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Deliverable D1.4

VICINITY business requirements specification

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List of Definitions & Abbreviations

Abbreviation	Definition
API	Application Programming Interface
B2B	Business to business
B2C	Business to customer
BRS	Business Requirements Specification
CO_2	Carbon Dioxide
DMS	Distribution Management System
EC	European Commission
EE	Energy efficiency
EU	European Union
EV	Electric Vehicle
GDPR	General data protection regulation
GUI	Graphical User Interface
ICT	Information and Communications Technology
IoT	Internet of Things
ISO/IEC/IEEE	International Standards Organisation, International Electrotechnical Committee and Institute of Electrical and Electronics Engineers
ITU-T	International Telecommunication Union
LoRaWAN	Low Power Wide Area Network
NB-IoT	Narrow Band IoT, a Low Power Wide Area Network radio technology Standard
OPEX	Operational expenses

PV	Photovoltaic
RES	Renewable energy source
SoI	System-of-Interest
SysML	System Modelling Language
UC	Use case
UX	User Experience
WP	Work Package
WP1	VICINITY concept Requirements, Barriers, Specification and Architecture
WP6	VICINITY Framework Integration & Lab Testing

1. Executive Summary

The latest dynamic developments in the Internet of Things realm, set humans across one of the biggest technology shifts in our human history. The sensing, measuring, controlling and business processes optimization technology networks approaching our daily life. Various IoT platforms are emerging on the market to manage these networks and deliver new business models and services

Nevertheless, these data-providing infrastructures are currently acting as isolated islands in the global IoT landscape. Interconnection of these islands might bring significant added value driving IoT market development, but exploitation of these benefits is inhibited by various interoperability barriers that are present in the current IoT ecosystems.

The VICINITY consortium – together with stakeholders from energy, building, transport and health domains – thoroughly explored these barriers & drivers[1] in parallel with the VICINITY demonstration sites survey (which results in extraction of pilot site needs – operational requirements)[2].

This collaboration resulted in the following key findings:

- Interoperability in IoT opens potential to use shared economy services and further advance optimization of resources utilisation and consumption with potential release of vendor locks;
- Data ownership questions are on the forefront of the stakeholders' minds;
- Consumers are concerned about potential loss of privacy and security risks, high complexity of service and technology intrusion into their daily life.

Moreover, the IoT market will be likely influenced by new major EU legislative changes and proposals in the past year, such as the European Commissions' Winter Package, the European Performance of Building Directive, the Energy Efficiency Directive, the Eco-Design Working Plan, the Renewable Energy Directive, the Electricity Directive, Electricity Regulation, and ACER Regulation, the Single Digital Market and the General Data Protection Regulation (GDPR).

Stakeholders' drivers & barriers, operational requirements of demonstration sites together with EU legislative changes and proposals formed basis for business requirement context in which set of high-level user requirements for IoT interoperability of ubiquitous applications, services and other smart objects were identified (see Table 1: Business Requirement Context). It spans between economics driven requirements, drive for new services provision on one hand and by compliance needs and response towards on-going disruptions in industry and public sector.

[1] D1.2 – "Report on business drivers and barriers of IoT interoperability and value added services"

[2] D1.3 – "Report on pilot sites and operational requirements"

Economics Driven	New Services	Compliance	Disruption in Industry
Renewable energy production is undergoing fundamental changes due to decentralization and smart technologies adaption	New services to existing clients	Digital Single Market	Digitizing Energy Industry
Energy efficiency performance drivers	New services to citizens	EE targets for 2020 for buildings	New business models proliferation for energy, assisted living and transport industries coupled with ways to provide services
Sharing economy, by leveraging local resource towards the community	Digitizing municipal services and involving citizens in co-creation	Winter package targets on regional and country levels	Municipal focus on assets management
Reduction in OPEX for energy generation, linking production and consumption and optimizing efficiency	Creating seamless integration between various agents in services provision	Mandatory Energy Audits	Proliferation of new smart devices
Cost reduction of services provision towards wider and growing segments (assisted living)	Substitution of costly tasks with value added activities	Privacy and security compliance	New telecom capacity for seamless data transmission

Table 1: Business Requirement Context

These requirements can be summarised in the following key findings:

- Advances in shared economy services and further optimisation of resources utilisation and consumption shall be supported through means of; potential trade of energy between buildings and grid owners, potential trade of space between buildings and parking owners, potential working market for space and energy storage, to measure space and energy load dynamically, to share data across digital services for value realisation, to support management and visualise intermittent energy sources;
- Interoperability to ease complexity, release vendor lock-ins and support data ownership are expected through flexible communication systems and information architecture to handle heterogeneity of current and future technical developments; transparent, secure and privacy-preserving information sharing with surrounding IoT devices, systems and services; adopting and adhere of traffic and health data standards;
- New business models shall be identified to optimise maintenance costs (such as energy peak management, parking space occupancy optimization, building energy efficiency), monetise excessive resources (such as possible trading of produced energy, energy storage or empty parking spaces) or improve quality of service and environment (such as elderly citizen supervision, indoor and outdoor climate monitoring);

- User experience need to be adapted to a variety of users with different abilities and capabilities, which differs between user groups in terms of complexity and price of devices and services
- Secure and privacy-preserving infrastructure when exchanging data (especially people's behaviour) in buildings, energy, transport and eHealth, through security policy of VICINITY and connected infrastructures; transparent auditable information sharing management; end-to-end data encryption; identification of data sources and smart objects behaviour; private data access based on data owners' consents.

The business requirements conclude the VICINITY Objective 1.2 "IoT interoperability requirements and barriers are elicited, captured and analysed as principal drivers of the VICINITY research activities". The results of Objective 1.2 support mostly the following VICINITY Objectives:

- Objective 1.3 "VICINITY research results are evaluated with stakeholders" will use business requirements as basis of VICINITY research results evaluation;
- Objective 1.4 "Exploitation business cases are elaborated and exploitation channels identified" will be shaped by business needs, expectations and constraints for validation of business case towards potential VICINITY customers;
- Objective 2.4 "VICINITY Technical requirements and solution architecture specified" will use business requirements as key input to identify VICINITY features[3] and solution architecture[4] to be able to support unlocked business drives and overcome existing barriers;
- Objective 5 "Value-added services explored and demonstrated" will be supported in exploration of potential new business models used to identify divers service across IoT domain with commercial benefit mind-set.

[3] D1.5 – "VICINITY functional and technical requirements specification"

[4] D1.6 – "VICINITY architectural design"

2. Introduction

This deliverable provides high-level business requirements specification resulting from Task 1.3 – Platform User and Business Requirement Definition including:

- High level domain related business requirements for IoT interoperability, ubiquitous applications, services and other smart objects based on results of deliverables of Tasks 1.1 - Elicitation of user requirements and barriers related to IoT interoperability and Tasks 1.2 - Pilot Sites Surveys and extraction of Use Case requirements;
- Set of common business requirements (such as usability, implementation, security, privacy, legal requirements).

