conditional-based approach and work method would be expected to generate more and more data. This in turn would lead towards continuously adjusting and evolving ways of performing tasks and reacting to operational changes in public and private sector. This is relevant within all VICINITY intervention domains: ENERGY; BUILDING; TRANSPORT and HEALTHCARE.

Many of the stakeholders are facing new technologies, and decisions on matters they have little or no knowledge about. In today's dynamic world with so many large disruptive approaches and changing business models, it is difficult for decision makers to identify, prioritise and fully adapt and trust the new opportunities, possibilities beyond limitations. [3]

[3] Adapted from D1.2 Barrier and opportunities report section: Consideration of Methods for mapping Business Requirements for new technology in new establish markets.

Therefore, VICINITY´s established comprehension-models as an iterative approach that allows for adaptive-mode results in greater insights into the models, goals, tools, work processes and business models explicitly and implicitly shared by the stakeholders (as in Figure 2).

Through live interactions and wider representation of VICINITY partners during the site visits a greater engagement across pilots was established.

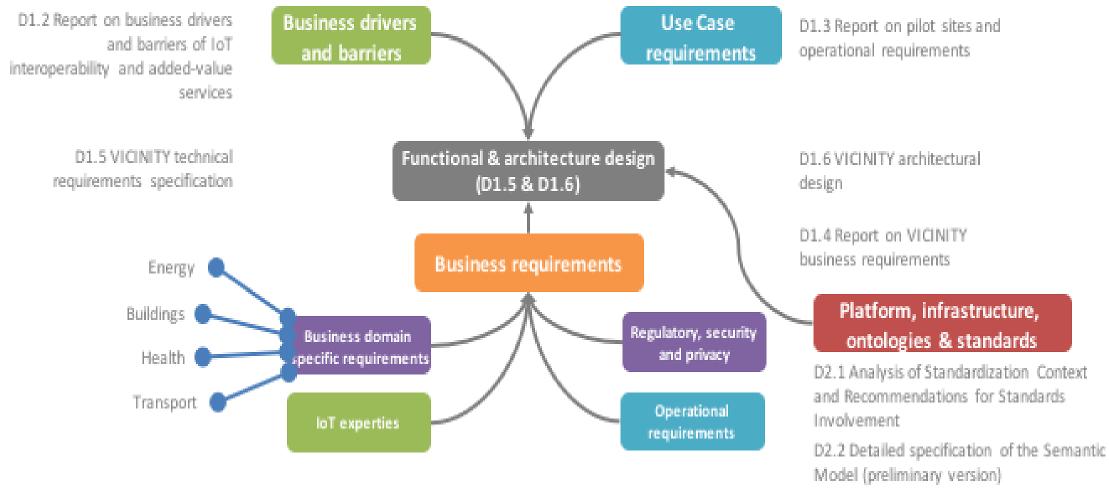

Figure 6 - Overview of VICINITY requirements approach (adapted from D1.2)

The table below reintroduces VICINITY types of requirements from D 1.2 relevant for solution design. There are three types of requirements that range in the level of detail they represent, from high-level overall solution expectations (operational requirements), increasing in the level of detail for Business requirements and resulting in Functional requirements coupled with non-functional ones.

Diagrammatic representation of the different types of requirements in VICINITY is presented in the Table 4:

	Requirements type	Considerations
High level Solution expectation	Operational	- User point of view implicit and explicit - High level user goals and expectations

Solutions expectation, Business impact more detailed	Business	- Stakeholder point of view - Scope of the project - Business objectives
Detailed System Functionality	Functional	- Functional (what the system does) - Non-functional (how well the system does it)

Table 4 - Different Types of Requirements in VICINITY

A matrix consolidating information gathered during DEMO sites survey was developed and presented further. Common categories were identified in attempt to make responses to what, where and how the DEMO sites would demonstrate the VICINITY solution.

2.2 Report on pilot sites and operational requirements

This report is the outcome of the consolidation of four survey reports conducted by ENERC in cooperation with each pilot instigator (TINYM, HITS, MPC and CERTH). The report lists operational requirements of each site, introduces the analysis of contingencies and expected results, lists specifications of the installed systems and equipment, as well as providing a technical description of functionalities with corresponding devices along with the gap analysis.

A comparative requirements' matrix for future replicable package creation of sites surveys for operational requirements was created. Knowledge management exchange between the pilot's sites, including stakeholder's engagement processes was successfully introduced. All pilot sites operational teams were presented with use cases and introduced to all four domains at DEMO sites. There are outstanding invitations to visit sites and share relevant experiences as the project develops.

During the course of stakeholder workshops a new method/ approach was co-created resulting in Initiatives prioritization matrix for cross-domain IoT relevant projects. The example presented is from the workshop in the Oslo Science Park (Figure 3. Prioritisation IoT method).

All identified operational risks are also listed in the Risk Register provided by D10.2 according to the methodology developed in WP10 and this is a live document that will be updated during the project lifetime.

A Mitigation Action Plan, including probability, consequences and risk computed consistent with the Risk Register from D10.2 is currently maintained by UNIKL in the project cloud.

2.3 Sites visits and workshops with stakeholders coupled with wider ecosystems.

The Timeline of the DEMO Sites visits, interviews and stakeholder workshops is presented in Figure 3, with the Project starting in January 2016 with interviews beginning in April 2016, followed by the site visits during the period of August/ September and with the final site survey visit in December. Simultaneously conducted activities building towards the operational requirements and the sites surveys are presented below.

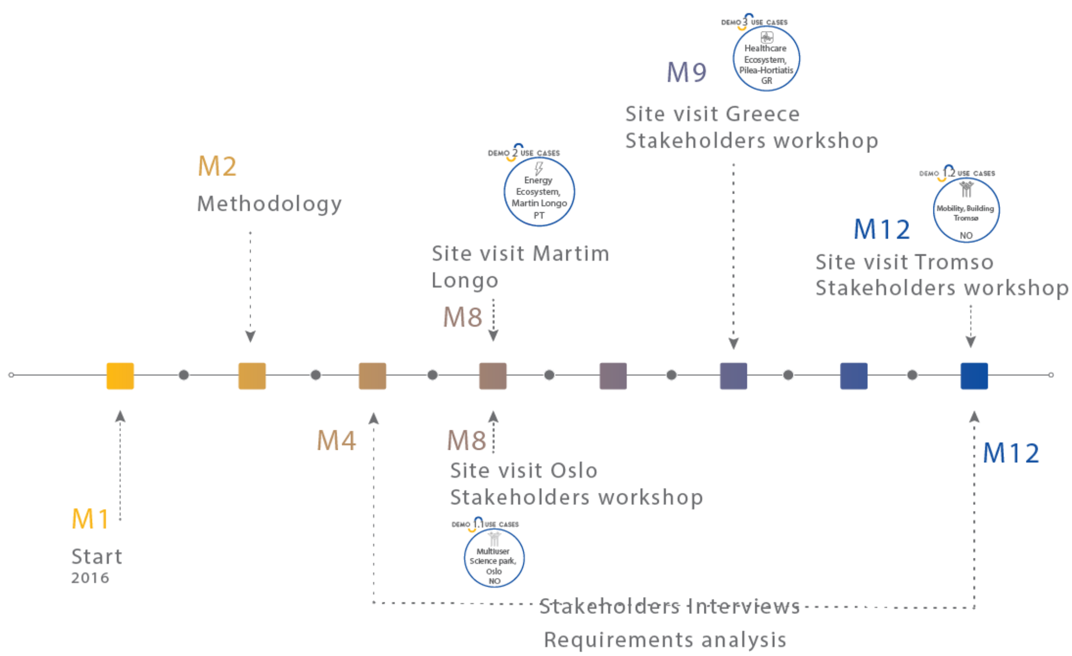

Figure 7 – Timeline of the DEMO Sites visits, interviews and stakeholder workshops 2016

2.4 Survey Approach

Four site surveys were organised that took place during the second half of the year. The aim of the visit was for the team to visit the site of future DEMO implementation from four teams: ENERC; TINYM; BVR and HITS. Each team surveyed relevant part of the site, participated in the organised workshops with extended stakeholders' engagement within each domain ecosystem. In addition, the team conducted internal discussions to advance use cases development for the pilot sites and prepared the next steps.

Informational materials and concept representations were prepared and shared with the stakeholders in various forms. The following VICINITY Concept representation was discussed:

Figure 8 - VICINITY Concept

VICINITY solution will be offering a bottom up, stakeholder-driven platform, offering interoperability as a service while enabling cross-domain interoperability. The solution will deliver capacity building for value-added services and data-driven cross-domain business models. It aims at model driven development for IoT Services, while contributing to standardisation and validation of standards.

2.4 DEMO Site 1 visit - Martim Longo and Alcoutim, Portugal

The first visit took place during the period between 1-3 of August, 2016 to Martim Longo and Alcoutim in Portugal. The following visits were conducted:

- Visit Solar Lab at Solar Demonstration Platform;
- Visit of Solar Demonstration infrastructures of the Platform;
- Visit of Municipal buildings (Secondary School, Swimming pool);
- Workshop on functional design (usability requirements) of VICINITY Neighbourhood management;
- Visit to the Municipality of Alcoutim followed by a discussion with the technical team.

The visit was organised by ENERC team. Members from TINYM and BVR were present.

USE CASE DEMO 2 Martim Longo, PT, Use Case site context

A comprehensive snapshot of each site context, including general description, use cases scenarios, data flows overviews and systems inventory is presented in a highly condensed form.

DEMO 2 USE CASES
Energy Ecosystem, Martin Longo PT

USE CASE SITE CONTEXT

General description	Smart Municipal Energy: Clustered energy system composed of municipal buildings nursing home, school and swimming pool and DER. The objective of the use case is to demonstrate the environment quality on 3 municipal buildings with distributed energy sources. Smart Energy NZEB Unit: Near zero energy building located on SolarLab demonstration site including PV and solar thermal energy sources. The objective is to demonstrate energy efficiency and environment quality on single building using data gathered from from different domain in neighbourhood. UV added value service: Providing recommendation on maximum sun exposure for Citizen in Martin Longo. The objective is to demonstrate use of energy data in health domain.
Use Cases' scenarios	Smart Municipal Energy Deployment of PV; Deployment of Solar-Thermal system; Finalize construction of nursing home; Smart Energy NZEB Unit; Roof PV should be deployed; Deployment of building air-conditioning; UV added value service; Humidity land sensor for water management in agriculture; No specific preconditions;
Data Flows	Smart Municipal Energy: - Temperature measurement, CO2 concentration, Movement, Luminance, Speed and direction of wind, PV production, electricity consumption, level of noise, relative humidity, commands to air conditioned, thermal energy production, energy consumption. Smart Energy NZEB Unit: - Temperature measurement in SolarLab, CO2 concentration, Movement, Luminance, Speed and direction of wind, PV production, electricity consumption, level of noise, relative humidity, commands to air conditioning, thermal energy production, energy consumption. UV and Perceived Temperature added value service: - Current radiation in region, Planned radiation in region, Recommendation on maximum sun exposure; Current and Forecast of Real and Perceived Temperature; Security and Privacy: - Data change with Use case should be end-to-end encrypted. No private data should be collected, processed and stored.
ICT/ IoT Infrastructure Inventory	Smart Municipal Energy: - Air-conditioned swimming pool: control the humidity and temperature of the swimming pool; Swimming pool heating: control the temperature of the swimming pool; Water pump: controlling pressure and amount of water in Municipal buildings; PV for municipal buildings: Providing electrical energy for the municipal buildings; Solar thermal panels: Providing thermal energy for the municipal buildings; Air-condition school: control the temperature in school class rooms; Gas power supply: back-up energy source; Gateway: gathering data from devices; Indoor measurement unit: providing room measurements (temperature, CO2, movement, notice, relative humidity); Municipal environment quality service: see above; Smart Energy NZEB Unit: Meteo station: providing current weather conditions; SolarLab roof PV: providing electricity for the building; Solar Thermal collector: Providing thermal energy for the building; Air-condition: Providing air-condition for building; Gateway: gathering data from devices; UV added value service: - Weather station: providing current solar radiation in the area; Gateway: gathering data from devices; Radiation predictive models: prediction of the radiation in the area; UV added value service: provides maximum solar exposure for the citizens; -providing current air temperature and relative humidity; Gateway: gathering data from devices; Temperature, Wind Speed and Relative Humidity in the area; Perceived Temperature: provides the perceived temperature for the citizens Humidity land sensor for water management in agriculture.

Table 5 - Use case 2 - site context

2.6 DEMO Site 2 visit - Oslo, Norway

The second visit took place during the period between 22-25 of August, 2016 to Oslo Science Park, Start up Lab and Municipality of As, Norway

The activities below took place as part of the business requirements solicitation process

- Pilot site location presentation and discussion with Oslo Start-up Lab;
- Pilot site location presentation/ workshop with operations management team of Oslo Science Park (Forskningsparken);
- Wrap-up pilot location internal workshop;
- Pilot site location presentation and discussion with As Municipality;
- Presentation and collaboration opportunities between VICINITY and OREEC.
- Visit and workshop with Forskningsparken facilities management team which is overseeing building management of 55 000 square meters with more than 50 tenants. The operations team manages the whole infrastructure including electricity, heating, water and air conditioning systems.

The Oslo Start-up Lab is an accelerator for more than 100 start up companies. It has IoT laboratory to provide access to the latest technology, allows for demonstration support and cross leverage of solutions;

The visit was organised by TYNM team. Members from ENERC and BVR were present.

USE CASE DEMO 1.1 Oslo Science Park, NO, Use Case site context

A comprehensive snapshot of each site context, including general description, use cases scenarios, data flows overviews and systems inventory is presented in a highly condensed form

DEMO 1.1 USE CASES

Multiuser Science park, Oslo NO

USE CASE SITE CONTEXT

General description	- Environment efficient neighbourhood - Energy efficient parking house neighbourhood - Costumer books the charging (kWh and kW) and parking time (h) at the facility from an APP, with the purpose of having a fully loaded car when leaving the building. Building manager gives the boundary conditions for the building, by setting peak goals (kW) and pricing for services (parking and charging). REST API proses customer input and Building boundary conditions to confirm charging/parking session, send confirmation to APP. Costumer arrives at designated charging bay, and starts charging. API starts monitoring and controlling charging to optimize load according to input from costumer and building manager - Neighbourhood water consumption service
Use Cases' scenarios	- Environment efficient neighbourhood - TBD - Will be added after Oslo Science Park investigation; - Energy efficient parking house neighbourhood - TBD - Will be added after Oslo Science Park investigation; - Neighbourhood water consumption service - TBD - Will be added after Oslo Science Park investigation;
Data Flows	- Environment efficient neighbourhood - Temperature measurement, CO2 concentration, Movement, Luminance, Relative humidity in shared rooms; Events of the room occupancy; - Energy efficient parking house neighbourhood - Parking place booking, current energy consumption, predicted energy consumption, type of the EV car, EV car current energy profile. - Neighbourhood water consumption service - Current water consumption by tenant, water consumption reports;
ICT/ IoT Infrastructure Inventory	- Environment efficient neighbourhood - TBD - Will be added after Oslo Science Park investigation; - Energy efficient parking house neighbourhood - TBD - Will be added after Oslo Science Park investigation; - Neighbourhood water consumption service - TBD - Will be added after Oslo Science Park investigation;

Table 6 - Use case 1.1 - site context

2.7 DEMO Site 3 visit - Thessaloniki, Greece

The third visit took place during the period between 1-2 of September, 2016 to the Municipality of Pilea-Hortiatis of Thessaloniki Region in Greece.
The below activities took place as part of the business requirements solicitation process:

- Visit Municipality Pilea-Hortiatis;
- Presentation of the municipality health services provided and managed. All relevant currently running programs on eHealth, supported by GNOMON partner were presented.
- Use cases discussion took place:
  - Discussion of the UC1(Assisted living and abnormal detection added-value service): Brainstorming with caregivers and assisted living personnel on potential integration of new services and equipment to assisted living scenarios; feasibility study and privacy concerns raised and analysed;
  - Discussion of the UC2 (Preventive medicine for middle-aged citizens): Discussions on use of wearable equipment and location-based services for triggering fitness lifestyle of middle-aged citizens. A new approach to the use cases development was presented. The suggestion to involve dieticians to support the identification and promotion of the use case was discussed;
- Visit to CERTH Facilities and Smart House Testing lab;
  - Technical discussions on the implementation and deployment of the two identified use cases;
  - Visit to the Smart House and IoT multisensorial infrastructure available at CERTH test lab facilities;

The visit was organised by CERTH and MPH team. Members from GNOMON, BVR, HITS and TINYM were present.