This document is prepared as a starting point for business audience to understand the basic concepts of the VICINITY solution.

The IoT paradigm and standards landscape is large and complex, and while the technology is still evolving, the adaption of standards is still immature. Interoperability is a key element, and ensures cooperation between the different domains. It is in this context that VICINITY may bridge the gap between domains by placing the ontology outside the physical domain (see task 2.1).

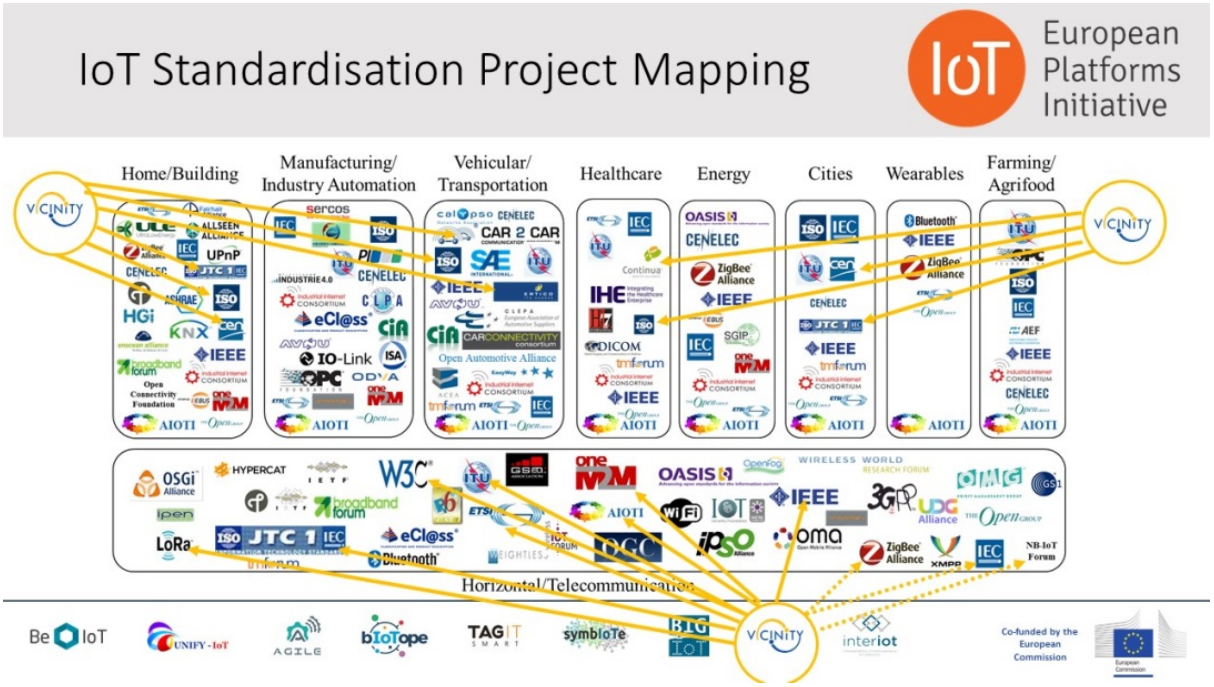


Figure 1: VICINITY bridging the gap of complexity in the IoT standardisation landscape

The following documents will further develop the requirements presented in this document:

- D1.5 VICINITY functional and technical requirements specification – to identify main VICINITY functional features;
- D1.6 VICINITY architectural design – to shape the VICNITY architecture;
- D2.2 Semantic interfaces – to shape the VICNITY Ontology;
- D5.1 VICINITY value-added services definition requirements and architectural design – to define value –added services demonstrated in VICINITY project.

- D9.12 VICINITY exploitation business plan – to include relevant business motivations and inhibitors in business plans.

The following tasks' relevant deliverables are used to extract business requirements specification:

- Task 1.1 – Elicitation of user requirements and barriers related to IoT interoperability:
  - D1.1 VICINITY requirement capture framework – provides methodology to manage business requirements within VICINITY;
  - D1.2 Report on business drivers and barriers of IoT interoperability and value added services – used to identify business requirements from stakeholders;
- Task 1.2 – Pilot Sites Surveys and extraction of Use Case requirements:
  - D1.3 Report on pilot sites and operational requirements – used to identify pilot site related business requirements;
- Task 2.1 – Analysis of available platforms, IoT infrastructures, IoT ontologies and standards:
  - D2.1 Analysis of Standardisation Context and Recommendations for Standards Involvement – mainly to follow security, privacy and ontology standards and legal constraints (Figure 1: VICINITY bridging the gap of complexity in the IoT standardisation);
- Task 9.1 – VICINITY Dissemination, Communication and Data Management Plan:
  - D9.2 Data management plan – lays out a number of premises for VICINITY's take on security and privacy, with references to standards, legislations, ethics.

The business requirements in this document are organised as follows:

- Chapter 2 provides a brief descriptive introduction and background to this report
- Chapter 3 describes the methodology adopted for gathering relevant issues
- Chapter 4 formulates the business requirements for VICINITY- based on the findings in chapter 3.

These requirements cover domains represented in VICINITY, including common business requirements which were identified as relevant.

3. Approach

This chapter describes the approach taken to define the business requirements specification as part of the over-all VICINITY requirement life cycle defined in the Deliverable D1.1: "VICINITY requirement capture framework".

3.1. Methodology

Requirement management process facilitates elicitation of stakeholders' expectation through requirements definition, technical specification and architecture design followed by the detailed design, implementation and validation phase. The business requirements establish consistent base-line stakeholders' expectation reflecting realistic real-world needs. The business requirements provide basis for solution validation.

The business requirements specification process[5] has been tailored to the needs in VICINITY as described in D1.1 and detailed for business requirements in this section.

The VICINITY Business requirement specifications consolidate the following inputs from different deliverables:

- Stakeholders drivers and barriers from D1.2;
- Operational and interface requirements from D1.3;
- IoT platforms, infrastructures, ontologies and relevant standards from D2.1;
- Requirement management methodology from D1.1.

The business requirements specifications serve as further input for:

- Technical requirement specification;
- Architecture design;
- Value-added service specification;
- Exploitation and dissemination plan.
- Figure 2 outlines the relationship of Business requirements to other requirements and deliverables in VICINITY.

[5] ISO/IEC/IEEE 29148 Systems and software engineering - Life cycle processes - Requirements engineering

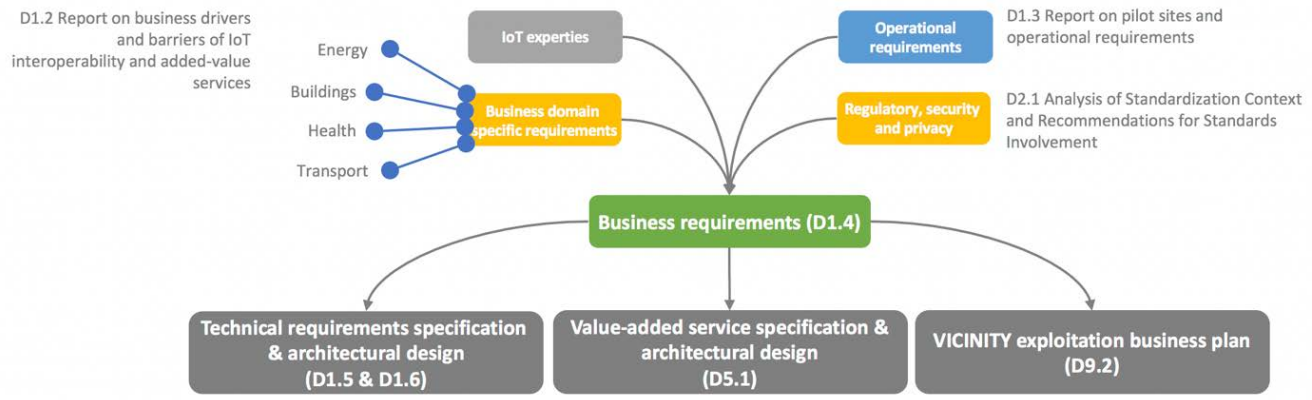


Figure 2 Relation of business requirements specification with other type of requirements

From the collected inputs the business requirements are extracted per each vertical domain (Figure 4). All business requirements for each vertical domain as described in section 4.1, 4.2, 4.3 and 4.4, are consolidated and sorted. Moreover, common business requirements are identified and clustered in separated horizontal fields, as described in section 4.5.

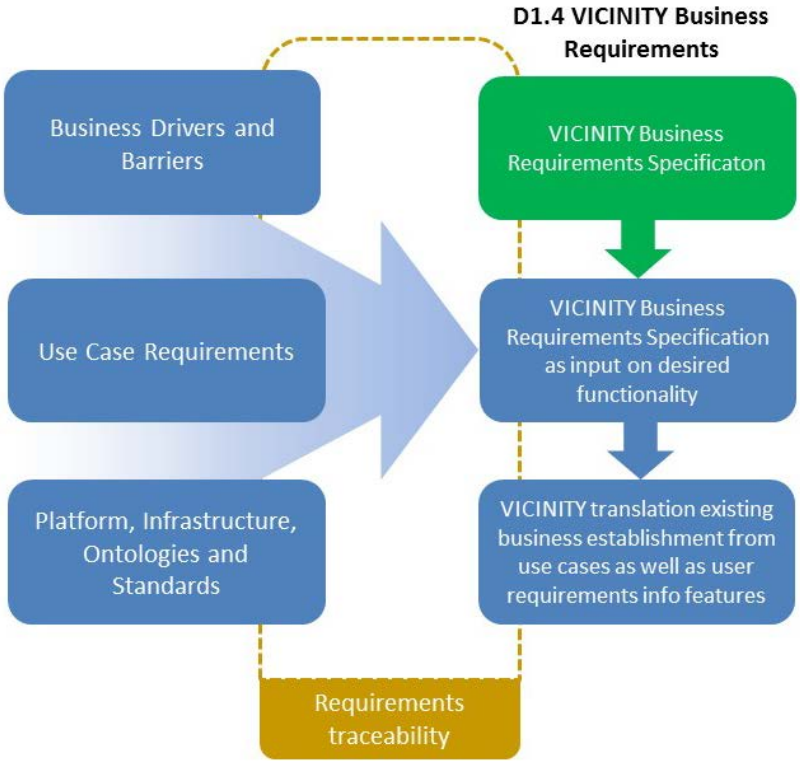


Figure 3 Relation upper level requirements and business requirements

The business requirements will be transformed into technical requirement specification and architectural design, which drives the whole VICINITY solution definition and subsequent implementation.

3.2. Business requirement identifiers and traceability

Every requirement of business requirements specification is identified by its unique identifier according to the following table:

Requirement group	Requirement identifier
Building domain requirements	VICINITY-BR-BLD010
Energy domain requirements	VICINITY-BR-ENR010
Transport domain requirements	VICINITY-BR-TRA010
Health domain requirements	VICINITY-BR-HLT010
Usability requirements	VICINITY-BR-USR010
Implementation requirements	VICINITY-BR-IMP010
Legal & Ethics requirements	VICINITY-BR-LEG010
Security objectives and threats	VICINITY-BR-SEC010

Table 2: List of requirements groups

3.3. System modelling

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 4: VICINITY requirement structuring process.

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 as previously described in section 3.1. Either way, problems and errors can be identified early in the design process. A new iteration starts, of which the results are reexamined. The same happens if during the lifetime of the VICINITY projects, some of the requirements will change.

Not only does this allow validating 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.