USE CASE DEMO 3 Thessaloniki, GR, Use Case site context

A comprehensive snapshot of each site context, including general description, use cases scenarios, data flows overviews and systems inventory is presented in a highly condensed form

DEMO 3 USE CASES

Healthcare Ecosystem, Pilea-Hortiatis GR

USE CASE SITE CONTEXT

General description	- ehealth for elderly people at home (35-50 beneficiaries) The goal of this service is to provide assisted living to elderly people and people with long terms needs providing them direct means of communication with a 24-hours call center with specialized staff in case assistance is needed and/ot their relatives. Devices included in the scenario are: • Fall detector / panic button • GPS monitoring • Alarm reception by 24hour help line - Abnormal behavior detection of elderly people living alone (5-10 beneficiaries/pilot houses) The goal of this added value service is to detect the abnormal behaviour of senior citizen and trigger an alarm. Devices included in the scenario are: • Energy consumption meters • Occupancy detectors • Entry/exit sensors • Smart medication/drug dispensers • Pressure sensing mats • Smart oven (provided by GRN Vicinity partner) • Smart fridge (provided by GRN Vicinity partner) • Alarm reception by elderly people's relatives - Health improvement for the middle-aged persons (30-40 beneficiaries) The goal of this added value service is to provide evaluation of the citizens health status, promote fitness awareness and improve their health based on health measurement data and exercise performed on daily basis, all monitored by specialized staff (pathologist, dietitian) Devices and events included in the scenario are: • Smart weight scales, • Blood pressure monitors • Fitness trackers • Beacons at municipal fitness spots (gym, track, pool) • Organize competitions such as 'urbathlon' • Medical monitoring by Pathologist and/or Dietitian
Use Cases' scenarios	Preconditions for the better deployment of the use cases are - the employment of a pathologist and a dietitian by the Municipality, to better facilitate and promote the middle-aged scenario realisation - the preperation of legal arguments in order to be able to address participants concerns in sensitive personal data safety/privacy and handling - the "marketing" strategy of the Municipality in order to find people willing to take part in the VICINITY
Data Flows	- ehealth at home / assisted living Fall detectors'/Panic buttons' signals, Position (GPS), Route, Energy consumption, Movement, Presence, Lid/oven/fridge open/close, Door entry/exit: real-time broadcasting of collected data through VICINITY gateway - preventive medicine / fitness awareness Weight, Blood pressure, Fitness measurements (distance, steps, etc.), Presence: real-time broadcasting of collected data through smart-phone application as a VICINITY gateway
ICT/ IoT Infrastructure Inventory	Abnormal behaviour of elder person in the house hold • Weight scale, • Blood pressure sensor • Water consumption, • Energy consumption, • Co2 measurement, • Luminance, • Iluminance,• Fire alarm, • Smart owen, • Smart fridge, • Push buttons with drug dispenser, • Movement in the building, • Pressure mat; • Occupancy and movement detectors • Gateway: gathering data from devices; Health improvement for the middle-aged persons •Weight scale •Blood pressure sensor •GPS monitor •Pedometer •Distance movement monitor •Smart-phone appliacation Gateway: gathering data from devices;

Table 7 - Use case 3 - site context

2.8 DEMO Site 4 visit - Tromsø, Norway

The fourth visit took place in December, to the location of the smart parking related to Ambient Assisted Living and Healthcare site in Tromsø, Norway. The Site is located within an Assisted Living Care centre building, and the VICINITY team met with the Care centre Assisted Living and Care centre operational management team on the 5th of December;

A workshop was held at the Regional Government office with Project management team of the transport domain. It was hosted on the 6th of December.

The visit was organised by HITS team. Members from BVR, TYNM and ENERC were present.

USE CASE DEMO 1.2 Tromsø, NO, Use Case site context

A comprehensive snapshot of each site context, including general description, use cases scenarios, data flows overviews and systems inventory is presented in a highly condensed form.

DEMO 1.2 USE CASES

Mobility, Building
Tromsø
NO

USE CASE SITE CONTEXT

General description	The test site is a cluster of buildings near the central part of Tromsø. The city is suffering from a high traffic load during peak times on a sparsely limited infrastructure. The use case will focus on a neighborhood of apartments and demonstrate how transport information and building data can be integrated with assisted living through agreements with car space owners and other interested partners. In order to address the needs of the individual residents, management of parking space and proximity to access points will be tailored to user defined profiles. Safety, predictability, reliability, accessibility and comfort are elements that will be incorporated when implementing load balancing and resource administration of parking space and available areas. Access control and appraisal systems are functionality that needs to be supported and affected by what kind of user that wants to access the parking space. Visitors need to be kept separate from residents, but the needs of the user and preferred actions will have an impact on the recommended parking space/placement. Moreover, healthcare and blue lights agencies will receive prioritisation of access and use.
Use Cases' scenarios	Shared parking space scenario (Driver who has agreed to benefit from shared service put his car in front of the outside garage. A camera sensor authenticates the vehicle, authorisation is done by the system based on booking and timing, garage door opens manually or automatically. A screen shows the way to the shared parking space. A light sensor at the parking space indicate wheater the space is already booked, waiting for tenant, available, not shared or any other status message. The parking sensor on ground senses if a vehicle is using the parking space. The residents are being reimbursed for their parking availability service through a third party service organised by VICINITY); access for health personnel and blue light agencies
Data Flows	Resident user gives scheduled access for his parking space; Market place shows availability for shared parking space; Registered driver/vehicle receive an offer if he is positioned in the neighbourhood by VICINITY or requests the sharing service externally; Access and authorisation details are sent to the garage facility; Entrance camera is awaked when a booking reservation is approaching; Inside information screen indicate route for the booked and shared parking space; light sensor goes into green when a vehicle plate is recognise and the vehicle is inside the garage; when vehicle is on top of parking ground sensor the light goes into red, either yellow if that vehicle is not recognised for this booking
ICT/ IoT Infrastructure Inventory	LoRaWAN city IoT infrastructure using 4G; Local system support with Camera sensor with number plate recognition software; physical signal to garage door to open; information screen managed by a small PC to control the inside routing and booking details; alarm if parking is overdue; periodic payment from vehicle user to resident via PC;

Table 8 - Use case 1.2 - site context

3. The Ecosystems Approach in VICINITY

In order for VICINITY solution to enable currently existing and envisioned business processes within the four selected DEMO sites due to opening possibilities through IoT, the operational requirements include both explicitly and implicitly stated requirements towards VICINITY. The implicit requirements are derived from the best practices in systems design overall and IoT specifically. The explicitly stated requirements are derived from conducted workshops, stakeholders' interviews and site managers across four domains.

IoT enabled solutions are novel to the users-community across the health, energy, building and transport domains within public and private services and are not well understood by stakeholders. Such systems and solutions involve multiple stakeholders and complex information exchanges, which give rise to related privacy and security concerns within.

Ecosystems for each DEMO site were created as visual representations in order to facilitate the understanding of interdependencies and to allow all stakeholders in the VICINITY Ecosystem for each use case to take into consideration all requirements of all participants. An example is given in Figure 6 for Smart Building, Energy and Transport Ecosystem in Oslo Science park DEMO site.

This type of visual representation was used in workshops with Internal and external stakeholders and sites managers. Data producing and consuming entities, services providers, systems and context of the DEMO sites are reflected in each Ecosystem. The DEMO site Ecosystem in Tromso, NO is depicted in Figure 7, Martim Longo in Portugal in Figure 8 and Pilea-Hortiatis in Figure 9. These graphics were further developed during site survey visits and use cases definitions. Further development of these Ecosystems concepts is expected in value added services development phase.

These Ecosystems approach will be maintained during system development phase and expected to evolve further.

The VICINITY team adapted the proposed approach of Dr. Ovidiu Vermesan and Dr. Peter Friess[4], creating a method of visualizing complex data and actor interdependencies in each of the domain-specific DEMO sites.

IoT enabled approach is "…dramatically changing how companies engage in business activities and people interact with their environment. The IoT's disruptive nature requires the assessment of the requirements for its future deployment across the digital value chain in various industries and many application areas."

Figure 9 - Interaction within ecosystems (adapted from "Digitising the Industry Internet of Things Connecting the Physical, Digital and Virtual Worlds")

Reflecting on the nature of IoT, which is changing the way of conceiving ICT systems while altering business and interaction processes we build further on work developed in D1.2 and present VICINITY ecosystems. As the concept of "IoT

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[4] "Digitising the Industry Internet of Things Connecting the Physical, Digital and Virtual Worlds "

includes both a vertical and a horizontal dimension", a key feature of an IoT Ecosystem is expected to be "the dynamic interaction between the providers and users of horizontal IoT platforms and applications and the providers and users of vertical solutions/domain-specific environments"[5].

We recognise these concepts, based on the work done in WP1, and will continue developing this approach reflecting the changing role of actors/ nodes in each domain-specific Ecosystem. Temporal development of the domain Ecosystem during development and demonstration phases of VICINITY will be presented.

Substantial changes to the role of each ecosystem nodes are expected during the life of VICINITY project. The four domains are being directly affected by the ongoing new market design in energy sector, new models introduction through digitalisation in health and building domains and related customers requirements driven changes in transport domain.

3.1 Actors: People, Systems, Applications, the Power System, and Other Stakeholders in Demo 1.1 use cases.

At the demo-site at Oslo Science Park, we will test use-cases that harvest and combine information from the interior of the facility, energy and transport to find new and better approaches to solve some of these issues through the interoperable approach VICINITY would provide.

[5] "Digitising the Industry Internet of Things Connecting the Physical, Digital and Virtual Worlds " by Dr. Ovidiu Vermesan , Dr. Peter Friess, http://www.internet-of-things-research.eu/pdf/Digitising_the_Industry_IoT_IERC_2016_Cluster_eBook_978-87-93379-82-4_P_Web.pdf

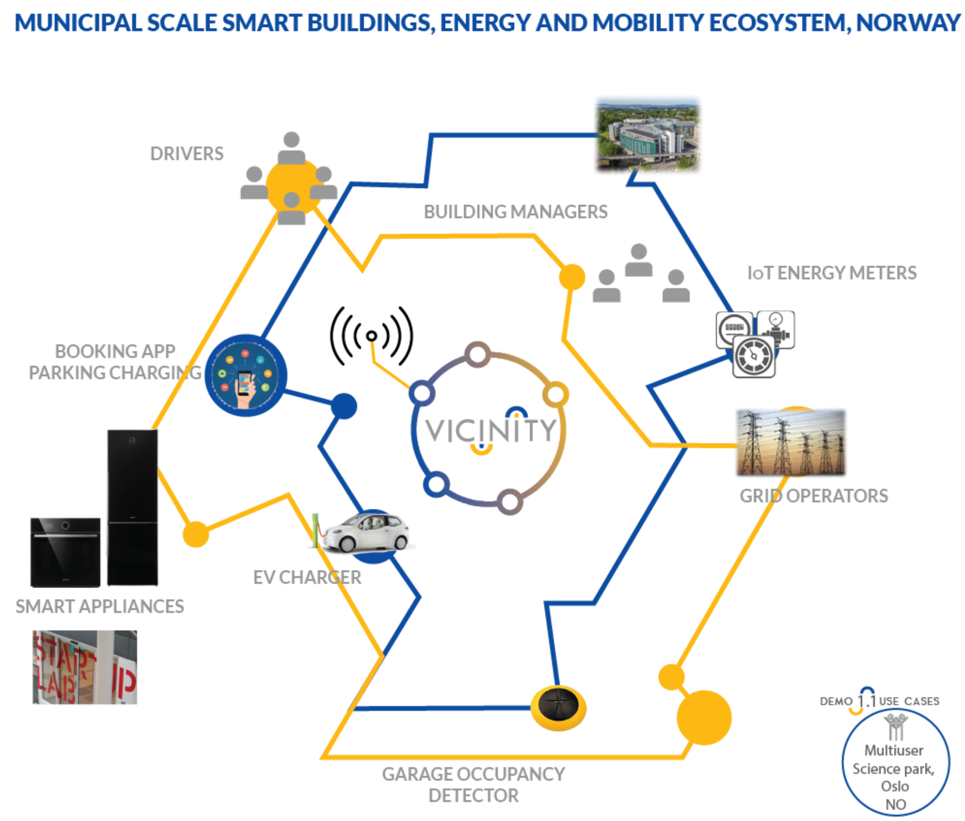

Figure 10 - Municipal scale Smart Building, Energy and Transport ecosystem – Norway

The following use-cases will be included in the demonstration at Oslo Science Park.

UC 1.1.1	**Virtual Neighbourhood of Buildings integrated in a Smart Grid Energy Ecosystem**
UC 1.1.1.1	Space utilisation
UC 1.1.1.2	IEQ Building Performance
UC 1.1.1.3	Building Energy Consumption
UC 1.1.1.4	Building Energy Profile
UC 1.1.1.5	Building Energy Flexibility
UC 1.1.1.6	Building peak load management
UC 1.1.1.7	Building Performance Visualisation
UC 1.1.1.8	Neighbourhood flexibility visualisation
UC 1.1.1.9	Smart Oven and Smart Refrigerator
UC 1.1.2	**Virtual Neighbourhood of Intelligent Parking Space**
UC 1.1.2.1	EV charging points way of location
UC 1.1.2.2	EV charging points history

UC 1.1.2.3 EV Parking space booking
UC 1.1.2.4 EV charging payment
UC 1.1.2.5 EV Charging points energy management
UC 1.1.2.6 Neighbourhood of EV charging points and buildings energy management

Virtual Neighbourhood of Buildings integrated in a Smart Grid Energy Ecosystem:

Name	Type	Description	Used Technology
UC 1.1.1.1 Space Utilisation	IEQ Sensor	Usage load and usage patterns of people inside buildings Calculated values based on co-variance in data from the IEQ sensor	Multi-sensor mesh device: Temp, Humidity, Light, Sound, CO_2 and Movement.
UC 1.1.1.2 IEQ Building Performance	SW Service	Classification and visualization of IEQ Performance for buildings Calculation and integration with BIM	BIM Server, machine learning
UC 1.1.1.3 Building Energy Consumption	SW Service	Classification of Energy Consumption for a building, based on historical consumption data - classify the online situation	Data from energy meters and use of buildings
UC 1.1.1.4 Building Energy Profile	SW Service	Classification of Energy profile of a building, based on historical consumption data and IEQ data, calculate the inertia of every room and the energy profile of the building	Data from BIM, IEQ, Energy, weather observation.

UC 1.1.1.5 Building Energy Flexibility	SW Service	Classification of Energy flexibility of buildings based on calculated energy profiles and energy consumption. Estimate how much energy can be turned off with only negligible negative impacts. Establish understanding of where, when and how long to shed or shift loads, or to trade flexibility with other actors.	SW Analysis
UC 1.1.1.6 Building peak load management	SW Service	Tool for peak load management for a building. Analysis of peak load patterns in the power consumption and a decision support system for planning consumption and use of the energy flexibility.	SW Analysis
UC 1.1.1.7 Building Performance Visualisation	SW Service	Online classification and visualisation of building performance Calculation based on info from UC 1.1.1.4 – UC 1.1.1.6 publish in Visualisation in FMS and VICINITY Neighbourhood manager.	SW Analysis

UC 1.1.1.8 Neighbourhood flexibility visualisation	SW Service	Classification and visualisation of energy flexibility between buildings Calculation based on info from UC 1.1.1.4 – UC 1.1.1.6 for all buildings in a neighbourhood. Publish in the VICINITY Neighbourhood manager. Used in a new value added service or application.	SW Analysis
UC 1.1.1.9 Smart Oven and Smart Refrigerator	Application	Smart appliances deployment Startup Lab for an improved energy resources consumption	Gorenje smart oven and smart refrigerator

Table 9 - Actors: People, Systems, Applications, the Power System, and Other Stakeholders: Virtual Neighbourhood of Buildings integrated in a Smart Grid Energy Ecosystem (Demo 1.1 use cases)

Virtual Neighbourhood of Intelligent Parking Space:

Name	Type	Description	Used Technology
UC 1.1.2.1 EV charging points location	Application	Identify EV charging points in an urban setting (Oslo) by registering an EV in the app and website, the EV driver should be able to locate the closest suitable charging point and plan the route accordingly. The app will include a list of available charging/parking spots in Oslo, and should administrate payments for charging and parking.	IoT infrastructure for communication between charging station and the SW Service. Communication with the AC and DC charger for the EV. Multiprotocol use to include e.g. MODBus, Tiny Mesh, WiFi, TCP/IP, OPC UA and/or more

UC 1.1.2.2 EV charging points availability	Application	Navigate to nearest suitable EV charging point based on position, type of EV, availability, range and local traffic	Data for UC 3.1 together with traffic info from telco and Google.
UC 1.1.2.3 EV Parking space booking	SW Service	Booking of parking space included EV charging in parking garage. The 15 charging points in the Science Park will be available for booking before arrival via app and/or the website	Cloud Service together with the IoT infrastructure.
UC 1.1.2.4 EV charging payment	SW Service	Payment for parking and charging included load based tariffs. Payment via a multi-user interface that includes RFIC, NFC, QR Code, LPRF and charging station to different clearing services	
UC 1.1.2.5 EV Charging points energy management	SW Service	Load and peak management between multiple EV charging points within the same building. Service that optimises the total peak load for all charging points based on the time and demand from the EV's.	
UC 1.1.2.6 Neighbourhood of EV charging points and buildings energy management	SW Service	Load and peak management in a virtual neighbourhood between multiple buildings and EV charging points Service that optimises the total peak load for all charging points and buildings in the virtual neighbourhood. Optimisation based on the	

		time and demand from EV's(UC 1.1.2.5)and buildings, combined with available energy flexibility(UC 1.1.1.8)	

Table 10 - Actors: People, Systems, Applications the Power System, and Other Stakeholders: Virtual Neighbourhood of intelligent parking space (Demo 1.1 use cases)

3.2 Actors: People, Systems, Applications, Databases, the Power System, and Other Stakeholders in Demo 1.2 use cases.

The DEMO site aims to demonstrate an extendable service for sharing available parking space through enablement of the smart parking pilot, which is connected to Assisted Living and Healthcare site in Tromsø, Northern Norway. The test site is located in a newly constructed cluster of buildings, which serves as a 'living lab' community for residents, elderly and young people, including citizens requiring health and assisted living services from the municipality.