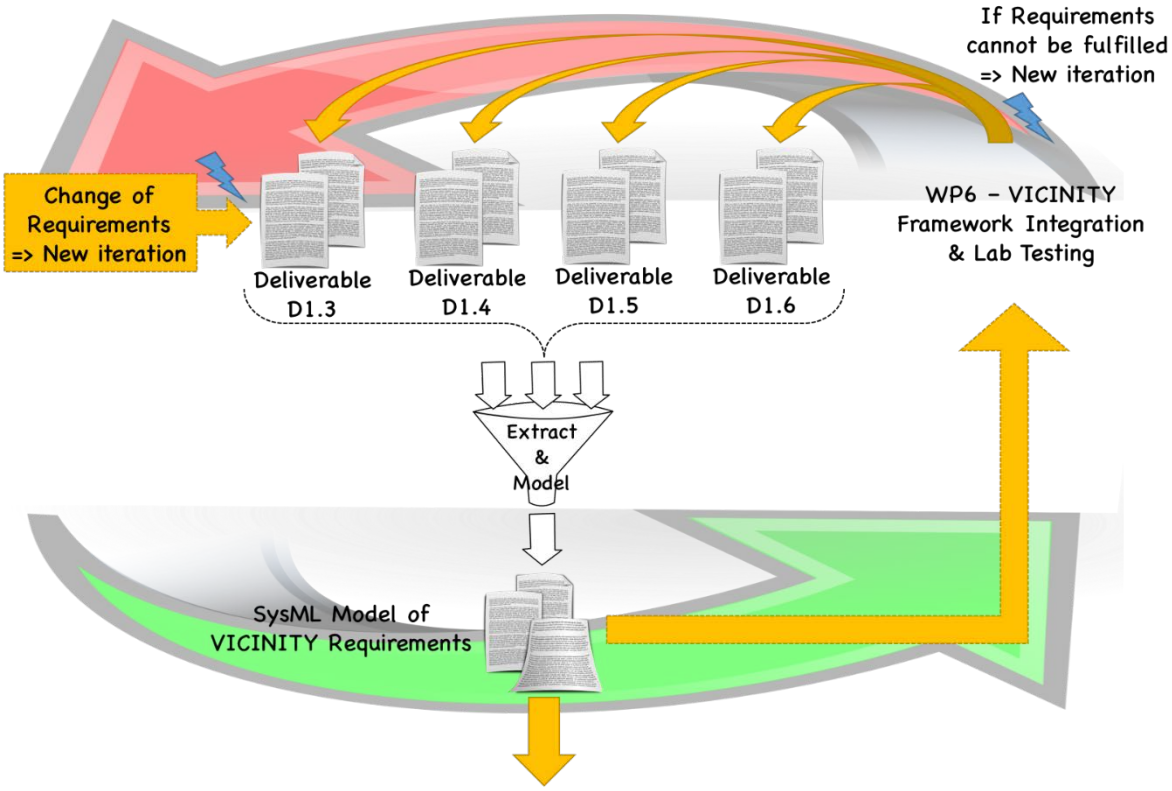


Figure 4: VICINITY requirement structuring process

3.4. Business requirements template

The business requirements will be included in Chapter 4 of this deliverable using the following requirement template including requirement title, requirement description, list of considered requirements, barriers and drivers and references to use cases:

VICINITY-REQ-0010	<Requirement title>
<Optional affected use case>	
<Requirement description>	
Considered requirements:	
<List of considered requirements, barriers and drivers numbers>	

Table 3: Table template for business requirements design for the reference purposes

4. VICINITY business requirements specification

The Business Requirements Specification (BRS) describes VICINITY consortium's motivation for why the system is being developed, defines processes and policies/rules under which the system will be used and documents the high-level requirements from the stakeholder perspective. In a business environment, the BRS describes how the organisation is pursuing new business in order to fit a new business environment for VICINITY, and how to utilize the system as a means to contribute to the business.

The description includes:

- **At the organisation level;**
  the organisational environment, goals and objectives, the business model, and the information environment
- **At the business operational level;**
  the business operation model, business operation modes, business operational quality, organisational formation, and concept of the proposed system in VICINITY.

The VICINITY business requirements specification is divided into four domains:

- Building domain;
- Energy domain;
- Transport domain;
- Health domain.

Figure 5 Pilots Domains

Each pilot has one or more domain focus - and hence differentiated business requirements. The resulting domain overlaps, and the cross-relevance are portrayed in the VENN-diagrams presented in Figure 6.

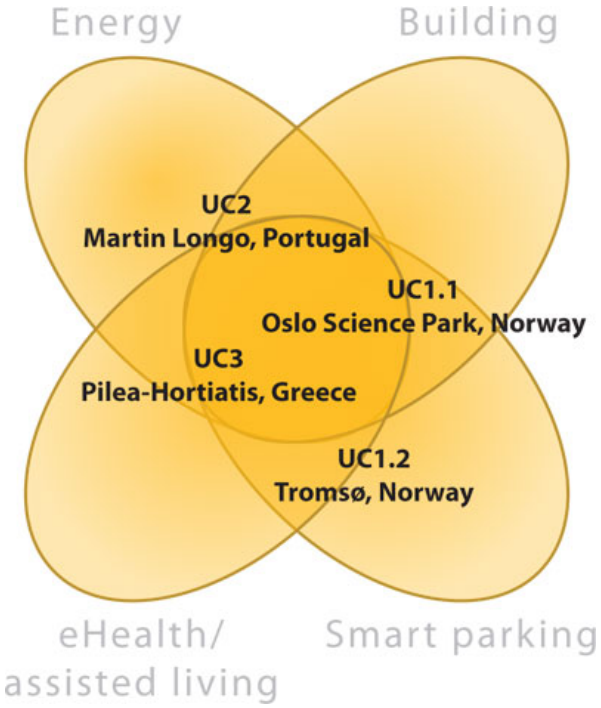
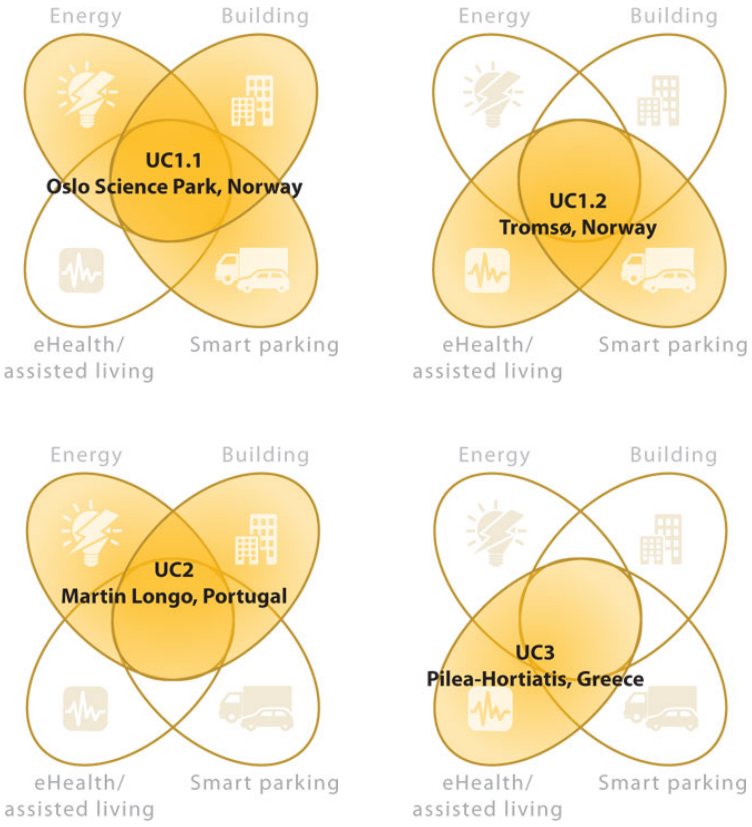


Figure 6: Level of influence by use case in building, energy, transport and health domain.

More specifically – the domains affected by the different use cases can be summarised like this:



Moreover, common requirements have been extracted from these domains and clustered into following topics:

- Usability requirements;
- Implementation requirements;
- Security requirements;
- Privacy requirements;
- Legal & ethics requirements.

The business requirements specification is summarized in the following high-level requirements:

VICINITY-BR-010	**Market for sharing and load balance**
Common assets in a neighbourhood need to be understood in order to identify the value of the assets. When capacity is high and need is low, the price for sharing is normally low. When capacity is low and need is high, the prices for sharing will be high. For addressing market value for limited assets, the following policies needs to be taken in to account: • Trade of energy between buildings and grid owners; • Trade of space between buildings and parking owners; • Working market for space and energy storage; • Tools to measure space and energy load dynamically; • Sharing of data across digital services for value realisation; • Management and visualise intermittent energy sources; • Synergies with other building systems (e.g. water management); • Structural plans for garage facility; • Cost-benefit, effective devices need to be selected;	
Considered requirements:	
VICINITY-BR-BLD010, VICINITY-BR-BLD020, VICINITY-BR-BLD030, VICINITY-BR-ENR020, VICINITY-BR-ENR021, VICINITY-BR-ENR031, VICINITY-BR-TRA070, VICINITY-BR-HLT020	

VICINITY-BR-020	Privacy-enabled infrastructure

When collecting and storing data regarding people's behaviour in buildings, energy, transport and eHealth common rules and regulations have to be followed:

- Security policy of VICINITY and connected infrastructures;
- Mitigate potential threats from breaching security objectives by security measures for acceptable risk;
- Behaviour influence on use of energy resources;
- Ownership to data and data management;
- Data protection against unsolicited access or operations;
- Consider the principle of data protection reform in Regulation 2016/679;
- Legislation need to adopt new demands;
- New kind of contracts need to be prepared for users and authorised third parties;
- Access control and accountability for own actions needs to be integrated in specifications;
- Audit management needs to be adopted and adhered for legitimate actors;

Considered requirements:

VICINITY-BR-BLD040, VICINITY-BR-ENR40, VICINITY-BR-ENR50, VICINITY-BR-ENR070, VICINITY-BR-TRA010, VICINITY-BR-TRA020, VICINITY-BR-TRA050, VICINITY-BR-HLT030, VICINITY-BR-HLT040, VICINITY-BR-LEG010, VICINITY-BR-SEC010, VICINITY-BR-SEC020, VICINITY-BR-SEC030, VICINITY-BR-SEC040, VICINITY-BR-SEC050, VICINITY-BR-SEC060

VICINITY-BR-030	User experience need to be adapted to a variety of users with different capabilities

When collecting demands from user groups experience from users and knowledge-based assignment need to be adhered for representative user groups in the neighbourhood:

- Adhere to visual standards and guidelines to allow for integration with systems;
- Include usability standards in the design process;
- Integrate safety precautions in the interface design;
- Consider technical limitations when creating user experience;
- Design for privacy by keeping personal information hidden;
- Design for impact and marketability;
- Take social engineering into account;
- Logistics perspective needs to be included;
- Affected user groups need to be involved;

Considered requirements:

VICINITY-BR-TRA060, VICINITY-BR-TRA080, VICINITY-BR-HLT010

VICINITY-BR-040	Interoperability to ease complexity

A modern neighbourhood is equipped with a complex range of technical systems. Needs to be taken into account are:

- Flexible communication systems and information architecture to handle heterogeneity of current and future technical developments
- Share building data;
- Novel data-driven cross-domain B2B and B2C energy services;
- Hybrid fully-automated demand-response systems;
- Transparency needs in granting access to service providers;
- Standards for traffic data need to be adhered as well as role of European standards in order to replicate and exploit further installations;
- Standards for health data need to be adopted and adhered;
- Different data sources to provide input;
- Interoperable with city IoT infrastructures, like LoRaWAN and NB-IoT.

Considered requirements:

VICINITY-BR-BLD050, VICINITY-BR-BLD060, VICINITY-BR-ENR010, VICINITY-BR-ENR030, VICINITY-BR-032, VICINITY-BR-ENR060, VICINITY-BR-TRA040, VICINITY-BR-TRA090, VICINITY-BR-TRA100, VICINITY-BR-TRA110, VICINITY-BR-HLT050

VICINITY-BR-050	New business models for collaborative value creation

For neighbourhood management as a new service the following needs to be taken into account:

- Dynamic data streams and IoT based tools to make management simpler and more cost efficient;
- Share building data;
- Optimise sizing, monitoring of space and energy consumption;
- New rental models for sharing of assets need to be prepared;
- Standard process for emergency cases need to be adopted and adhered;
- Standard applications and business models used in telecom IoT infrastructures.

Considered requirements:

VICINITY-BR-BLD070, VICINITY-BR-BLD080, VICINITY-BR-ENR010, VICINITY-BR-TRA030

4.1. Building domain Requirements

Buildings are some of the most expensive assets to operate and maintain used in our cities and urban centres. It was found that building owners and managers see economic value through a potential improvement in efficient usage of resources and optimization of building maintenance as facilitated by IoT and VICINITY. Building efficiency includes not only how and when the resources are used but also how many users need the same resource within the buildings neighbourhood.

A recently conducted study [16] in collaboration with Statsbygg, the Norwegian State Property owner, reports that a standard university building has an average energy cost optimization potential of about 15 – 20 % of the total energy cost. However, a lack of visualisation of consumption of resources and lack of accountability prevents these savings to be made. IoT gives the property-owner a high-resolution multichannel information-window, making possible to optimise the use of considerable resources inside the building as well as between buildings (cross assets) within a neighbourhood both virtually and physically.

VICINITY-BR-BLD010	**Market for load management**
As grids reach maximum use capacity or reach its exploitation limit, the importance of load management increases. To be able to trade between buildings and grid owners, working markets with load pricing, as well as load shedding and shifting prices must be in place.	
Considered requirements:	
VICINITY-B&D-BLD01	

VICINITY-BR-BLD020	**Interoperable load management**
Facility managers and grid owners should support to interoperability between various IoT assets (i.e. load flexibility and constraints) that are needed for load management across various building (e.g. devices, charging station) and energy assets (such as RES, batteries,), to be able to trade loads in practice.	
Considered requirements:	
VICINITY-B&D-BLD01	

VICINITY-BR-BLD030	Data integration for cross-domain synergies

Facility management should be able to share data across digital services and activities for value realisation, thus data integration and interpretation across semantic domains are needed, such as:

- Building domain: temperature, humidity, luminescence, noise, movement, building performance,
- Energy domain: energy consumption, weather forecast, energy flexibility, load and peak management,
- Transport: parking space occupancy, parking space prices payments.

Considered requirements:

VICINITY-B&D-BLD02

VICINITY-BR-BLD040	Monitoring behaviour and intrusion of privacy

Collecting and storing data related to people's behaviour in buildings should be governed by transparent contracts and happen in accordance with relevant rules and regulations. Encryption and/or aggregation of data to protect identities where relevant.

Potential rules and regulations:

- lTU-T Security in Telecommunications and Information Technology: An overview of issues and the deployment of existing ITU-T Recommendations for secure telecommunications;
- ITU-T Recommendation E.408: Telecommunication networks security requirements;
- EN 61508 Functional safety;
- ISO 9160 Data encipherment -- Physical layer interoperability requirements;
- IEEE 802.11 Security of wireless communication networks;
- IETF RFC 2818 HTTP Over TLS;
- EC Regulation 2016/679.