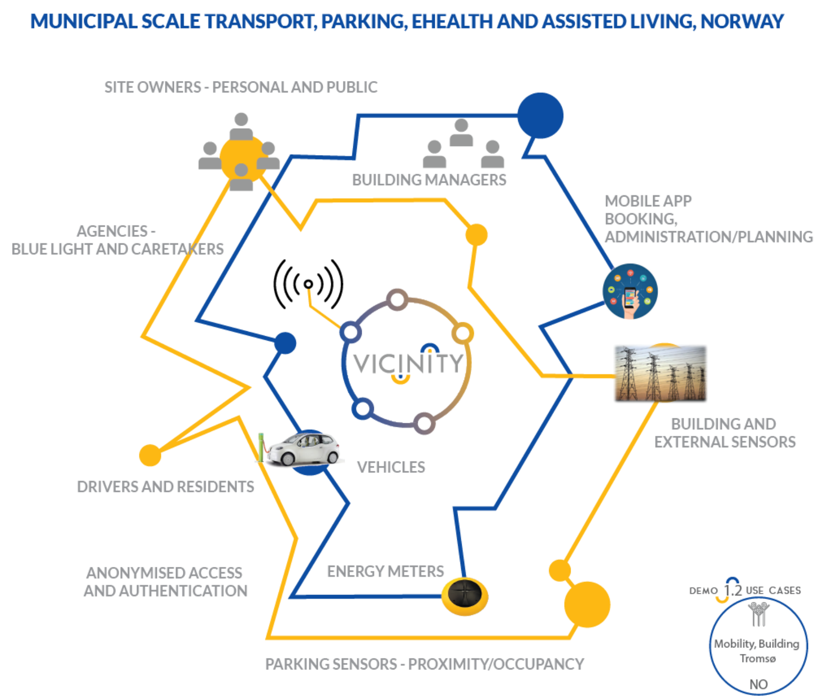

Figure 11 – Municipal scale Transport, Parking, eHealth and Assisted Living – Norway

The following use-cases will be included in the demonstration at Tromsø:

UC 1.2.1 Vehicle user
UC 1.2.2 Vehicle
UC 1.2.3 Smartphone
UC 1.2.4 Parking Space Stakeholder
UC 1.2.5 Blue Light Agencies
UC 1.2.6 Space Management Sensors
UC 1.2.7 Space Alarm System
UC 1.2.8 Cloud Server
UC 1.2.9 iParking
UC 1.2.10 Smart City
UC 1.2.11 Administration Tool

Name	Type	Description	Used Technology
UC 1.2.1 Vehicle user	User	Person that needs a parking space close to their destination	
UC 1.2.2 Vehicle	Real-time positioning device	Moving vehicle in a street network of available space for parking	
UC 1.2.3 Smartphone	Mobile device	Device used to set up the system and map to the parking space	
UC 1.2.4 Parking space stakeholder	User	Property owner having parking space available on certain times during week	
UC 1.2.5 Blue light agencies	Public	Certain agencies that must have access to parking space on emergency	
UC 1.2.6 Space management sensors	Technology	A network of sensors collaborating to find out if space is free or in-use	

UC 1.2.7 Space alarm system	System	Traditional alarm system which makes high noise when an illegal entity tries to occupy empty space without booking	
UC 1.2.8 Cloud server	Server	Runs the cloud space application that manages parking monitoring system set up and operation	
UC 1.2.9 iParking	Mobile app	Connects the driver with the owner and offers option to book, report and administrate the areas and parking space.	
UC 1.2.10 Smart city	Management	One of the actors in need of better exploiting available resources in order to reduce traffic congestion and pollution in order to improve living conditions and introduce regulations.	
UC 1.2.11 Administration tool	Software	The system that offers information and administrates available parking space and areas.	

Table 11 - Actors: People, Systems, Applications, Databases, the Power System, and Other Stakeholders (Demo 1.2 use cases)

3.3 Actors: People, Systems, Applications, the Power System, and Other Stakeholders for Demo 2 use cases.

In this DEMO site we set the goal to demonstrate value added services that could be enabled through the VICINITY framework based on renewable energy generation infrastructure and including: weather station, Solar Lab, and Municipal cluster of buildings. The aim is to cross leverage available resources and systems and to create value through community-scale VICINITY enablement and promote sustainable energy in the Municipality as well as between the citizens. Renewable energy site operator is expected to benefit from predictive operations enablement, while municipal smart grid concept could be modelled and enabled by VICINITY solution. Enablement of smart appliances grid services, predictive maintenance services and energy efficiency goals within household, public building and a lab environment are planned.

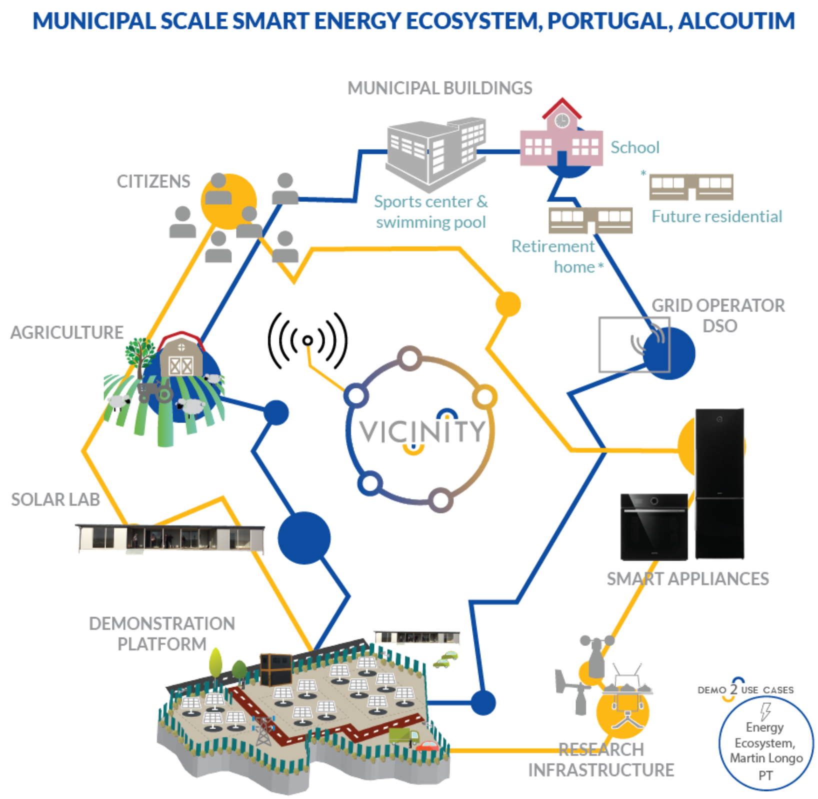

Figure 12 - Municipal scale Smart Energy Ecosystem – Portugal

The following use-cases will be included in the demonstration at Martim Longo:

UC 2.1	SOLAR LAB Resources Management
UC 2.2	Municipal Buildings IEQ Management
UC 2.3	Building Energy Consumption
UC 2.4	Building Energy Profile
UC 2.5	Building Energy Flexibility
UC 2.6	DNI Verification
UC 2.7	RES DER Operating Model OPEX
UC 2.8	Weather Station
UC 2.9	UV for citizens
UC 2.10	Smart Refrigerator
UC 2.11	Smart Refrigerator and Smart Oven
UC 2.12	Land Humidity
UC 2.13	USEF Smart Grid framework VICINITY enablement modelling

Name	Type	Description	Used Technology
UC 2.1 SOLAR LAB Resources Management	System	Modelling a pilot use case to replicate the ecosystem of municipal buildings	NZEB Systems
UC 2.2 Municipal Buildings IEQ Management	System	Classification and visualization of IEQ Performance for buildings	Monitoring System and Indoor Environmental sensors
UC 2.3 Municipal Buildings Energy Consumption	System	Classification of Energy Consumption for a building, based on historical consumption data - classify the online situation	Data from energy meters and use of buildings
UC 2.4 Municipal Buildings Energy Profile	System	Classification of Energy profile of municipal building (School and Sports facility), based on historical consumption data and IEQ data, calculate the inertia of every room and the energy profile of the building	Data from sensors

UC 2.5 Municipal Buildings Energy Flexibility	System	Classification of Energy flexibility of Municipal buildings based on calculated energy profiles and energy consumption. Estimate how much energy can be turned off with only negligible negative impacts. Establish understanding of where, when and how long to shed or shift loads, or to trade flexibility with other actors.	SW Analysis
UC 2.6 DNI Verification	Companies	Verification of Pyrheliometers of Renewable energy producers based on acquired data from a weather station	Solar CPV Technologies Weather Station
UC 2.7 RES DER Operating Model OPEX	Application	Predictive maintenance based on monitored data, Software and simulation models	Weather Station,
UC 2.8 Weather station	Specific equipment and sensors	Collects and Provides real time weather and indoor environmental data	Several measurement equipment's: -Temperature and Humidity sensors; Wind Speed sensor; Wind Direction sensor; Precipitation measurement equipment; Baro Transmitter; Data logger; Pyrheliometers; Pyranometer; Pyrgeometers; Transmitter for illuminance and luminance; Energy

			Measurements
UC 2.9 UV for citizens	Value Added Service	Provides maximum time of sun exposure based on UV radiation intensity recommendation	Weather Station
UC 2.10 Smart Refrigerator	Application	Smart appliances deployment on Solar Lab and Operations Facility for an improved energy resources consumption	Gorenje smart refrigerator
UC 2.11 Smart Oven and Smart Refrigerator	Application	Smart appliances deployment on School and typical household in the proximity of Municipal building cluster for an improved energy resources consumption	Gorenje smart oven and smart refrigerator
UC 2.12 Land Humidity	Application	Improvement on the use of water resources in agriculture	Humidity Sensors
UC 2.13 USEF Smart Grid framework VICINITY enablement modelling	Framework	Testing the components of USEF (Universal Smart Grid Framework)	Various

Table 12 - Actors: People, Systems, Applications, Databases, the Power System, and Other Stakeholders (Demo 2 use cases)

3.4 Actors: People, Systems, Applications, Databases, the Power System, and Other Stakeholders for Demo 3 use cases.

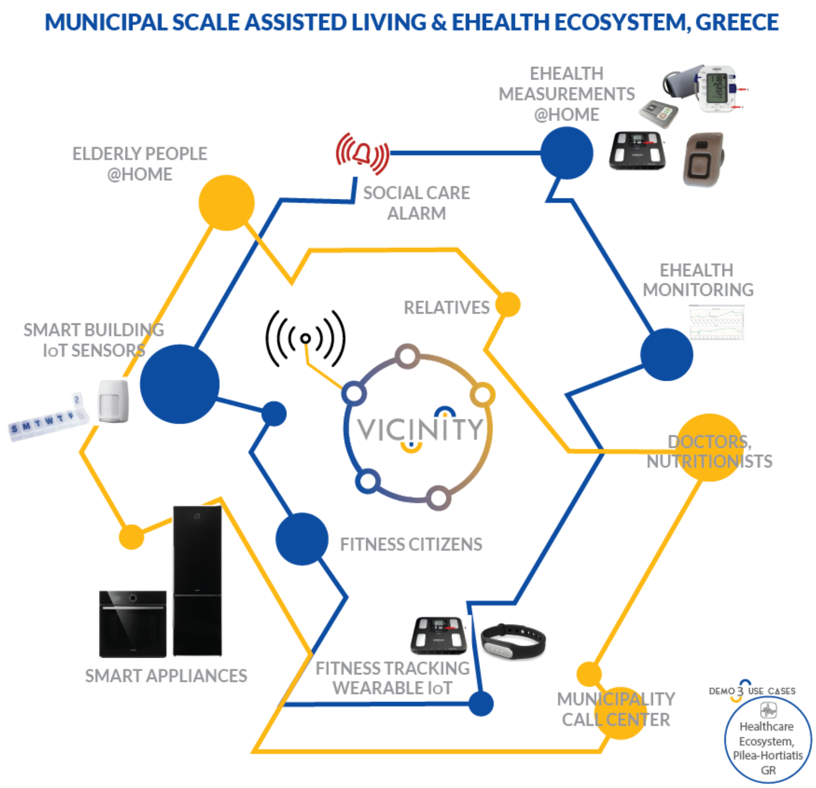

Figure 13 - Municipal scale Assisted Living & eHealth Ecosystem

Caring for an aging population is one of the major challenges for future healthcare public system and beyond. An important step is fulfilling the need to move from institutional care to assisted living at home environment, in particular for elderly people living alone and people with long-term needs and chronic illness (such as people with hypertension, dementia, and obesity). Digitised, automated and predictive medical care services are expected to enable people to obtain a better quality and independent life. Health improvement based on public programs aimed at middle-aged persons could be enabled by VICINITY solution and demonstrated at the Municipal level.

The following use-cases will be included in the demonstration at Pilea-Hortiatis:

UC 3.1	Abnormal behaviour of elder person in the household
UC 3.2	Health improvement for the middle-aged persons
UC 3.3	Smart Oven and Smart Refrigerator

Name	Type	Description	Used technologies
UC 3.1 Abnormal behaviour detection of elderly people living alone	Added value service	The goal of the added value service is to detect abnormal behaviour of senior citizen, based on IoT sensors deployed and integrated with existing sensors at people homes. When an incident is detected, an alarm will be triggered notifying the senior's relatives based on information collected about elder person's health profile along with the immediate health status and the household environment.	Smart Building integrated sensors: - Energy consumption meters - Occupancy detectors - Entry/exit sensors - Smart drug dispensers (monitoring prescribed medication) - Pressure sensing mats - Smart oven / fridge (provided by GRN partner)
UC 3.2 Health improvement for the middle-aged persons	Added value service	The goal of this added value service is to provide evaluation of the citizens health status, promote fitness awareness and improve their health based on health measurement data and exercise performed on daily basis, all monitored by specialized staff (pathologist, dietician). Municipal-scale competitions will be organised (such as 'urbathlon') to promote and trigger fitness lifestyle	- Smart weight scales - Blood pressure monitors - Fitness trackers - Beacons at fitness spots (gym, track, pool)

UC 3.3 Smart Oven and Smart Refrigerator	Application	Smart appliances deployment in elderly citizens' homes to detect abnormal behaviour	Gorenje smart oven and smart refrigerator

Table 13 - Actors: People, Systems, Applications, the Power System, and Other Stakeholders (Demo 3 use cases)

4. Use cases site surveys

VICINITY Use Cases strategic relevance

Objectives	Business drivers and barriers
Environmentally efficient neighbourhood: - Optimal usage of shared resources (such as meeting rooms) - Energy efficient shared parking facility : - Customer books the charging (kWh and KW) and parking time (h) at the facility from an APP, with the purpose of having a fully loaded car when leaving the building. - Building manager gives the boundary conditions for the building, by setting peak goals (kW) and pricing for services (parking and charging) - REST API proses costumer input and Building boundary conditions to confirm charging/parking session, sends confirmation to APP - Costumer arrives at designated charging bay, parks and starts charging the vehicle - API starts monitoring and controlling charging to optimize load according to input from costumer and building manager - Neighbourhood water consumption service: - Optimization of water consumption by tenants of the building; **Demo 1.1**	**Barriers:** - Lack of systematic data capture and missing tools for handling such complex data structures; - The major concerns in IoT deployments are the ethical issues of collecting building data and using this to deduce information about people's behaviour. **Drivers:** - Better information about environment and resources should support optimal usage of the resources through data sharing with tenants; - IoT as a tool allowing them to measure properties of buildings' performance automatically and seamlessly; - The potential to optimize their maintenance activities in small repetitive tasks - Cost optimisation potential and/or direct impact on the bottom line. - Better information about environment and resources should support optimal usage of the resources through data sharing with tenants.
- Cost/efficiency of shared available parking space; - Serve residents with available parking space when needed; - Demonstrate how sensors installed in parking area immediately can show availability; - Optimise usage of shared parking space in the neighbourhood; - Give access to health care personnel and emergency services for immediate access to the building; **Demo 1.2**	**Barriers:** - The willingness for residents to share their parking space when not used - Complex ownership relationships, responsibility assignment in parking site can inhibit deployment of parking solutions **Drivers:** - Bringing the IoT to the transport domain opens the door to new parking sharing services, which benefits visitors, parking place owners, rental companies and building owners/management
- Maximum cost and technical efficiency for management of smart grid enabled energy network; - Gathering data from sensors from RES generation and buildings within Municipal setting; - Building information models to reduce the amount of time needed for decision making. **Demo 2**	**Barriers:** - Lack of information, regulation, knowledge of the users and stakeholders, poor infrastructure conditions in some cases, lack of monitoring equipment and data storage **Drivers:** - Optimization of energy generation and consumption through the use of sensor data. Allowing for the overall energy cost of the neighbourhood as well as new services to evolve; - Real time data and monitoring promises a greater impact on consumers energy-resource use-patterns with a more efficient and rational use of energy.
- Assisted living for elderly people with the use of smart devices - Abnormal behavior detection of elderly people living alone and alarm triggering to relatives and/or call center - Continuous monitoring and evaluation of citizens health status - Awareness of fitness and healthy lifestyle - Promotion of predictive medicine, lowering the need of institutional healthcare - Health improvement based on health measurement data and exercise performed on daily basis, all monitored by specialized staff (pathologist, dietitian) **Demo 3**	**Barriers:** - Difficulties on convincing elderly people to intervene and install IoT devices/sensors at their home and on training them on their usage - Handling and sharing of sensitive personal data **Drivers:** - New technology equipment for fitness use at affordable prices - Familiarisation with social networks and sharing of personal data - Health data monitoring by specialized staff (pathologist, dietitian)