Considered requirements:

VICINITY-B&D-BLD03

VICINITY-BR-BLD050	Openness to deal with complexity

A modern building is usually equipped with a vast and complex range of technical system. A communication flexibility and information architecture that can handle the speed and heterogeneity of current and future technical developments is needed.

Considered requirements:

VICINITY-B&D-BLD04

VICINITY-BR-BLD060	Incentives to share building data
The managers need incentives to share data from buildings, parking spaces, local grids, such as reduced peak loads, rent on parking spaces or sales of locally produced energy.	
Considered requirements:	
VICINITY-B&D-BLD05	

VICINITY-BR-BLD070	Expected impact
Availability of IoT based tools with simple management will change how facility management as a service can be delivered. Dynamic systems, flexible to interconnect or extended various services and devices together, are expected to replace legacy systems.	
Considered requirements:	
VICINITY-B&D-BLD07	

VICINITY-BR-BLD080	New business models
IoT technology provides opportunities to obtain a new basis for digital data in the building industry. This basis gives us completely new opportunities for monitoring, classification, analysis of the use and performance of a building and thus new opportunities for control and management. Access to such data will change many of the existing business models and will push forward many new models and new types of services.	
Considered requirements:	
VICINITY-B&D-BLD05	

VICINITY-BR-BLD090	Indoor environment quality (temperature, humidity, CO2, sound and light)
Facility owners, tenants, building managers should be supported in measurement and visualisation of the interior conditions and parameters to understand the resources consumption and their effects on wellbeing.	
Considered requirements:	
VICINITY-OR001, VICINITY-OR015	

VICINITY-BR-BLD100	Resource usage and occupancy
The facility owner, tenants and building managers should be supported in measurement the resource usage and / or occupancy to optimise resource maintenance or identify situations required manual or automatic intervention.	
Considered requirements:	
VICINITY-OR005	

VICINITY-BR-BLD120	Energy consumption monitoring
Aggregated energy consumption patterns of equipment usage can be offered to the building owners and managers, providing an opportunity to understand the impact of EV charging within a building and manage the process in an economic way avoiding peak consumption.	
Considered requirements:	
VICINITY- OR007	

VICINITY-BR-BLD130	Oven and Fridge usage monitoring
The service providers should have access to devices utilisations to be able to customise the device operation and maintenance leading towards “appliances as a service model”.	
Considered requirements:	
VICINITY-OR018	

VICINITY-BR-BLD140	Energy consuming equipment, resource consumption and CO_2 equivalent measurements
The facility owners, managers and tenants should have access to information of activities and resource consumption in order to identify and optimise the buildings operative parameters.	
Considered requirements:	
VICINITY-OR034	

VICINITY-BR-BLD150	Improve common areas cleaning operations
The facility owners, managers and tenants should have access to an overview of registered activities and resource consumption, in order to identify areas in actual need of cleaning, thus reduce the energy consumption and minimise the wear on other parts of the building.	
Considered requirements:	

VICINITY-OR037

4.2. Energy domain Requirements

The Energy sector has a high strategical value and there are high expectations as to potential impact of the IoT within the industry as a whole.

IoT overall and VICINITY as one of the particular solutions is expected to help in achieving RES energy penetration targets, energy efficiency goals and decarbonisation of economies on the high level, while increasing visibility of processes and improving quality of data resulting in higher quality of services.

The Energy ecosystem approach on the municipal level adapted by VICINITY is expected to facilitate data sharing and visualisation of impact on various stakeholder entities.

VICINITY-BR-ENR010	***Novel data-driven cross domain B2B and B2C energy services***
Continuous energy consumption monitoring and control should be supported by interoperability across standards and vendors of the connected devices. Energy consumption systems should addresses functionality that extends beyond energy load balancing during peak periods (periods with high energy consumption). The need for continuous monitoring through system analysis and integration in the building environment should also contribute to the data analysis. Such services would open for B2B solutions and a B2C spectrum of services where a common platform could support the increasing in level of services driven by similar logic and approach.	
Considered requirements:	
VICINITY-B&D-ENR01	

VICINITY-BR-ENR020	***Managing energy sources across standards and vendors of the connected appliances***
Management energy source across different standards and appliances' vendors enables management of various sources of production (electricity and heat) and sinks (consumption/ uses of energy) to meet demand as smoothly and sustainably as possible. Management of energy sources should be supported by interoperability across standards and vendors of the connected devices.	
Considered requirements:	
VICINITY-B&D-ENR01	

VICINITY-BR-ENR021	*Visualise intermittent energy sources*
Establishing and visualising the process of managing a wide range of occasionally used supplies and sinks enables create new business opportunities and add flexibility to the use of electricity. Management of intermittent supplies and sinks should be supported by interoperability across standards and vendors of the connected devices.	
Considered requirements:	
VICINITY-B&D-ENR02	

VICINITY-BR-ENR030	*IoT solutions as building blocks of demand response systems*
Create Interoperable and secure IoT systems to facilitate and form the building blocks of supply and demand management systems, including: in-home communication between smart appliances and energy management systems; and integration to grid operators as well as auxiliary service providers.	
Considered requirements:	
VICINITY-B&D-ENR03	

VICINITY-BR-ENR031	*Synergies with building*
The Synergies with other systems in buildings should also be incorporated in the energy management system (e.g. water). Many resources provided within a building consume electricity in addition to the appliances and other devises. Interdependencies of one resource consumption and the impact on the other resource are not well understood. Increasing interoperability in consolidating this information is expected to create positive synergies.	
Considered requirements:	
VICINITY-B&D-ENR03	

VICINITY-BR-ENR032	*Hybrid fully-automated demand response systems*
Consumers with a B2C relationship will need “a system which should learn the user's preferences and optimize automatically without the need of user interaction.” To achieve this, hybrid fully-automated systems enabled by IoT solutions should be designed, demonstrated and tested.	
Considered requirements:	
VICINITY-B&D-ENR03	

VICINITY-BR-ENR040	*Behaviour influence on use of energy resources*
Engaging consumers in both sectors, businesses and households to manage, produce and store energy and other available resources. Energy efficiency gains should be visualised.	
Considered requirements:	
VICINITY-B&D-ENR04	

VICINITY-BR-ENR050	*Data ownership, data management*
Ownership of data and information about ownership, access, and other related information about the device, should be made available for improved data management and transparency when installed. The data in question could be e.g. heartbeats, value, volt detection, device ID code, registered ownership, placement etc.	
Considered requirements:	
VICINITY-B&D-ENR05	

VICINITY-BR-ENR060	*Transparency needs in granting access to service providers*
Energy consumers would be anticipating potential economic gains, while transitioning from passive to active energy monitoring. This also increases energy efficiency, because with advice the users might achieve a better rational use of energy, benchmark designed performance and actual performance of systems. They are willing to give data access to service suppliers and intermediaries but have concerns as to: their privacy, level of data protection that can be guaranteed and the security of their data. Energy consumers should provide access to data in secure and privacy-preserving way.	
Considered requirements:	
VICINITY-B&D-ENR06	

VICINITY-BR-ENR070	**Solar Thermal energy production/consumption monitoring**
The facility owners and managers should be supported in monitoring of energy production/ consumption and facility resource occupancy and/or utilization and heat production over various devices in order to be able to improve the understanding of production, consumption and utilization and provide an opportunity to optimize billing for renters.	
Considered requirements:	
VICINITY-OR006, VICINITY-OR008	

VICINITY-BR-ENR080	Energy and Water consumption monitoring
The facility owners, managers and tenants should be supported to measure, cluster and visualise of the energy and water consumption of devices to provide an opportunity to do assessment of alternative models of management reduce resource consumption and systems substitution decision making.	
Considered requirements:	
VICINITY-OR002	

VICINITY-BR-ENR090	Weather Conditions for energy producers
The data owners should be supported to share available weather data to energy producers from scientific equipment providing them an opportunity to optimise their renewable energy production.	
Considered requirements:	
VICINITY-OR004	

VICINITY-BR-ENR100	EV Charging Booking App
EV charging enabled parking place may be booked by facility owners, thus offering the ability to manage energy production and consumption (demand-response) as well as EV charging utilization to facility owners and/or managers, to identify smooth positive and negative peaks in the electrical energy consumption of buildings taking into account energy price, parking place occupancy plan and price. The facility owners should be supported in optimization of parking space, EV Charing utilization and management of energy production and consumption.	
Considered requirements:	
VICINITY-OR009, VICINITY-OR010, VICINITY-OR011, VICINITY-OR012	

VICINITY-BR-ENR110	Oven and Fridge usage monitoring
The household owners should be supported with information on resource consumptions and demand response services providing them opportunity to improve energy efficiency of their households and/or improve usage of excess renewable energy.	
Considered requirements:	
VICINITY-OR017, VICINITY-OR024, VICINITY-OR029	

VICINITY-BR-ENR120	Solar Panels Soiling monitoring
Plans for solar panel cleaning based on condition of soiling as opposed to periodic cleaning, could be offered by solar panel operators in order to improve panels' quality of service and reduce costs for cleaning. Solar panel operators should be supported in soiling monitoring.	
Considered requirements:	
VICINITY-OR026, VICINITY-OR028	

VICINITY-BR-ENR130	Energy consuming equipment, use of facilities patterns by tenants
Facility owners, manager and tenants should be supported to benchmark progress/compliance towards reaching energy efficiency targets with and without energy audits.	
Considered requirements:	
VICINITY-OR035	

Sharing more data via VICINITY would increase the visibility of processes and enhance data quality resulting in better quality of services which might lead to higher financial returns in a medium to long term period. Knowledge sharing at municipal level as well as increased competitiveness through deployment of new systems are positive drivers for early adopters. A lack of internal resources, lack of commitment from the management, and regulatory compliance issues complicates this further, such that data protection and security by design will be a key driver.

4.3. Transport domain Requirements

The transport sector is recognised by a large amount cross-domain technologies and standards within fields such as road side technologies, car-to-car communication, car-to-road communication, tunnel technology, smart traffic light, smart signs etc. The transport sector covers all means of logistics, being on the ground, rail, at sea or by air. This is commonly part of ITS (Intelligent Transport System). Solutions that offer a foundation for exchanging information between systems, opens for many opportunities. Transportation technology can be considered the life blood of smart cities, as areas that suffer from pressure on the infrastructure reduce green areas, residents' quality of life and financial status of the affected areas. It is in this context that VICINITY focus on smart parking technology for demonstration purposes.

Smart parking is based on optimising the usage of areas in and around the parking facility. Not just based on available space, but also on specifications that ranges from particular needs and demands to scheduling, environmental considerations, accessibility, security/privacy issues to available services. For a more in-depth analysis and descriptions, see Annex II: Transport – market and demands. Further descriptions of requirements for the transport domains are listed below.

VICINITY-BR-TRA010	**Abide to legislation**
Parking sites should abide to legislation for ownership models, income from rental, privacy[6] and security[7] agreements regarding access and authorisation to indoor parking sites[8].	
Considered requirements:	
VICINITY-B&D- TRN05, VICINITY-B&D-TRN06	

VICINITY-BR-TRA020	**New kind of contracts need to be prepared**
Contracts that define responsibilities for ownership of parking space, access and personal data should be defined.	
Considered requirements:	
VICINITY-B&D- TRN05, VICINITY-B&D-TRN06	

[6] EC Regulation 2016/679, EU's Data Protection Directive 95/46/EC, Regulation 45/2001/EC, EU Council Decision 2008/615/JHA

[7] ITU-T Recommendation E.408

[8] Directive 2010/40/EU

VICINITY-BR-TRA030	New rental models need to be prepared
Transaction and rental models should be introduced for long term, short time, subscription based and contract based usage.	
Considered requirements:	
VICINITY-B&D-TRN01, VICINITY-B&D-TRN03	

VICINITY-BR-TRA040	Standards for traffic data need to be adhered
Agreements should adhere to standards [9]used for exchanging (semantic) data with ITS equipment, traffic control centrals, nearby vehicles, and digital signs.	
Considered requirements:	
VICINITY-B&D-TRN02, VICINITY-B&D-TRN06	

VICINITY-BR-TRA041	Supporting European standards and communication protocols
Support for standardised communication protocols used for smart parking and relevant equipment needs to be anchored on a contractual level. The European standard DATEX II should be the preferred choice. The common rules in the field of data provision and publication are based on this standard, and it is the basics for public procurement and apply for all smart parking detection technologies, payment terminal and other transactions, traffic information and control centres data work.	
Considered requirements:	
VICINITY-B&D-TRN01, VICINITY-B&D-TRN02, VICINITY-B&D-TRN06	

VICINITY-BR-TRA042	Privacy and security settings must be implemented
The encryption and storage of data, should adhere to EU's Data Protection Directive 95/46/EC2 as well as national legislation. This includes anonymising person data and other information that can identify an individual.	
Considered requirements:	
VICINITY-B&D-TRN02, VICINITY-B&D-TRN06	

[9] CEN TC278, ISO/TC204 and all related standards, with special attention to C-ITS, including ETSI TC ITS.