Table 14 - Use cases Strategic Relevance

Operations planning

	Pilot facilities	Infrastructure	Technical description
Demo 1.1	- Oslo Science Park. Building B and D, Offices and laboratories - Start up Lab Accelerator - Oslo Science Park - Parking garage	- Intelligent Building System - Living Lab VICINITY Demonstration site - Intelligent Parking/Charging System	Building operations enhanced with indoor environmental and usage data. Combined with energy consumption and load data for energy flexibility utilization in and between building stages, as well as with parking garage EV chargers. Accelerator management commited to demonstrate VICINITY system, provide as an enabler for additional value add services creation by startups in the lab and visitors. Booking of EV charging and parking for enhanced load balancing and payment for electricity. Energy flexibility utilization connected to building use case.
Demo 1.2	- Social Housing in Teaterkvarteret 1.akt - Shared Parking in Social Housing building	- LoRaWAN IoT city infrastructure via 4G installed by Telenor and made available for research for the next 5 years. Prioritisation of Parking allocation to the special needs residence and special services vehicles - Intelligent Transport Shared Parking services for neighbourhood community	Access to test site, guidance to parking close to entrance buildings Residents share their privately owned parking space when not in use in order to benefit for parking needs
Demo 2	- Solar Lab - Nursing Home - Sports Complex - School	- Solar Demonstration Platform and NZEB - Assisted Living - Multi Sport and Swimming Pool facility - School	Enhancement of NZEB through deployment of sensors to derive data from the interior environment, energy generation and smart applicances allowing cross domain solutions. Improvement of energy efficiency and indoor environment quality by deployment of sensors Use of sensors to measure air, humidity, temperature, light quality and smart meter to monitor the energy use and water consumption to optimize the consumption and to enhance user health and facility flexibility Deployment of sensors and smart meter to monitor key space comfort parameters allowing for an optimized use of the air conditioning system and improved health
Demo 3	- Citizens elderly homes - Municipality Sport Complex - Medical call center	- eHealth at home services support and enablement / assisted living services - Preventive medicine outreach / fitness awareness programs facilitation - eHealth at home / assisted living support	Smart home (and other) IoT-powered functionalities Sport equipment functionalities are enhanced by IoT sensors/beacons for location-based awareness applications Medical care IoT-powered services

Table 15 - Operations planning for each use case in function of facilities

Operations planning

	User requirements	Potential spin offs/ Value added services	Possibilities for Vicinity and IoT in each ecosystem
Demo 1.1	Keep relevance to the main goals of the facility management team and to the Start up Lab strategic demonnstration goals.	- Environment quality service - The goal of the service is to measure environment quality of the selected environment; - Energy peak consumption service - The goal of the service is to collect and predict the energy consumption peaks by EV vehicles; - Water consumption service - The goal of the service is to exchange the water consumption measurements with tenants;	- Expand beyond core planned functionality - Create open innovation collaboration network with the Start up Lab community to keep building smart neighbourhood cluster services and solutions
Demo 1.2	Easy to set up the availability profile of their parking space; Safe usage and income of promised benefits	More shared services in the neighbourhood, integration with municipality welfare system, resident installation of home automation systems	Interoperability between VICINITY and city IoT infrastructure LoRaWAN: -Interoperability with other smart parking sites for shared parking space in a city-wide IoT infrastructure -Interoperability on access control to shared parking space in a city-wide IoT infrastructure -Smart parking interoperability between city-like IoT infrastructures -Smart lightning interoperable digital signs for visualization of way in to allocated shared parking space -Booking app interoperable with city-like IoT infrastructures
Demo 2	No explicit restrictions	- Municipal environment quality service: The goal of the service is to improve municipal buildings environment quality based on information collected indoor and outdoor environment condition including energy production measurement; - Establish processes for systems substitutions for EE improvement in the municipal sector - Lower OPEX for destributed energy production sites through optimisation of maintanance and other services - Provide wider range of services to the local community based on untapped capcity of scientific -Cross domain UV added value service: The goal of the UV added value service is to provide recommendation on maximum solar exposure for citizens in Martim Longo.	- Supply the adequate equipment to monitoring and collect the data information according to each ecosystem specification. - Expand beyond 4 domains, establish regional relevance IoT competency cluster - Add demonstrators - Focus on enabling transition towards decarbonisation for municipal buildings and services
Demo 3	Privacy and control over personal data	- Building monitoring equipment/sensors and abnormal activity detection technology promoted as a service, for usage in assisted living scenarios (both for private homes and social houses, clinics/hospitals).	TBD

Table 16 - Operations planning for each use case in function of user requirements

VICINITY READY Requirements

Technical

Demo 1.1	Prepare system and facilities for sensors installations. PrepAre for building capacity to deliver: -Charging stations needs to be connected to a cloud; -Drivers need to have an electronic key (app, rdid, nfc etc.); -Buildings boundary conditions must be in the cloud; Costumers need to be registered in the system.
Demo 1.2	-Deployment of parking site sensors, light sensors, camera sensor for number plate recognition; -Design and develop front office and back office system to handle requests, booking, confirmation, payments -Manage stakeholders expectations and incorporate feedback
Demo 2	Municipal buildings cluster: -Deployment of room sensors and air-conditioning controllers; -Development of the added value service; optimise use of energy and water in the municipal cluster of buildings Smart Energy NZEB Unit: - Deployment of the rooftop PV system; Deployment of air conditioning system; - Deployment of smart devices; Deployment of room sensors and gateways; - Development of enviornmnetal awareness value added service: Humidity land sensor for water management in agriculture: Maintanance processes adjustments
Demo 3	-Deployment of smart IoT monitoring devices/sensors at elderly homes; -Deployment of communication infrastructure (e.g. gateways);

Table 17 - VICINITY ready technical requirements

VICINITY READY Requirements

Non Technical

Demo 1.1	Manage expectations of the team responsible for operational requiernmnts of the multitenants cluster of buildings. Provide dynamic support for Start up lab evolving demonstration needs, developers community expectations and Vicinity requiernmnets. Stakehoders managemnt and systems training. Design and introduce processes
Demo 1.2	Building trust and managing expectations. Residents need to feel safe allowing non residents to use their privately owned garage and parking space; lock doors for entrance to the building; easy entrance and exit from garage without vehicle; information system to be trust-worthy. Design and introduce processes
Demo 2	Preparing sites and stakeholders for Vicinity solution introduction, which would be the first IoT project experience for the Municipality. Buildings management personnel will need to be introduced to the solution, its capabilities and potential. Solar Demonstration and Solar lab personnel will need to become super users in order to provide initial support to wider stakeholder group. Lead stakeholders need to be informed on the process, results expectations need to be managed, suggestions and feedback need to be taken into consideration. Design and introduce processes
Demo 3	Establishment of the following groups of users: - Elderly people - Fitness group - Health care experts/ doctors - Legal expert

Table 18 - VICINITY ready non-technical requirements

5. Operational requirements within context of stakeholders expectations towards the VICINITY solution and its perception

Figure 14 - Privacy, Security, Trust, Complexity, Data ownership, Compatibility concerns

According to the conducted interviews, while trying to understand stakeholders perceptions of the strengths and weaknesses of the envisioned solutions of VICINITY interoperability system and expectations became apparent.

The following summarises encompasses general perception of stakeholders:

- "Strengths: efficient, time saving, minimizing environmental impact, cost saving and providing better quality of life".
- "Risks: Loss of privacy and security, compatibility, complexity and legislation, dependence on technology, disruption of existing business models; Complexity Developing legislation regarding ownership of data".

Later on when analysing stakeholder perception of VICINITY to some domain stakeholders it was noted that this was their first exposure to IoT systems and domains. There is a lot of uncertainty and complexity as to such systems rollouts within public and private settings. At this stage of VICINITY project development (M12 of a 4 year project), stakeholders have perceived its strengths as follows: VICINITY is a solution "…allowing rapid innovation across a broad range of services by integration of standards, protocols and interoperability".

5.1. Cross dissemination

All use cases that are being considered in VICINITY are communicated between the Municipalities and various stakeholders in each ecosystem. This allowed all DEMO sites participants to get to know the use cases of other Demo sites in the project and consider potential functionality and applicability of such use cases. This process also allowed for prioritisation of projects and operational considerations prioritisation. This activity was positioned as part of continuous information exchange and visits to other sites by Municipal participants.

	ENERGY	IEQ BUILDING	AMBIENT ASSISTED LIVING; eHealth	TRANSPORT
DEMO 1.1	Energy resources; energy system; renewables on site production management; smart appliances integration in DMS	Eviornmantal quality, including occupancy management		EV charging booking; Charging stations utilisation management;
DEMO 1.2	Energy resources management		Prioritisation of occupancy for services agencies	Parking occupancy management as a shared resource; EV charging management; prioritisation of occupancy for services agencies
DEMO 2	Solar producer operations optimisation; scientific equipment share models; Energy production and Consumption for smart grid communities; smart appliances integration in DMS; Municipal buildings neighbourhood; Energy Efficiency	Environmental qualities visualisation and analysis linked to resources consumptions and systems management. Space occupancy optimisation.		EV charging within NZEB concept nano grid
DEMO 3			Improvement of elder citizens quality of living avoiding accidents by monitoring household environment, user abnormal behavior and by using smart household appliances; Coordination of services providers.	

Table 19 - Pilots Cross Domain

5.2. IoT initiatives / relevance prioritisation method for site managers

During the workshop with the operations managers of the commercial office and Research Park in Oslo the discussion geared towards and resulted in need to find a way to prioritise the initiatives and activities as to potential impact and integration into VICINITY.

In the second part of the workshop a way of prioritization was presented to the team. Through an open discussion led by BVR, TINYM and ENERC teams a prioritised list of building´s management operational processes, relative importance of system components to the overall building operations and their usage economic impact relevance were consolidated. The resulting outcome and its visualisation allowed for prioritisation of the IoT related initiatives and helped to identify role VICINITY would fulfil for delivery of these services. The method used resulted in the outcomes presented in the graphic Figure 15 Below for all four DEMO sites.

Figure 15 – Stakeholder prioritisation of the use cases

Subsequently resources-use-prioritisation was presented and linked to facilities-users-comfort-requirements and potential ways of modifying facilities users behaviour was discussed.

We believe this approach is relevant for all facilities managers, where resources use could be minimised through IoT enabled facilities management measures. Integration of the end users in the DEMO site ecosystem aiming at behavioural changes impact on energy and resources efficiency utilization could be achieved in DEMO 1.1. It is an important criteria of success for site operators. Figure 16 outlines the prioritisation outcomes for DEMO 1.1. site.

The same approach was used in subsequent discussions with operations managers in the Tromsø assisted-living facility. The discussion was led by HITS, ENERC, TYNM and BVR. It centred on identifying areas of highest complexity in processes management. It also highlighted the relative economic and social impacts from an operational management standpoint. Given the duration of the project, near-future trends are an important factor in the design of the systems and were included in the scope of the discussion. It allowed the identification of the area of medium-term highest-growth that is expected to impact operations and economic costs to society overall.

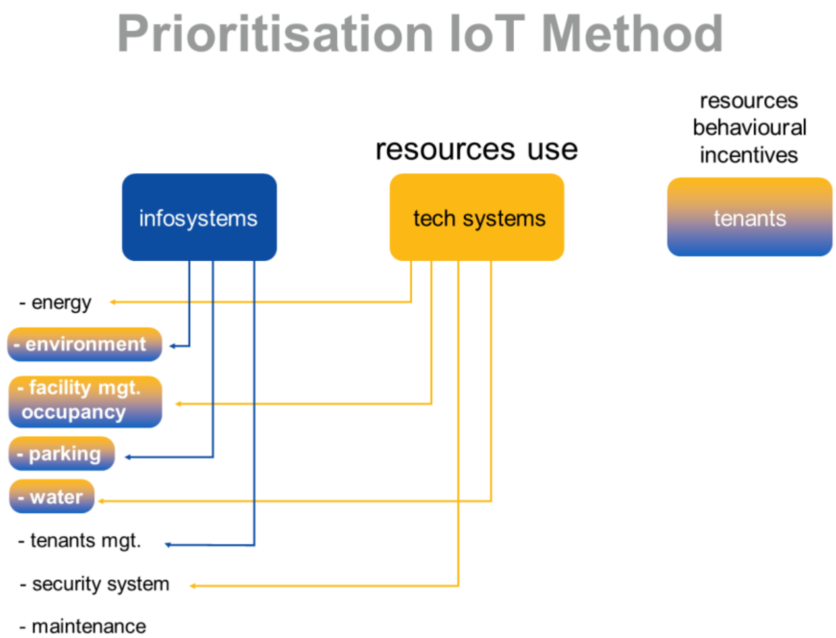

Figure 16 - Prioritisation IoT Method

Application of this method resulted in an operational requirement to consider inclusion of the services beneficiaries in operations of the systems. Additionally it was suggested that low complexity systems to operate IoT value added services by people with disabilities should be created by the consortium.

We will continue developing this VICINITY impact relevance prioritisation method per operational segment, such as Municipal facilities management, private facilities management, energy generation sites and public and private services delivery during the course of the project and will seek ways to incorporate the resulting requirements into the VICINITY solution.

VICINITY bottom up interoperability approach builds further by identifying business drivers of stakeholders and barriers, which is expected to result in new business models creations, which are domain specific and through developed methods in VICINITY become cross domain relevant. The Figure 17 below visualised the VICINITY approach further, building where the bottom up interoperability approach ends.

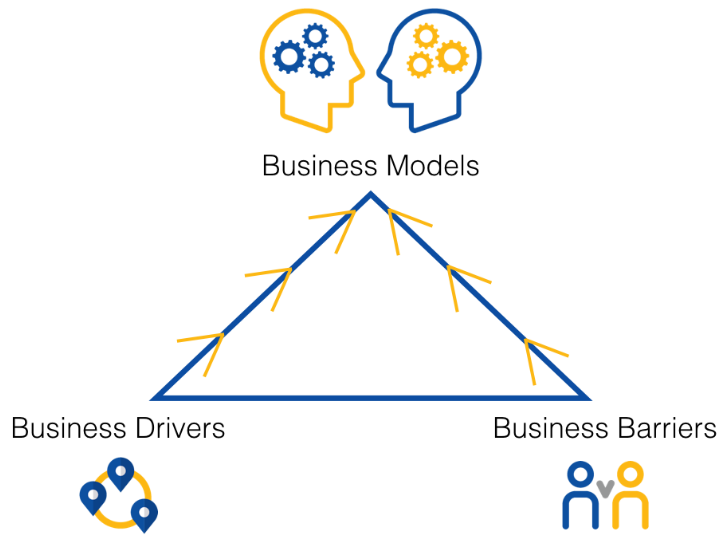

Figure 17 - Business Models Process

6. Operational Requirements Overview

6.1 Definition of Operational Requirements:

A commonly adopted definition of the operational requirements for the Use cases in VICINITY is given below:

Operational requirements in VICINITY project for pilot sites represent the basis for system design requirements, they identify system capabilities as per explicit and implicit statement by stakeholders. This allows system functionality to be described in a way which fulfils a business and operational need and leads to the delivery of a product or service.

Other definitions are given below:

- Requirement is a statement which translates or expresses a need and its associated constraints and conditions[6]

[6] ISO/IEC/IEEE 29148:2011

- Use case is a class specification of a sequence of actions including variants, that a system (or an entity) can perform, interacting with actors of the system[7]

The following quotes from references describe the 'context domain', along with the relevance to the stakeholders' business environment.

- "The requirements for a system that can provide the services needed by users and other stakeholders in a defined environment."[8]
- "The stakeholder needs and requirements definition process identifies stakeholders, or stakeholder classes, involved with the system throughout its life cycle, and their needs. It analyses and transforms these needs into a common set of stakeholder requirements that express the intended interaction the system will have with its operational environment and that are the reference against which each resulting operational capability is validated. The stakeholder requirements are defined considering the context of the system-of-interest with the interoperating systems and enabling systems."[5]

Operational requirements gathering was not specifically developed for VICINITY project, but adapted as per methodology overview in D1.2 of WP1 VICINITY project. A user-centric approach to elicitation and close knowledge management facilitated by interactive approach served as a differentiator of the adapted approach. The VICINITY consortium partners discussed, analysed and agreed on the fields to be presented in "Operational requirements". All fields used are part of the adopted method and will be maintained in the following requirements deliverables, such as D1.4 and D1.5 where business and technical requirements will be presented. This will ensure continuity and traceability in building the VICINITY system architecture to meet stakeholder's requirements and research goals.

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[7] IEC 62390, ed. 1.0:2005-01

[8] ISO/IEC/IEEE. 2015. Systems and Software Engineering -- System Life Cycle Processes. Geneva, Switzerland: International Organisation for Standardisation / International Electrotechnical Commissions / Institute of Electrical and Electronics Engineers. ISO/IEC/IEEE 15288:2015.

Internal VICINITY consortium operational requirements are not included in this deliverable. A separate coverage of security and privacy approaches and requirements will be provided in the subsequent deliverables given the importance and relevance of the topic to the stakeholders in all VICINITY use cases and the ecosystems.

Sources of the Operational requirements in VICINITY:

1. Stakeholders interviews
2. Site Managers and Demo site operators
3. Extended Project partners network
4. Advisory board members
5. Workshop within Municipal and site operators settings

Traceability of stakeholder requirements to internal and external stakeholders and their needs will be achieved through adaption of SysML (Systems Modeling Language) and to be maintained by UNIKL for the duration of the project.

Many requirements have been identified that will need to be fulfilled by VICINITYs proposed architecture and implementation. The requirements identified in D1.3 - Report on pilot sites and operational requirements, D1.4 - Report on VICINITY business requirements and D1.5 – VICINITY technical requirements specification need to be addressed. Furthermore, the results of D1.6 – VICINITY architectural design also have an impact on the overall model of requirements. The process on how VICINITY will deal with these requirements is depicted in Figure 18.

Partner UNIKL will use the inputs from D1.3 to D1.6 to create a SysML Model of all requirements VICINITY needs to address. This model is on one hand used to track that these requirements are met by the VICINITY. On the other hand, the model is used during WP6 to check and validate these Inputs. If some proposed requirements cannot be met, either the architectural design or the requirements themselves need to be changed. Either way problems and errors can be identified early in the design process. A new iteration starts of which the results are checked again. The same happens if during the lifetime of the VICINITY projects, some of the requirements will change.

Not only does this allow to validate that all requirements are met, but also which of them may cause or are subject to threats and risk and thus need to be handled with special care.

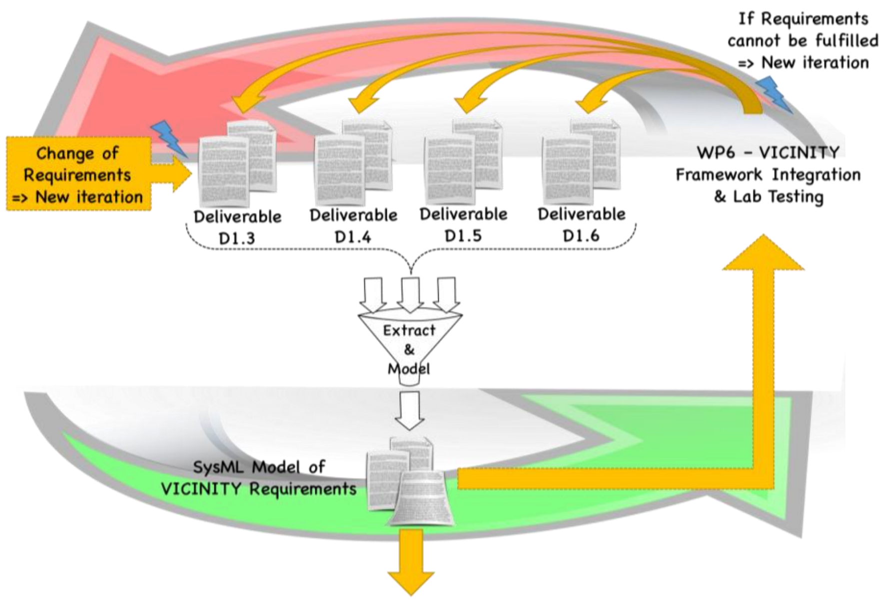


Figure 18 - Process of Requirements Modelling and Tracking

During the project, the process of eliciting and analysing operational requirements from external stakeholders has evolved. The process was set in line with defined methodology in D1.1 of WP1. The VICINITY consortium partners discussed and agreed on a continuous approach linking the goals with outcomes of the process, documenting them in D1.3 and continuing analysis and further processing for D1.4 and D1.5 of elicited information.

The list of fields for acquiring each requirement was agreed on. The technical team internal requirements are not included in the current list. A separate workshop with stakeholders and site managers will take place with the goal of prioritizing the requirements and distilling the final list. During this exercise the internal requirements list will be discussed and incorporated into the core VICINITY Functional requirements.

The below diagram outlines the above Phases based approach.

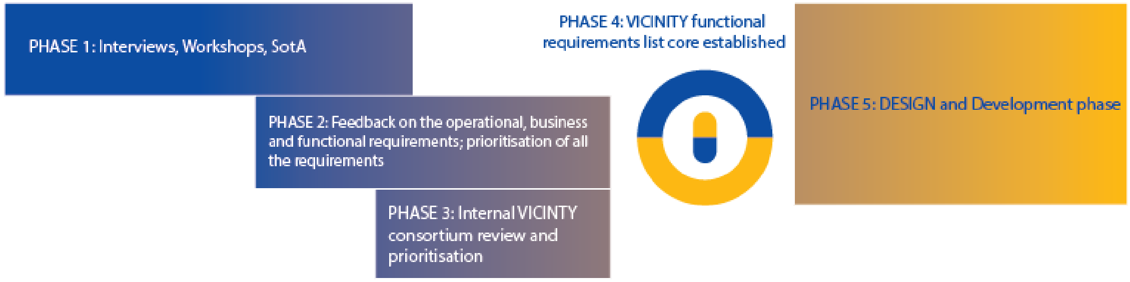


Figure 19 - Different phases of VICINITY

The Phase 1 goal was information solicitation and analysis through described methods. The Phase 2 feedback processing and operational requirements along with business requirements gathering, subsequently lead towards Phase 3 of the next round of reviews and prioritization that would result in VICINITY core functionality requirements. The main goal of these activities would lead towards the VICINITY solution architecture design and development phase.

The first phase included: stakeholders and site manager's interviews, workshops and site visits. There were completed for all four Demo locations. The second phase of prioritisation of the operational requirements with the stakeholders and internal team is ongoing. The third phase of benchmarking and distilling the core requirements will take place in the first trimester of 2017 and the final list of all the requirements forming the VICINITY core will be finalised at the end of this trimester.

Understanding of operational business priorities and scope of the activities of the DEMO sites was an important exercise coupled with work done by the consortium in the Tasks of WP1, leading towards D1.2. This knowledge derived from a broad group of stakeholders and internal discussions helped to distil overall operational requirements towards the VICINITY solution. These requirements will also be distilled and prioritised further. The results of operational requirements gathering are presented in this deliverable below. The process began with the stakeholder workshops and additional focus groups for 'DEMO case 3' in Greece.

Figure 20 illustrates the timeline of the requirements gathering process from the "month four" start to a site visit 1 to Martim Longo in Portugal on August 1-3, followed by site visit to Oslo on August 23-25, to Greece on the 3-4 of September, concluding the exercise with the Tromsø, Norway site visit on the 5-6 of December. Simultaneously the responsible teams were conducting stakeholder interviews.

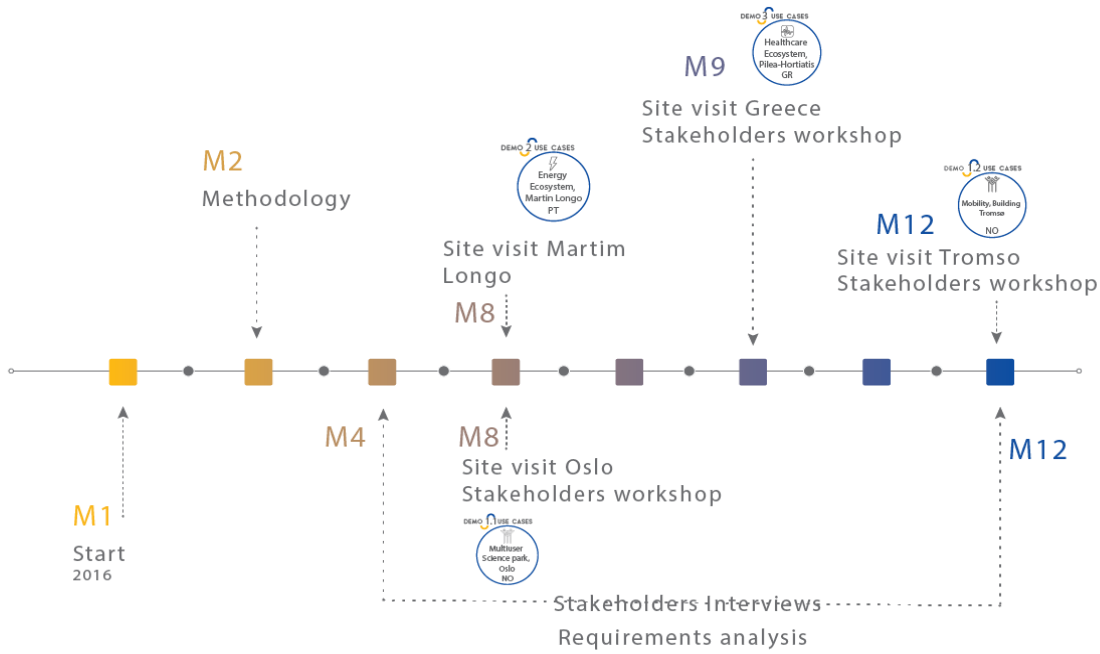


Figure 20 – Timeline of the DEMO Sites visits, interviews and stakeholder workshops

6.2 Operational Requirements Description

The following table reflects the outcomes of User and Use case Operational Requirements of VICINITY, based on workshops and the sites surveys. The presented operational requirements are for energy, building, healthcare and transport domains. The first table lists the explicit requirements

Explicit requirements presented are the requirements expressed by the business users and DEMO site operators. The Explicit requirements are the ones that are not directly expressed and were analysed and discussed indirectly with the stakeholders and within the consortium. It is anticipated that the implicit requirements would lead to explicit requirements.

OPERATIONAL REQUIREMENTS in VICINITY							
EXPLICIT type	**Operational Requirement**	**Function - Feature**	**Use-cases facilities**	**Domains**			
#				**E**	**B**	**H**	**T**
ORE_001	Develop an ability to understand, through measurement and visualisation the interior conditions and parameters driving resources consumption and effects on wellbeing, while providing high degree of anonymization	Indoor environment quality (temperature, humidity, CO_2, sound and light)	School; Municipal Swimming Pool & Sports Pavilion; Nursing Home; Solar Lab	✔	✔		
ORE_002	Develop an ability to understand, through measurement and visualisation of consumption devices, in the managed facilities with possibility of cluster effect understanding leading toward assessment of alternative models of management, reduced resources consumption and systems substitution decision making	Energy and Water consumption monitoring	School; Municipal Swimming Pool & Sports Pavilion; Nursing Home; Solar Lab; Elderly Citizens homes; Medical Call Centres	✔	✔		
ORE_003	Create cross-domain models to share available data from scientific equipment to municipal relevance resulting in added value services to citizens.	Weather Conditions	Solar Lab	✔	✔	✔	
ORE_004	Create new models to manage building occupancy through understanding and analysis of use patterns linked to resources consumption and optimization	Movement monitoring	All buildings		✔	✔	

ORE_005	Incorporate energy production sources driven information with other domains, such as occupancy, and other resources use across various facilities for various type of energy and heat production	Solar Thermal energy production/ consumption monitoring	Solar Lab; Municipal Swimming Pool & Sports Pavilion; Nursing Home	✔	✔		
ORE_006	Develop ability to aggregate energy consumption patterns of equipment's within different functional buildings. Understand the impact of EV charging within a building and manage the process in an economic way avoiding peak consumption.	Energy consumption monitoring	All buildings; EV Charging	✔	✔		✔
ORE_007	Integrate energy production sources driven information with other domains, such as occupancy, and other resources use across various facilities	Solar PV energy production/ consumption monitoring	Solar Lab;	✔	✔		
ORE_008	Facilitate management of energy resource and EV charging through models that takes cost of resources into consideration	EV Charging Booking App	EV Charging	✔			✔
ORE_009	Facilitate the management of demand response, smooth positive and negative peaks in the electrical energy consumption of buildings	EV Charging control demand/response	EV Charging, All Buildings	✔	✔		✔
ORE_010	Facilitate availability management of resources and EV charging through models that takes availability and occupancy into consideration	EV Occupancy detection	EV Charging	✔	✔		✔

ORE_011	Facilitate energy resource management and EV charging through models that takes cost of resources into consideration and reflect it in the payment system	EV Charging payment system	EV Charging	✔	✔		✔
ORE_012	Provide interoperable technological means to deliver input in an economical way to provide parking services	Camera and Light sensor for number plate recognition	Smart Parking Sites; Health Care; Assisted Living		✔		✔
ORE_013	Provide interoperable technological means to deliver economical models to provide parking services system with a professionally managed facility	Parking Sensor for occupancy detection	Smart Parking Sites; Assisted Living				✔
ORE_014	Provide interoperable technological means of integrating sensors to deliver input in an economical way for visibility, services and future decision making supports	CO_2 Monitoring	Elderly Citizens Homes; Municipality Sports Complex; School; Solar Lab			✔	
ORE_015	Include household appliances for a wider services of health care at home systems	Oven and Fridge usage monitoring	Elderly Citizens Homes		✔	✔	
ORE_016	Include household appliances for a wider services of resources consumption and DMS	Oven and Fridge usage monitoring	Municipal Facilities, Solar Lab, individual homes	✔	✔	✔	
ORE_017	Develop new models for automated operations at household appliances operations and maintenance leading towards "appliances as a service model"	Oven and Fridge usage monitoring	Solar Lab; Elderly Citizens Homes	✔			

ORE_018	Include various low cost devices widely available as information sources for condition assessment for caretakers in homecare environments	Blood pressure and walking monitoring	Elderly Citizens Homes;			✔	
ORE_019	Facilitate creation of the new services and solutions within healthy lifestyle paradigm for Municipalities IoT enabled	New model	Cross facilities	✔	✔	✔	✔
ORE_020	Facilitate creation of the new models and new services and solutions within shared economy paradigm for Municipalities IoT enabled	New model	Cross facilities	✔	✔	✔	✔
ORE_021	Create a method for VICINITY enabled systems maintainability	New model	Cross facilities	✔	✔	✔	✔
ORE_022	Create a method for VICINITY enabled systems reliability provision	New model	Cross facilities	✔	✔	✔	✔
ORE_023	Develop an ability to store excess renewable energy as thermal cold energy in the smart refrigerators, to be released when energy production reduces	Energy storage in smart refrigerator	Solar Lab, Elderly Citizens Homes, School.	✔	✔		
ORE_024	Introduce and facilitate the use of wearables for older end-users, given their limited ability to operate smart phones.	Wearables	Elderly Citizens Homes			✔	✔
ORE_025	Facilitate operational transition of Solar Panel condition-based cleaning instead of periodic cleaning.	Solar Panels Soiling monitoring	Solar Lab	✔	✔		
ORE_026	Improve efficiency of Common Areas Cleaning Operations	New Model	Solar Lab	✔	✔		

ORE_027	Facilitate operational transition to Solar System condition-based (predictive) maintenance, instead of periodic maintenance.	Solar Systems	Solar Lab	✔	✔		
ORE_028	Develop an ability to automatically control the functioning of a smart oven, triggered by the availability of an excess of renewable energy	Smart oven	Cross facilities	✔	✔		
ORE_029	Allow for flexible development environment to allow for third parties services building for demonstration purposes in the Accelerator´s living lab	Development	Startup Lab Accelerator	✔	✔	✔	✔
ORE_030	Allow citizens to be informed about the maximum recommended time for skin exposure to sun according to UV intensity	UV monitoring	Solar Lab			✔	
ORE_031	Allow citizens to be informed about the perceived temperature due to the influence of wind speed and air humidity	Wind Speed and Air Humidity Monitoring	Solar Lab			✔	
ORE_032	Improve the use of water resources in agriculture	Land humidity monitoring	Solar Demonstration Platform	✔			
ORE_033	Provide ways to get visibility into carbon footprint of buildings operations and resources consumption	Energy consuming equipment, resource consumption and CO2 equivalent measurements	All buildings	✔	✔		✔

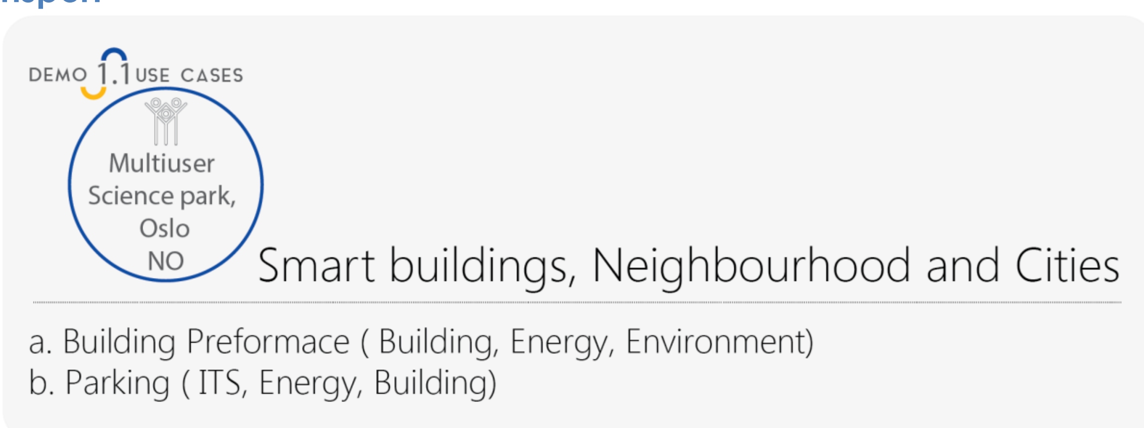
ORE_034	Create a way to benchmark progress/ compliance towards reaching energy efficiency targets based on energy audits and without energy audits criteria	Energy consuming equipment, use of facilities patterns by tenants	All buildings	✔	✔		✔
ORE_035	Develop an ability to automatically detect abnormal in-house conditions (deviation from occupant's usual habits) and trigger alarms, utilizing real-time information from building sensors (motion detectors, pressure mats, appliances usage monitoring etc.)	Building sensors	Elderly Citizens Homes		✔		
ORE_036	Develop an ability to monitor and detect abnormal drug prescription and trigger alarms	Smart drug dispenser	Elderly Citizens Homes		✔	✔	
ORE_037	Develop an ability to track and "credit" interaction with sport equipment within an incentivation/award system	IoT sensors /beacons for location-based awareness applications	Municipality Sport Complex		✔	✔	
ORE_038	Develop an ability for remote monitoring of assisted living occupants health status and in-house conditions (abnormal detection)	Health and Home Monitoring devices	Medical call centre		✔		
ORE_039	Allow for the system to be operated by youth segment that needs special care, but is able to handle tasks. This would potentially create inclusion into the job market of the fastest growing special care group.	System and Model	Smart Parking, Assisted Living			✔	✔

Table 20 - Operational Requirements relevance per Domain

OPERATIONAL REQUIREMENTS in VICINITY: IMPLICIT							
IMPLICIT type	Operational Requirement	Function - Feature	Use-cases facilities	Domains			
#				E	B	H	T
ORI_001	EASE OF USABILITY	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_002	AFFORDABILITY OF IMPLEMENTATION	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_003	EASE OF OPERABILITY	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_004	EASE OF SUPPORTABILITY	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_005	SCALABILITY in Number of users	IaaS	Cross Facilities			✔	
ORI_006	Economically OPERABLE without increase in personnel	IaaS	Cross Facilities			✔	
ORI_007	FLEXIBLE in adapting additional data sources	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_008	SECURABLE privacy and security wise	IaaS	Cross Facilities	✔	✔	✔	✔
ORI_009	AVAILABLE to support operations	IaaS	Cross Facilities	✔	✔	✔	✔

Table 21 - Operational Requirements: Implicit

6.3 Use case 1.1 – Norway (Oslo Science Park) - Buildings and Smart Transport



Scope and objectives of use case

Buildings are central objects and tools in all parts of our urbanity.

Buildings are perhaps the object that society *spends most of our critical resources, such as energy and capital*. Buildings are where we spend most of the human resources we use in our urban way of living. Human resources represent about 90 % of the total cost over a building's lifetime. In a smart urban living context, we need to understand the way we use our buildings and how buildings perform. At the Norwegian demo-site at Oslo Science Park, we will test use-cases that harvest and combine information from the interior of the facility, energy and transport to find new and better approaches to solve some of these issues through the interoperable approach VICINITY would provide.

Table 22 and 23 present further details of the operational context of the use cases at the DEMO site, including facilities and users per three domains represented.

Operational Requirements Context

DEMO 1.1 USE CASES Multiuser Science park, Oslo NO	Buildings	Energy	Transport
Devices	IEQ sensor units, e.g. Serinus Technology IEQ units In the office settings: CO2-level, temperature, relative humidity, noise, movement, light. In the laboratories setting: CO2-level, temperature, relative humidity, noise, movement, light.	Energy meter readers with wireless capabilities (WM-Bus or similar)	Charger meter readers with wireless capabilities (Meshcrafts) EV Chargers Occupancy detector
ICT Infrastructure	Internet connection via 3G Radio mesh communications backbone - Tiny Mesh 868MHz	Internet connection via 3G Radio mesh communications backbone - Tiny Mesh 868MHz	Internet connection via 3G Radio mesh communications backbone - Tiny Mesh 868MHz
Urban Facilities	Oslo Science Park, Building B and D - offices, laboratories, conference halls Startup Lab Accelerator facility at the Science Park premises. (The organisation and the facility will become testing ground and demo site)	Oslo Science Park, Building B and D - tenant consumption and buildings operations electricity consumption	Oslo Science Park parking garage
Knowledge & Users	Operations & maintenance department; Students; Workers/researchers; Visitors	Operations and maintenance department; Grid operator; Neighbourhood buildings operators	Operations & maintenance department; Students; Workers/researchers; Visitors/drivers; Neighbourhood building users/operators
rocesses awareness	Energy use rationalisation; Improving the environment quality and life quality; Contribute to environmental sustainability and future generations; Optimisation of resource efficiency; Load and areal flexibility	Energy use rationalisation; Load balancing; Contribute to environmental sustainability and future generations	Energy use rationalisation; Space utilisation optimisation; Load balancing; Contribution to environmental sustainability and future generations; Balance Payment for resource use

Table 22 - Use case 1.1 Operational Requirements Context

DEMO 1.1 USE CASES
Multiuser Science park, Oslo NO

Facility	Use Case	Description
Oslo Science Park Building B and D Offices and laboratories Energy meters Start up Lab	Intelligent Building System	Building operations enhanced with indoor environmental and usage data. Combined with energy consumption and load data for energy flexibility utilization in and between building stages, as well as with parking garage EV chargers.
Start up Lab Accelerator	Living Lab VICINITY Demonstration site	Accelerator management commited to demonstrate VICINITY system, provide VICINITY as an enabler for additional value add services creation by startups in the lab and visitors.
Oslo Science Park Parking garage	Intelligent Parking/Charging System	Booking of EV charging and parking for enhanced load balancing and payment for electricity. Energy flexibility utilization connected to building use case.

Table 23 - Use case 1.1 per facility

Short description of the site

Oslo Science Park:

In the use cases at Oslo Science Park, we will combine information from the Building, Energy and Transport domains. The two overarching approaches that will be demonstrated at this demo-site are the following:

(1) Virtual Neighbourhood of Buildings integrated in a Smart Grid Energy Ecosystem

(2) Virtual Neighbourhood of Intelligent Parking Space

The first group of use-cases will test functionality with focus on energy, energy efficiency, space utilization and usage patterns, indoor air quality (IEQ) and buildings in a neighbourhood.

This use-case will demonstrate how information from the energy part of the building, together with real-time information about Indoor Environmental Quality (IEQ) and information about buildings physics from a Building Information Model (BIM), can give an estimate of

- the use load of the building,
- the performance of the building and

- enable the calculation of a real-time estimation of the building's energy flexibility.

This estimate will be published via the VICINITY platform to the local grid owner for load management in the local grid.

The second group of use-cases will demonstrate the use of IoT technologies in a smart mobility framework: Smart parking and EV Charging combined with information and services form the building and energy domains.

Oslo Science Park – background:

- Operated by OsloTech – a team of 14 people
- Four semi-independent building stages under one roof.
    - Can be considered as four separate buildings.
- 55 000 m^2 - offices, laboratories, conference halls, parking garage
- 240 tenants with 2400 employees. Research companies, university, technology, start-ups.
- Heat pump, cooling systems, electric heating, HVAC, power meters, water meters
    - About 2 500 MWh heating (delivered, incl. heat pump) and 1 000 MWh cooling per year.

The two most independent building stages will be the demo location, combined with the parking garage in the basement.

- Most rooms in the two parts will have IEQ sensors installed. These will communicate in an RF Mesh network.
- Data from power meters will be collected with sensors (pulse counters, ampere meters or optical devices as needed) and communicated via an RF Mesh network.
- The energy meters and the IEQ devices will communicate in the same RF network and use common gateways to deliver the messages to an API. This API will stream data to applications, e.g. for online calculation of available energy flexibility in the buildings.

The cloud service will integrate sensor data from the building and information from the BIM. The same information will in also be input for the calculation and visualisation of physical usage loads and the usage patterns in the building. This information can also be input to the building facility management system.

Table 24 presents DEMO site gap analysis that lists operational objectives and identifies potential deficiencies, while offering mitigation actions. Table 25 introduces DEMO site risk management matrix, including potential impact assessment and offers management measures. This exercise allows VICINITY to plan, mitigate potential risks and manage site operators expectations, while developing VICINITY.

DEMO 1.1 USE CASES
Multiuser Science park, Oslo NO

DEMO 1.1 GAP ANALYSIS

Operational Objective	Current Status	Deficiency	Mitigation Plan
Operate systems for energy and resources measurements	Automated energy meters	Large number of the energy meters without communication option.	To install systems where the electrical structure does not interfere with exisiting building structure. Wireless aftermarket readers.
Install infrastructure for EV charging in the parking facility of the building	A new system is under implementation	Location of the the EV charging station is inside payable parking space of the facility	Parking garage is main parking facility. Already in wide use with limited alternatives. Paid parking should not be problematic.
Operate systems and create approapriate infrastructure for IEQ measurement and syncronisation with demand for electricity loads	To be installed	New installation	The benefits of the new installations and additional capabilities they are expected to bring are well percieved and anticipated across many stakeholders. Similar installations already up and running.
Access and analyse additional value that can be obtained from information obtained from energy, IEQ, use of facilities and parking services for better facility management	Strategic plan	Complex approach driven by facility management team. Requires high level of coordination and knowledge, and anticipated to have high organizational impact	Management support and planning with close follow up.

Table 24 - Use case 1.1 GAP Analysis

DEMO 1.1 USE CASES — Multiuser Science park, Oslo NO

DEMO 1.1 Risk Management matrix

Risk type	Potential Impact	Management measures
Stakeholders and Demo site partners responsiveness risk;	Meeting timings of DEMO installations rollout and demonstration phase.	Ensure timely and ongoing communication of project rollout requirements.
Budget provisions for Vicinity ready installations;	Meeting budget provisions for technical installation on DEMO site	Identify, verify and obtain sign-off on all items requiring budget allocation. Ensure timely acquisition of items in accordance with project rollout plan.
Coordination risks between all stakeholders in Ecosystems of Demo sites;	Delays due to coordination contingencies between stakeholders in the ecosystem resulting in delays.	Ensure regular project feedback loop to all stakeholders, so that any delays can be identified early on and corrected.
Operations risks during the demonstration phase;	Potential interference from other implementations on site, proper use of the installed systems, access to the DEMO site	Introducing appropriate operating procedures in which information from the demo use cases are included in the daily operation and service procedures.
Site operator long term commitment risk.	The multiyear duration of the project and its various phases of development might impact site operator commitment, since benefits are spread between many stakeholders. Changes in locally managed budgets	Clear agreements as to ongoing operations and collaboration to be made with stakeholders, including commitment to relevant budgets if required and agreed. Set multiyear operations and communications plan. Ongoing engagement.

Table 25 - Use case 1.1 Risk Management matrix

6.4 Use case 1.2 – Norway (Tromsø) – Neighbourhood Smart Parking Assisted Living ecosystem

DEMO 1.2 USE CASES

Mobility, Building
Tromsø
NO

Transport, Parking, eHealth and Assisted living

a) Shared parking
b) Access for bluelight agencies

Scope and objectives of use case

The smart parking pilot connected to Assisted Living and Healthcare site in Tromsø, Northern Norway aims to demonstrate an extendable service for sharing available parking space. The test site is located in a newly constructed cluster. This is a living lab community for residents, elderly and young people, some of them requiring health and Assisted services from the municipality. The urban area is crowded with apartments, offices, a theatre and amusement activities with less and less outdoor parking space. The demo site is a small and manageable building with three entrances covered by a shared garage facility.

Most of the value-added opportunities that have been offered involve sharing the parking spaces for shorter and longer periods – only if a resident wants to share his space. Health care personnel and ambulance/blue light agencies will be the first group to benefit from this new service. In addition, sharing of parking space will be offered when larger events, like conferences and concerts are taking place in this neighbourhood. Table 26 and 27 present further details of the operational context of the use case at the DEMO site, including facilities and users.

DEMO 1.2 USE CASES
Mobility, Building
Tromsø
NO

Operational Requirement Context

	Transport Smart Parking
Devices	Camera license plate sensor, Smart lighting sensor, Parking occupancy sensor
ICT Infrastructure	Low Power Wide Area Network (LoRaWAN) is a media access control (MAC) protocol for wide area networks. IoT city infrastructure Tromsø is installed via 4G by Telenor and made available for research and innovation for the next 5 years
Urban Facilities	Neigbourhood garage facility – tenant access and usage of shared garage door supporting special needs for residents in the buildings above the parking
Knowledge & Users	User categories consist of social care takers, tenants of the facility with special needs, relatives of the residents and visitors. In stage 2 services would be extended to the neighbourhood as a shared economy model. Training to the young special needs residents, facility managers and service providers to the special needs caretakers on devices and systems levels.
Processes awareness	Sharing services modelled after AirBnB model

Table 26 - Use case 1.2 Operational Requirements Context

DEMO 1.2 USE CASES
Mobility, Building
Tromsø
NO

Facility	Use Case	Description
Social Housing in Teaterkvarteret 1.akt	Prioritisation of Parking allocation to the special needs residence and special services veihcles	Access to test site, guidance to parking close to their preference and needs. Blue light agencies have access close to lift in respective building
Shared Parking in Social Housing building	Intelligent Transport Shared Parking services for neighbourhood community	Residents share their privately owned parking space when not in use in order to benefit for parking needs

Table 27 - Use case 1.2 per facility

Short Description of the site

Parking administration is handled through a simple booking service for available parking space with reimbursement features for the parking space owner.

The parking service requires a range of functions and features to be included by developers of IoT systems and devices. These include

- interfacing to the area management and digital economy,
- access and security management ,
- public and private services related to health and assisted living.

Most of the value-added opportunities may be found in the proposal to rent out parking space for shorter or longer intervals, as well as controlling the parking space.

The most important aspects of the smart parking use case is displayed in Figure 22. It describes how the smart parking logical system governs the assignment of available parking space.

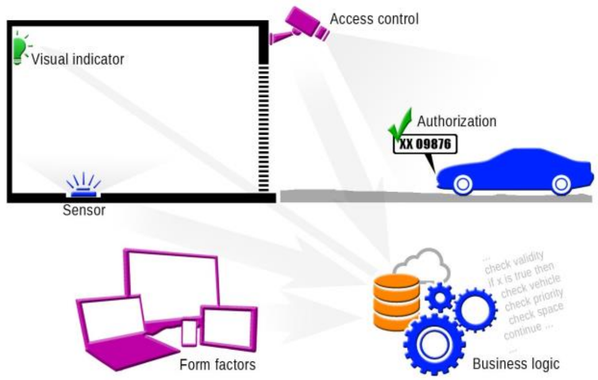


Figure 21 - A demonstration of a small portion of the smart parking use case

In short, an access control device (i.e. a camera, pin code, QR code, biometric scanner or something similar) is used to validate the vehicle that wants to get access to the garage facility. If authorization is received, the entrance opens, and a visual indicator (i.e. LED lights, a smart light, one or more digital signs) marks the status of the available parking spot or spots. Access control, maintenance, logs and other value added services will be handled through a number of different form factors i.e. mobile devices and laptops.

Table 28 presents DEMO site gap analysis that lists operational objectives and identifies potential deficiency, while offering mitigation actions. Table 29 introduces DEMO site risk management matrix, including potential impact assessment and offers management measures. This exercise allows VICINITY plan, mitigate potential risks and manage site operators expectations, while developing VICINITY.

DEMO 1.2 USE CASES
Mobility, Building
Tromsø
NO

DEMO 1.2 GAP ANALYSIS

Operational Objective	Current Status	Defficiency	Mitigation Plan
Operate a service for sharing parking space	No sharing service available	Higher usage of parking space made from outside to increase availability	To ensure residents and board agree on establishing a sharing service
Access control for tenants	No generic access control system available today	Dynamic access control based on authorisation	To ensure a common access control system can be implemented
Indoor guidance to allocated parking space	No indoor guidance exists	New function to optimise parking space	To ensure that available neighbourhood parking space can be optimised
Parking occupancy indicator	No occupancy indicator exists	New function to signal occupancy in neigbourhood	To manage parking site using security and privacy measures

Table 28 - Use case 1.2 GAP Analysis

DEMO 1.2 USE CASES
Mobility, Building
Tromsø
NO

DEMO 1.2 Risk Management matrix

Risk type	Potential Impact	Management measures
Stakeholders and Demo site partners responsiveness risk	Meet the high demand for more dynamic parking space allocation in the city neighbourhood	Number of shared service space available versus usage
Budget provisions for Vicinity ready installations	Allocate additional budgets from stakeholder provision for technical installation on DEMO site	Share value of additional budget provided by city IoT infrastructure for next 5 years
Coordination risks between all stakeholders in Ecosystems of Demo sites	Delays due to coordination contingencies between stakeholders in the ecosystem resulting in more delays	Host regular workshops and focus on risk factors with local stakeholders
Operations risks during the demonstration phase	Potential cross-domain win-win from other implementations on site, proper use of the installed municipality welfare systems	24/7 operations, Service Level Agreement provded by Telenor telecom operator
Site operator long term commitment risk	Committed 5 year support from city IoT infrastructure might impose several new applications, which might impact each other and site operator commitment. Changes in locally municipality budgets	City-wide IoT infrastructure and welfare system support for VICINITY neigbourhood win-win

Table 29 - Use case 1.2 Risk Management matrix

6.5 Use case 2 - Portugal (Martim Longo) - Neighbourhood GRID ecosystem

Scope and objectives of use case

Demonstrate value added services that could be enabled through the VICINITY framework based on renewable energy generation infrastructure including: weather station, Solar Lab, and Municipal cluster of buildings. The aim is cross leverage and create value through community-scale VICINITY enablement and promote sustainable energy in the Municipality as well as between the citizens.

The ecosystem is comprises a diverse cluster of municipal buildings, currently not equipped with any smart technologies or distributed energy generation facilities. The buildings include a sports pavilion, an indoor swimming pool, a nursing home and an elementary school. This has potential to impact the whole load dynamics of the proposed system which needs to be modelled based on performance drivers.

Moreover, a residential development is an addition to the cluster is under construction and VICINITY framework could be demonstrated within the facilities that could be built already with such knowledge and potential.

Various use cases at the Solar Demonstration Platform and the adjacent infrastructure of the Municipality of Alcoutim will demonstrate the functionality that the VICINITY solution aims to provide. This includes facilitating the interoperability of data sharing is expected to and result in cross-domain benefits.

The current Use Case will target collaborative management of a community-scale energy ecosystem linking: Solar Lab, Demonstration Platform, weather station and the Municipal buildings. This energy ecosystem could form a data exchange and allow flows to be managed from both the Generation and Demand sides. It must be managed and maintained at maximum cost and technical efficiency levels. Effective management can only be obtained from knowledgeable and informed decisions. These will be achieved by gathering data from sensors and building information models that will reduce the amount of time needed to: elaborate on a decision; visualise available data; and interlink infrastructures throughout the ecosystem. Potential Use Cases for a VICINITY demonstration in Neighbourhood GRID ecosystem are:

- Facilities environment quality service for Smart grid ecosystem in Municipal buildings (School, Indoor swimming pool, Nursery home, Sport Pavilion);
- DNI calibrated data added value services to third party solar energy generation producers (CPV);
- Solar Lab environment quality service for Nanogrid Smart Energy system in Near Zero Energy building Solar Lab;
- UV added value service for predictive infrared/ max sun exposure services to the citizens;
- Perceived temperature added value service for providing the "feels like" temperature to the citizens;
- Humidity land sensor for water management in agriculture;
- Smart Energy Assets management, preventive maintenance:
    - Predictive Solar Energy Generation modules cleaning and maintenance;
    - Energy loads monitoring and control;
    - Smart energy system management (HVAC, Lighting and other equipment);

Table 30 and 31 present further details of the operational context of the use cases at the DEMO site, including facilities and users per three domains represented.

DEMO 2 USE CASES
Energy Ecosystem, Martin Longo PT

Operational Requirement Context

	Buildings	Energy
Devices	Meteo station; Sensors: Indoor temperature, Humidity, Noise, Movement, CO2, Luminance and Iliminance, A/C units in SolarLab, Swimming pool, Nursing home and most School classrooms. Swimming pool water temperature controller Water pump & Smart appliances	Solar PV and solar thermal collectors on SolarLab and Municipal Buildings; Solar radiation measurement station (direct, difuse and UV); Smart Meters and data logger in Municipal buildings & SolarLab
ICT Infrastructure	Fixed & WiFi Internet connection and 3G signal in all locations; Radio mesh communications backbone - Tiny Mesh 868MHz	Fixed & WiFi Internet connection and 3G signal in all locations; Radio mesh communications backbone - Tiny Mesh 868MHz
Urban Facilities	Swimming pool building; Sports Pavilion building; Elementary school building; Water pump station;	SolarLab Platform
Knowledge & Users	Students; Citizens; Public Workers Visitors	Research & Development; Students; Workers; Companies
Processes awareness	Awareness-raising for energy use rationalisation; Improving the environment quality and life quality within public facilities; Contribute to environmental sustainability and future generations,	Awareness-raising for energy use and resources consumption rationalisation; Improving the environment quality and life quality; Contribute to environmental sustainability and future generations; optimise operations and maintenance of the renewable energy generation site; optimise use of scientific equipments towards community

Table 30 - Use case 2 Operational Requirements Context

Short Description of the site

The Solar Demonstration Platform located in Alcoutim, Southern Portugal is a project providing Plug and Produce solution on a 42ha marginal land plot in a low-density region. It is located in one of the highest solar radiation regions in Europe.

The Platform provides a range of services for renewable energy producers and technology companies, such as project development, infrastructure, operating services and technology commercialization.

5 years ago the team envisioned, designed and implemented this innovative shared infrastructure platform model for renewable energy production. It allows a reduced infrastructure footprint, optimized shared operations and maintenance, and created critical mass for spin off research and innovation

projects. The result is a dynamic scientific-technological ecosystem, in which various companies are able to test, validate, research, deploy and commercialize their technologies.

4MWp CPV systems currently installed on the Platform are avoiding about 1045 ton CO2eq yearly. Solar energy generation is amongst the least-invasive energy technologies with very low environmental impact. In addition, solar panels provide shading, which allows for the regeneration of poor quality soil. The Platform is adding various indigenous species such as the cactus Opuntia Ficus Indica to the perimeter of the platform for fire prevention, security and optimal land utilization.

Traditional integration of utility scale solar parks into the grid follows a pattern of isolated, independent projects. The Solar Demonstration Platform model departs from the legacy renewable energy generation models (one producer, one support infrastructure) to the innovative accommodation of energy production technologies (infrastructure and service facilities shared by many producers). For the grid operator, the platform model provides optimized grid management. Also, owing to its use of new transmission lines, the Platform improves grid robustness.

Barriers to accelerating clean energy deployment include high project capital costs, licensing and permitting costs and specialized O&M activities. These barriers add to the slowdown of renewable energy proliferation across the globe. The Alcoutim Solar Demonstration Platform Plug and Produce model significantly reduces project development, capex and opex costs and thereby supports the acceleration of clean energy deployment and decarbonisation as well as renewable technology deployment and industry growth. The team has originated a network of collaborations with scientific, industrial, governmental and local entities, capitalizing on the excellent local solar resource by creating value-add activities in the region.

R&I activities are aimed at expansion to accommodate other alternative energy technologies, such as energy storage, wind and smart grids.

The Municipal cluster of buildings is located in Martim Longo (Alcoutim) and is composed of an elementary school, a sport pavilion, an indoor swimming pool facility and a nursing home. All of the facilities are close to each other and they are used by the citizens from the Municipality.

Figure 22 - Elementary School and Nursing Home, respectively

Figure 23 - Solar Demonstrations Platform (CPV plant)

DEMO 2 USE CASES

Energy Ecosystem, Martin Longo PT

Facility	Use Case	Description
Solar Demonstration Platform/Municipal buildings	Smart Building Operations with integrated RES production	Interlink application between solar generation on platform with Municipal building operations, resembling a shared solar infrastructure/VPP paradigm.
Solar Lab	Smart Energy NZEB	Enhancement of NZEB through deployment of sensors to derive data from the interior environment, energy generation and smart applicances allowing cross domain solutions.
3x Municipal buildings:	Municipal Smartgrid	Clustered energy system composed of municipal buildings and DER. Each specific building functionalities are enhanced by IoT.
Nursing Home	Smart Energy Assisted Living	Improvement of energy efficiency and indoor environment quality by deployment of sensors.
Sports Complex	Smart Energy Multi Sport and Swimmg Pool facility	Use of sensors to measure air, humidity, temperature, light quality and smart meter to monitor the energy use and water consumption to optimize the consumption and to enhance user health and facility flexibility
School	Smart Energy School	Deployment of sensors and smart meter to monitor key space comfort parameters including temperature, humidity and CO2, allowing for an optimized use of the air conditioning system and improved health.

Table 31 - Use case 2 per facility

Table 32 presents DEMO site gap analysis that lists operational objectives and identifies potential deficiencies, while offering mitigation actions. Table 33 introduces DEMO site risk management matrix, including potential impact assessment and offers management measures. This exercise allows VICINITY to plan, mitigate potential risks and manage site operators expectations, while developing VICINITY.

DEMO 2 USE CASES
Energy Ecosystem, Martin Longo PT

DEMO 2 GAP ANALYSIS

Operational Objective	Current Status	Deficiency	Mitigation Plan
Measure solar energy generation.	Solar Thermal system installed. Solar PV system to be installed.	Solar Thermal does not have measurement system. Solar PV is a new installation.	Solar PV new installation has good economic rationale under self-consumption legislation.
Measure energy consumption in Municipal buildings.	Municipal buildings have standard analog energy meters.	Analog meters will need to be replaced by Smart (digital) Meters.	Dialogue has started with Smart Meter suppliers and DSO regarding installation of Smart Meters.
Monitor smart appliances (fridges and ovens) in Municipal buildings and SolarLab.	To be installed.	New installation	Delivery planning with Gorenje is ongoing and on schedule.
Dynamic monitoring of IEQ across pilot buildings	To be installed.	New installation	Delivery planning with Serinus is ongoing and on schedule.
Optimal visualisation and use of information from IoT enabled sources	Under design and development phase	Personnel training is needed	Engaging start up community in the region and leveraging best practices for training during systems installation and exploitation phase

Table 32 - Use case 2 Gap Analysis

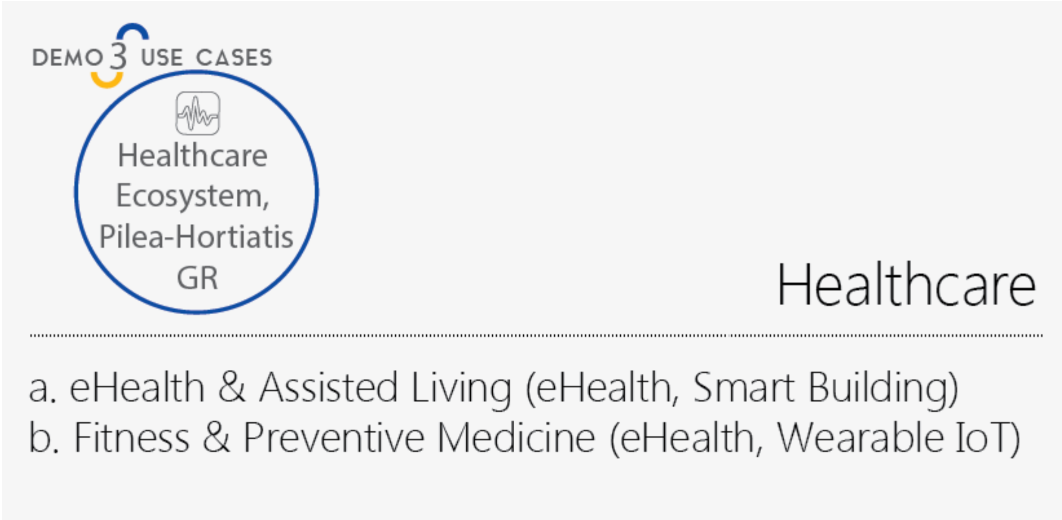
DEMO 2 USE CASES
Energy Ecosystem, Martin Longo PT

DEMO 2 Risk Management matrix

Risk type	Potential Impact	Management measures
Stakeholders and Demo site partners responsiveness risk;	Meeting timings of DEMO installations rollout and demonstration phase.	Ensure timely and ongoing communication of project rollout requirements. Sign off on these by first and second line responsible staff at stakeholders on the Municipal level.
Budget provisions for Vicinity ready installations;	Meeting budget provisions for technical installation on DEMO site	Identify, verify and obtain sign-off on all items requiring budget allocation. Ensure timely acquisition of items in accordance with project rollout plan.
Coordination risks between all stakeholders in Ecosystems of Demo sites;	Delays due to coordination contingencies between stakeholders in the ecosystem resulting in delays.	Ensure regular project feedback loop to all stakeholders, so that any delays can be identified early on and corrected.
Operational risks during the demonstration phase;	Potential interference from other implementations on site, proper use of the installed systems, access to the DEMO site	Agree and introduce appropriate operating procedures to avoid any unauthorised use or access to installed systems, and continued access by authorised staff.
Site operator long term commitment risk.	The multiyear duration of the project and its various phases of development might impact site operator commitment, since benefits are spread between many stakeholders. Changes in locally managed budgets	Clear agreements as to ongoing operations and collaboration to be made with stakeholders, including commitment to relevant budgets if required and agreed. Set multiyear operations and communications plan. Ongoing engagement.

Table 33 - Use case 2 Risk Management matrix

6.6 Use case 3 – Greece (Pilea-Hortiatis) - eHealth/Assisted Living



Scope and objectives of use case

Caring for an aging population is one of the major challenges for future healthcare. An important step is the need to move from institutional care to assisted living at home, in particular for elderly people living alone and people with long-term needs and chronic illness (such as people with hypertension, dementia, and obesity). Electronic medical care services enable these people to obtain a better quality and independent life.

Short description of the site

This Use Case will demonstrate how sensors, actuators and integrated communication devices installed at home can provide assisted living to elderly people and people with long-terms needs. This allows remote monitoring of end-users' health parameters, providing them with a direct means of communication with a 24-hours call centre with specialist staff in case assistance is needed. Furthermore, by utilizing sensors from the building and smart homes domain (such as motions sensors, occupancy trackers, pressure mats etc.), more advanced added-value services can be implemented such as triggering alarms when abnormal conditions are detected in the assisted living environment and notifying the elderly person's relatives.

Another use case will target middle-aged people (e.g. citizens with problems such as obesity and hypertension) to use smart wearable sensors and IoT proximity sensors to track their everyday activities and promote a more healthy lifestyle. The municipality will be able to collect information and create "municipal-scale" social networking of urban citizens, tracking their fitness "achievements", awarding or further triggering them towards specific goals set,

based on each individual's special needs. The whole scenario will be promoted and assisted by doctors (pathologist or dietician) in collaboration with the municipality health services, that will further be leveraged through campaigns and organization of municipal-scale contexts.
Table 34 and 35 present further details of the operational context of the use cases at the DEMO site, including facilities and users per two domains represented.

DEMO 3 USE CASES — Healthcare Ecosystem, Pilea-Hortiatis GR

Operational Requirement Context

	Buildings	Healthcare
Devices	Abnormal behaviour of elder people in the household Water consumption, Energy consumption, CO_2 measurement, Fire alarm, Smart oven, Smart fridge	Abnormal behaviour of elder people in the household Weight scale, Blood pressure sensor, Push buttons with drug dispenser, Health improvement for middle-aged people Weight scale, Blood pressure sensor, Pedometer
ICT Infrastructure	Internet connection	Internet connection and 3G
Urban Facilities		Medical Call Center, Municipality Sport Complex
Knowledge & Users	Elderly people, people with long term needs (such as people with hypertensive, dementia, obesity etc.) Relatives Medical Call Center Health service providers	Elderly people, people with long term needs (such as people with hypertensive, dementia, obesity etc.) Middle aged fitness groups Doctors; Dieticians Relatives Medical Call Center services providers Health service providers
Processes awareness	Enhance independent living, safety and active ageing	Enhance independent living, safety and active ageing; Promote fitness activities of municipal citizens

Table 34 - Use case 3 Operational Requirements Context

DEMO 3 USE CASES
Healthcare Ecosystem, Pilea-Hortiatis GR

Facilities	Use Case	Description
Citizens elderly homes	ehealth at home services support and enablement / assisted living services	Smart home (and other) IoT-powered functionalities
Municipality Sport Complex	Preventive medicine outreach / fitness awareness programs facilitation	Sport equipment functionalities are enhanced by IoT sensors/beacons for location-based awareness applications.
Medical call center	ehealth at home / assisted living support	Medical care IoT-powered services

Table 35 - Use case 3 per Facility

DEMO 3 USE CASES
Healthcare Ecosystem, Pilea-Hortiatis GR

DEMO 3 Risk Management matrix

Risk type	Potential Impact	Management measures
Budget provisions for Vicinity ready installations;	Meeting budget provisions for technical installation on DEMO site	- Part of the equipment already available from currently running programs - Extensions in building sensors expected to be provided by consortium partners and paid for by municipality funds
Coordination risks between all stakeholders in Ecosystems of the Demo site;	Delays due to coordination contingencies between stakeholders in the ecosystem resulting in delays.	Main demonstration partners already running similar program together for over 2 years
Operations risks during the demonstration phase;	Potential interference from other implementations on site, proper use of the installed systems, access to the DEMO site	Municipality health services already involved (through currently running programs) and will continue to support the demonstration realisation
Difficulty in finding elderly people willing to participate in Assistive Living at Home Use Case scenarios	Limited participation to extract significant statistics and to facilitate sufficient demonstration	- Already established sufficient number of cases from already running municipality e-health at home program (through national funds) - Municipality campaigns planned early in the process - Focus on privacy concerns
Difficulty in finding middle-aged people willing to participate in Preventive Medicine Use Case scenarios	Limited participation required in order to to build a social network for realisation of the comparison/ incentivation scheme for the demonstration	- Municipality campaigns planned early in the process - Contractual involvement of health personnel (e.g. dieticians) to secure potential participants from regular patients - Focus on privacy concerns in tracking

Table 36 - Use case 3 Risk Management matrix

DEMO 3 USE CASES
Healthcare Ecosystem, Pilea-Hortiatis GR

DEMO 3 GAP ANALYSIS

Operational Objective	Current Status	Defficiency	Mitigation Plan
Deploy building sensors for real-time monitoring of elderly people houses, allowing detection of abnormalities	Standalone solutions, mainly for hospitals and with limited detection capabilities	Privacy and obtrusiveness may raise opposition of deployment in elderly people houses	Use of wireless, unobtrusive solutions, target for smooth installation and limited maintenance needed. Follow best practice for data storage and handling.
Personalised social incentivation and award for middle-aged people towards healthy lifestyle	Wearable trackers with dedicated smartphone applications	Limited interest raised among municipal citizens. Privacy and obtrusiveness in tracking may limit use.	Promotional campaigns from Municipality, support from dedicated health personnel (e.g. dieticians), best practice for data storage and handling.
Connected smart drug dispenser for monitoring and detection of abnormalities in drug prescription	Non-affordable, standalone solutions (not connected)	Unwillingness to use from elderly people due to fear of complexity/real complexity in use	Ease of use of high importance. Intuitive GUI, close follow up.

Table 37 - Use case 3 Operational GAP Analysis

6.7 Application of Gorenje technology in use cases 1.1, 2 and 3

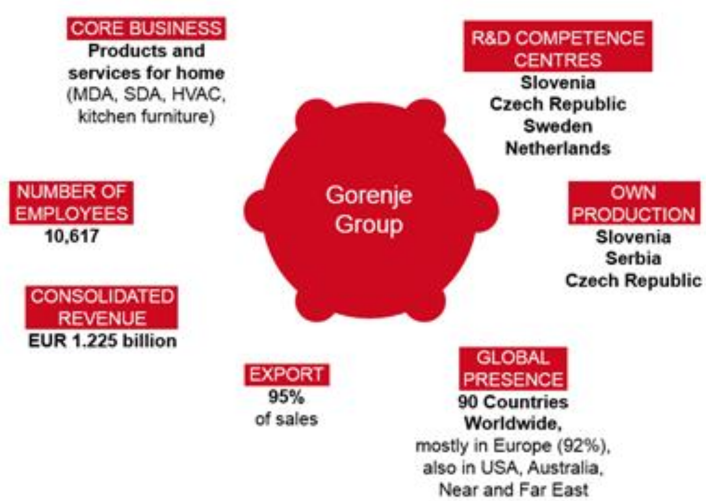


Figure 24 - Gorenje Group overview

Smart refrigerator and smart oven use cases in DEMO 1, 2 and 3

a) Refrigerator eHealth

Use case name: Refrigerator eHealth

Description: A refrigerator, which is placed in the user's household, sends messages about doors being opened or closed (e.g. REFRIGERATOR_DOOR_STATUS, FREEZER_DOOR_STATUS) to the VICINITY platform as they occur. Based on the frequency of these events, or e.g. on the hourly distribution of this events, the VICINITY platform could raise an alarm to a supervising health personnel if there is no activity on predefined scenario.

Primary actor: User

Supporting Actors: Refrigerator, VICINITY infrastructure

Stakeholders and interests: Supervising health personnel are interested in monitoring user's activities so that they are able to intervene in case if supervised user is unable to inform them for assistance.

Pre-conditions:

- User is using a smart refrigerator
- Appliance is connected to the VICINITY infrastructure

Post conditions:

- Success end condition:
  - events are sent to the VICINITY platform, where they are processed accordingly
- Failure end condition:
  - there is no connection to the VICINITY infrastructure
- Minimal guarantee:
  - Appliance is periodically sending status messages (which could be considered also as heartbeat messages) to inform VICINITY platform that the appliance is still connected.

Main success scenario:VICINITY platform inspects the incoming events and raise an alarm if needed.

Extensions: Other types of actions, which are performed on the refrigerator, triggered by the user, could be also transferred to VICINITY platform, where they also could be considered.

b) *Refrigerator stores an excessive energy*

Use case name: Refrigerator stores an excessive energy

Description: Refrigerator, which is placed in the user's household, is receiving messages from the VICINITY platform. At some point, the VICINITY platform detects that there is an excessive energy produced and sends message to adequate appliances to start storing the excessive energy.

The refrigerator receives command to enter SuperCool or ExtremeFreeze mode (messages: SUPERCOOL_FUNCION = ON, EXTREMEFREEZE_FUNCTION = ON), which lowers the cooling temperature significantly. This allows the demand to then to be reduced and energy production may be lowered for a time until the temperature rises again to a pre-set working temperature. This saves energy during a period of lowered energy production or excess demand elsewhere.

Primary actor: VICINITY platform

Supporting actors: Refrigerator, renewable energy neighbourhood or household, user

Stakeholders and interests: User is interested in preserving environment, by storing an excess of energy produced (which in many cases is also cheaper), and to use it when there is a shortage of energy

Pre-conditions:

- Household has a smart refrigerator
- Smart refrigerator has the 'REMOTE CONTROL' option enabled
- Appliance is connected to the VICINITY infrastructure
- Household is part of the renewable energy neighbourhood, which also takes part in the VICINITY platform

Post conditions:

- Success end condition:
    - the refrigerator is receiving commands from the VICINITY platform, which takes decisions when to start energy savings cycle and when to stop it

- Failure end condition:
    - there is no connection to the VICINITY infrastructure
    - user did not enable the 'REMOTE CONTROL' option
    - no message is received from the VICINITY platform
- Minimal guarantee:
    - Appliance is periodically sending status messages (which could be considered also as heartbeat messages), informing the VICINITY platform that the appliance is still connected.
    -

Main success scenario: Refrigerator receives messages when to enter and when to exit the SuperCool and the ExtremeFreeze modes.

Figure 25 - Gorenje Kitchen appearance

c) Oven, which bakes when the excess of energy is produced

Use case name: Oven, which bakes when the excess of energy is produced

Description: The oven, which is placed in the user's household, is receiving messages from the VICINITY platform. At some point, the VICINITY platform detects that there is an excessive energy produced and sends message to adequate appliances to start storing the excessive energy.

The oven, which has the remote control enabled and the baking recipe preloaded (messages: SET_STEPBAKE_STEP, HEATER_SYSTEM_SUB, SET_OVEN_TEMPERATURE, SET_BAKE_TIME_MINUTES), awaits for command to start baking by the recipe (message: START).

Once the baking process is started, it will be carried out, until the recipe is over or stop baking command is received (message: STOP).

Primary Actor: VICINITY platform

Supporting Actors: Oven, renewable energy neighbourhood or household with solar panels, user

Stakeholders and interests: User is interested in preserving environment and making savings performing energy-consuming actions during the period of a higher energy production.

Pre-conditions:

- Household has a smart oven
- User has enabled the 'REMOTE CONTROL' option
- Appliance is connected to the VICINITY infrastructure
- Household is part of the renewable energy neighbourhood, which also takes part in the VICINITY platform or has solar panels, which are also part of the VICINITY platform.

Post conditions:

- Success end condition:
  - the oven is receiving commands from the VICINITY platform, which takes decisions when to start energy savings cycles
- Failure end condition:
  - there is no connection to the VICINITY infrastructure
  - user did not enable the 'REMOTE CONTROL' option
  - no message is received from the VICINITY platform
- Minimal guarantee:
  - Appliance is periodically sending status messages (which could be considered also as heartbeat messages), informing the VICINITY platform that the appliance is still connected.

Main success scenario: The oven starts baking by a pre-set recipe at the exact moment when it receives a start command from the VICINITY platform.

7. Conclusions

In line with the VICINITY challenge to offer a bottom up, stakeholder driven platform offering interoperability as a service, and enabling cross-domain interoperability, Task 1.2 conducted site surveys in four Demo site locations in the second half of 2016 after starting the stakeholder interviewing process.

The goals of the VICINITY site-surveys were to solicit input towards contextual operational understanding for each domain of: operational and business processes currently in place, future aspirations, design and development requirements, DEMO site ecosystems and gather implicit and explicit feedback on the envisioned system.

Workshops and formal discussions were conducted in order to assist the DEMO site manager in prioritising their IoT focused goals. These exercises resulted in the creation of various matrixes and methods definitions that helped to focus their business goals and refine use-cases.

User requirements of Task 1.1 were translated into the features required in the VICINITY platform. The outcome of this task was consolidated in D1.3.

At each DEMO site:

1. The site survey exercises served as an effective way of communication between the technical staff on site, management, and wider stakeholder community, while introducing VICINITY consortium members;
2. Organisation, environment and constraints DEMO site specific were analysed and presented in surveys;
3. Explicitly stated needs were analysed and transformed into a set of stakeholder requirements for the operational environment;
4. The stakeholder operational requirements took account of the DEMO site locations and the needs of commercial, civic and personal needs of each site. (see Annex 9)
5. The implicit requirements were derived from the best practices in systems design in IoT and reflect the envisioned VICINITY solution design.
6. Gap analyses were conducted and analysed using a pre-defined risk management methodology.
7. The requirements were grouped and consolidated per domain and were described, focusing on their domain relevance.

8. European interoperability context goals were taken into consideration, in line with the Digital Single Market agenda developments;
9. The requirements were grouped and consolidated per domain and were described in the D 1.3, focusing on their domain relevance;
10. To complement the gathering of operational requirements in a single domain via site surveys, novel cross-domain use-cases were proposed which rely on information sharing across domains. The VICINITY consortium will continue exploring such opportunities at subsequent stages of the project.

Requirements were solicited from: stakeholders interviews, DEMO site managers, demo site operators, internal project partners and advisory board members. In addition, the Workshops within Municipal and site operators' settings provided a comprehensive list of Operational Requirements for further analysis in D 1.4. and D 1.5 as inputs for the system architecture design. This approach fulfilled the goal of VICINITY to contribute towards the functional design of the VICINITY solution.

VICINITY Operational Requirements detailed here serve as an input to the VICINITY architecture design in terms of: setting main goals for the system; defining boundaries; and categorising stakeholders' expectations along with presenting internal interoperability requirements.

It could be concluded that Internet of Things enabled solutions are novel to the user and operator communities across Health, Energy, Building and Parking domains and are therefore not well understood. Such systems and solutions involve multiple stakeholders and complex information exchanges, which give rise to data-sharing concerns such as privacy and security. Domain-specific business goals will be met in a collaborative context using the operational requirements for the pilot sites presented in this document.

Understanding stakeholders' real needs, perceived needs and expressed needs is challenging in the cross-domain environments. The ecosystem approach is one of the ways to facilitate this process. To show additional services, interoperable data exchange systems will be needed. Artefacts showcasing some of the wider ecosystem identified here will greatly enhance the success of VICINITY.

The VICINITY bottom-up interoperability approach was an effective method of gaining an understanding stakeholder operational requirements. This work will continue and would lead toward VICINITY architecture definition.

8. References

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9. Annex 1

9.1 Oslo Science Park

Oslo Science Park; has offices and a conference centre located between the campus of University of Oslo and Oslo University Hospital - Norways largest knowledge hub. Activities, conferences, breakfast seminars, great people and networks gives energy to the daily life of the park.

Oslotech aims to contribute to economic growth and to be a catalyst for the growth of new companies in Norway with focus on the Oslo region. Oslotech's task is to facilitate and contribute to the commercialisation of the results from research.

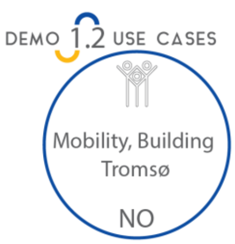
OSLOTECH RUNS OSLO SCIENCE PARK

Since 1986 they have built and operated Oslo Science Park. Today 220 companies, 2400 people and research organizations rent offices and labs here. This is a full service concept with offices and labs, an incubator, parking, conference centre, kindergarten, cafées, etc. Many companies are born and raised here during the last 30 years, like Chipcon, Kelkoo, KappaBio Science, Zwipe, Affitech, Genomar, Taskon, DragonBox etc.

WHAT HAPPENS IN OSLO SCIENCE PARK?
Oslotech Initiates and develops networks and clusters. Examples are Oslo Medtech, The Life Science Cluster and Oslo Edtech Cluster. We provide courses and workshops in entrepreneurship and innovation in Science for Society and Build2Grow. Oslotech develops and supports StartupLab – Norway's largest tech-incubator with 65 startups. We are also an investor in Founders Fund, investments in early stage tech-companies.

Every year Oslotech and partners organize and host many different events in our large in-house conference centre, bringing together students, researchers, enterpreneurs, people from industry, and investors. The Cutting Edge Festival gathers more than 500 participants, and Norwegian Investment Forum is the largest annual venture capital event in Norway.

9.2 Tromsø



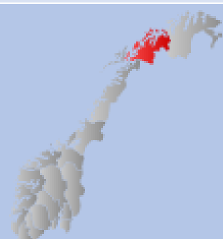
Tromsø; is a city and municipality in Troms county, Norway. The administrative centre of the municipality is the city of Tromsø. It is considered the northernmost city in the world with a population above 70,000. Including the annual influx of students more than 75,000 live in Tromsø through the year accompanied with a growing stream of tourists summer- and wintertime. It is the largest urban area in Northern Norway and the third largest north of the Arctic Circle (following Murmansk and Norilsk). Most of Tromsø, including the city centre, is located on the island of Tromsøya, 350 kilometres north of the Arctic Circle. Substantial parts of the urban area are also situated on the mainland to the east, and on parts of Kvaløya - a large island to the west. Tromsøya is connected to the mainland by the Tromsø Bridge and the Tromsøysund Tunnel, and to the island of Kvaløya by the Sandnessund Bridge. The city is warmer than most other places located on the same latitude, due to the warming effect of the Gulf Stream.

Tromsø kommune
Romssa Suohkan

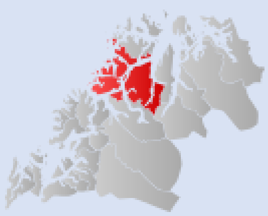
Municipality

Tromsø and the Tromsø Bridge

Coat of arms



Troms county within Norway



Tromsø within Troms county

Coordinates: 69° 40′ 58″ N 18° 56′ 34″ ECoordinates: 69° 40′ 58″ N 18° 56′ 34″ E	
Country	Norway
County	Troms
District	Nord-Troms
Administrative centre	Tromsø
Government	
• **Mayor** (2017)	Jarle Aarbakke (Social democrats)
Area	
• **Total**	2,520.11 km²
• **Land**	2,473.36 km²
• **Water**	46.75 km²
Area rank	18 in Norway
Population (2016)	
• **Total**	73,480
• **Rank**	7 in Norway
• **Density**	27.9/km²
• **Change** (10 years)	14.2 %
Demonym(s)	Tromsøværing
Time zone	CET (UTC+1)
• **Summer (DST)**	CEST (UTC+2)
ISO 3166 code	NO-1902
Official language form	Neutral
Website	http://tromso.kommune.no

9.3 Martim Longo

DEMO 2 USE CASES
Energy Ecosystem, Martin Longo PT

Martim Longo; is a Portuguese civil parish in the municipality of Alcoutim, on the eastern side of the Algarve (South of Portugal). The population in 2011 was 1,030, in an area of 128.45 km².

The area enjoys one of the highest Global Solar Radiation in Europe, relevant for solar energy production. The Algarve region aims to become "Zero Carbon region" which already implemented a pioneer project "VAMUS – Algarve Sustainable Urban Mobility Project" to thinking and planning solutions that allow efficient, inclusive and environmentally friendly journeys. Algarve is also has a highly developed tourism sector, which is the most popular tourist destination in Portugal. Its population triples to nearly 1.5 million people in the peak holiday season thanks to seasonal residents, and receives an average of 7 million foreign tourists each year.

Martim Longo	
Parish	
 **Coat of arms**	
	
Coordinates: 37.439°N 7.766°WCoordinates: 37.439°N 7.766°W	
Country	Portugal

Region	Algarve
Subregion	Algarve
Intermunic. comm.	Algarve
District	Faro
Municipality	Alcoutim
Area	
• **Total**	128.45 km²
Population (2011)	
• **Total**	1,030
• **Density**	8.0/km²

9.4 Pilea-Hortiatis

DEMO 3 USE CASES
Healthcare Ecosystem, Pilea-Hortiatis GR

MUNICIPALITY OF PILEA-HORTIATIS

Municipality of Pilea-Hortiatis; Pilea–Hortiatis is a municipality in the Thessaloniki regional unit – the second largest Greek city- in the administrative region of Central Macedonia, Greece. The municipality of Pilea–Hortiatis was formed at the 2011 local government reform by the merger of three former municipalities that became municipal units, namely Pilea, Hortiatis and Panorama, while the seat of the municipality is Panorama. It has 70.210 inhabitants (2011 Census) and it covers an area of 167.800 km^2 representing 4.29% of the area of Thessaloniki. It has an urban, mountainous and coastal landscape, since it extends from the lowland coastal area of Pilea to the mountain area of Hortiatis (1.201m height) and its forest is of a great natural beauty. It has Mediterranean climate with mild and wet winters and very warm and dry summers. However, the variations in landscape along the Municipality cause as well variations at the climate.

The main productive sector of the Municipality is services and commerce. Within the Municipality there are many commercial facilities, multinational companies, public organisations, large public hospitals, private clinics and medical centres, the largest shopping centres in Northern Greece, international hotels, etc. In addition to this, of equal importance is the presence of the Technology Park, which hosts a large number of new technology and IT business along with the operation of the Centre for Research and Technology (the Coordinator of the VICINITY project). It is also home to one of the EU's decentralized agencies, Cedefop, the European Centre for the Development of Vocational Training. The Municipality of Pilea - Hortiatis actively participates in the European Network of Cities UTN, the European Network of Qualitative Cities (QCITIES), the European Pact for Local Sustainable Energy (EUM) and the European Network "City Sec".

It is a relatively sparsely populated district offering opportunities for major residential and business development, in the context of more general development prospects enjoyed by the broader Thessaloniki area. Emphasis is currently being laid on the development of a new service economy, an area in which Pilea-Hortiatis offers numerous competitive advantages such as its proximity to the airport and to major road axes, the existence of ample open spaces as well as the necessary infrastructure for further development. The great challenge faced by the Municipality is to combine economic growth with respect to the environment and regional climate along with a guaranteed quality of life for its residents.

Pylaia
Πυλαία

Location within the regional unit:	
Coordinates: 40° 36′ N 22° 59′ ECoordinates: 40° 36′ N 22° 59′ E	
Country	Greece
Administrative region	Central Macedonia
Regional unit	Thessaloniki
Municipality	Pylaia-Chortiatis
• Municipal unit	24.379 km²
Population (2011)	
• Municipal unit	34,625
• Municipal unit density	1,400/km²
Time zone	EET (UTC+2)
• Summer (DST)	EEST (UTC+3)

References:

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https://en.wikipedia.org/wiki/Troms%C3%B8
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https://en.wikipedia.org/wiki/Algarve
https://en.wikipedia.org/wiki/Pylaia