VICINITY-BR-TRA043	Integration with other transport related sectors
Integration with other transport related sectors – most notably car sharing and public transport should also be supported in order to establish the foundation for a healthy ecosystem, and also alleviate some of the pressure on the infrastructure, thereby reducing the climate footprint.	
Considered requirements:	
VICINITY-B&D-TRN02, VICINITY-B&D-TRN06	

VICINITY-BR-TRA044	Support datasets with information about EV charging stations
Support and access to updated information on available EV charging stations with technical information, current status and availability, should be supported.	
Considered requirements:	
VICINITY-B&D-TRN02, VICINITY-B&D-TRN06	

VICINITY-BR-TRA050	Access control need to be integrated in specifications
Different ways of getting access – in particular to underground garage facilities – should be defined. This would include authorisation equipment and systems like camera systems for reading licence plates, car based sensor, card reader, RFID, Bluetooth, geo fencing and biometric systems. Other reader/detection units might be integrated when deemed necessary.	
Considered requirements:	
VICINITY-B&D-TRN04, VICINITY-B&D-TRN05, VICINITY-B&D-TRN06	

VICINITY-BR-TRA060	User experience should be adapted to a variety of users with different backgrounds and capabilities
Demands on user experience design should be an integral part of the solution. This should address devices and accessibility, in particular with an emphasis on supporting unified design. Certain disabilities and lack of previous experience might affect the usability aspect. Especially users on that handles the parking experience on small devices need to be receive specific attention, as there is little or no time for training, and the systems will be based on a on-demand approach. This is even more important when the mobile devices will offer interaction with 3rd party services that will be built on top of the parking experience. User experience should be continuously measured and evaluated by UX designers through anonymous tracking of user navigation on the panel.	
Considered requirements:	
VICINITY-B&D-TRN01	

VICINITY-BR-TRA070	Structural plans for garage facility
Access to and visualisation of structural plans/layout for garage facilities should be included in the administrative system. This includes an overview of the building complex/landscape with information about access points, charging stations, fire extinguishers, escape exists, alarm signals as this is necessary in order to provide a proper service that can be implemented and expanded on a longer term.	
Considered requirements:	
VICINITY-B&D-TRN01, VICINITY-B&D-TRN02, VICINITY-B&D-TRN05	

VICINITY-BR-TRA080	Logistics perspective needs to be included
The transport domain contains challenges within areas such as logistics (e.g. assignment, allocation, optimising routes, history). Transportation does also include such topics as authorisation/ authentication/access, integration of other services and visualisation of complex information. This means that proper knowledge of priorities, special requirements for vehicles and users, historical data and ownership of transport related equipment and services will be one of many parameters that will influence logistics and other outcomes from the transport related issues. Therefore, Interoperability on these areas including other value added services should be supported.	
Considered requirements:	
VICINITY-B&D-TRN05, VICINITY-B&D-TRN06	

VICINITY-BR-TRA090	Different data sources to provide input
Interoperability on rulesets that support actions based on changing values and their relevance to the transport domain should be supported. This includes data from manual booking, trigger mechanisms based on rulesets integrated with other domains (i.e. eHealth and building), request from technical or health care personnel, ground based sensors and visual data from other sources.	
Considered requirements:	
VICINITY-B&D-TRN02, VICINITY-B&D-TRN03, VICINITY-B&D-TRN05	

VICINITY-BR-TRA100	Unified descriptors create opportunities for replicating and scaling up the installations
The Technical Specification standard CEN 16157-6:2013, Annex D (Data Dictionary), describes DATEX II data exchange specifications for traffic management and information, of which part 6 deals with Parking publication. Standardisation of DATEX II establish a basis for common exchange between the traffic and the travel information sector, thus opening for cross-domain value-added services. This standard serves for setting out the rules for parking management and should be part of the common framework for handling smart parking related activities.	
Considered requirements:	
VICINITY-B&D-TRN01, VICINITY-B&DTRN02, VICINITY-B&D-TRN06	

VICINITY-BR-TRA110	Camera and Light sensor for number plate recognition
Camera with Automatic Licence Plate (ALR) detection and reading capabilities affect authentication and authorisation processes, and is part of the entrance security system. This operation also provides the facility owners and managers with information about how many and what registered vehicles that are present at any time.	
Considered requirements:	
VICINITY-OR013	

VICINITY-BR-TRA120	Parking Sensor for occupancy detection
Detection of parking space occupancy could be applied to optimisation of both short-term and long-term parking space usage. These data can also be when correlated with data from ALR-detection and hence improve parking services processes.	
Considered requirements:	
VICINITY-OR014	

4.4. Health domain Requirements

The health sector is one of the core areas to be included to and benefit from the concept of smart cities. Under the context of the VICINITY project, two health related scenarios were studied during the requirement analysis process; assisted living at home and preventive medicine. In order for the demonstrations to be tested appropriately and effectively, a set of specific business requirements should be defined and followed.

Multiple sensors, mainly in the form of wearables but other activity tracking sensors as well, will provide several real-time health condition measurements by monitoring patients' behaviour, ideally 24/7. Apart from the obvious technical challenges a real-time 24/7 data transmission involves and taking into account the "sensitivity" of health related data, a number of other challenges arises regarding ownership and usage of data, security and privacy, trust of authorized third parties and legal challenges as well. Moreover, concerns regarding trust in data origin are principal business inhibitor. Therefore, a business requirements framework is necessary for the case.

VICINITY-BR-HLT010 Healthcare personnel need to be involved
In the case of health domain, smart monitoring would include several health condition measurements that need to be processed and evaluated by the equivalent professionals. Therefore, as the demonstrations run in municipality level, the participating municipality should ensure the involvement of the necessary healthcare personnel.
Considered requirements:
VICINITY-B&D-HLT01, VICINITY-B&D-HLT03, VICINITY-B&D-HLT04

VICINITY-BR-HLT020 Cost-benefit, effective devices need to be selected
The devices involved should be low cost and effective, in terms of measuring and tracking as many health conditions as possible but also in terms of ease of use. The right balance among the latter factors will guarantee a decent amount of potential active participants. Complex, inefficient devices might lead users to reduce their level of participation or even completely abandon them.
Considered requirements:
VICINITY-B&D-HLT01, VICINITY-B&D-HLT02

VICINITY-BR-HLT030 Audit management must be adopted and adhered
As authorised third parties will have access to user's personal data – especially in case of emergency, the user should have a fully-detailed, complete picture of who and when accessed his/her data. Therefore, an effective audit management mechanism should be introduced.
Considered requirements:
VICINITY-B&D-HLT03, VICINITY-B&D-HLT04

VICINITY-BR-HLT040 Contracts need to be prepared for authorised third parties
As users' personal health data will be shared to authorized third parties, trust is a major concern. Therefore, contracts defining ownership of data, usage of data and privacy should be introduced.
Considered requirements:
VICINITY-B&D-HLT04

VICINITY-BR-HLT050 Standards for health data need to be adopted and adhered
Miscommunication is a major issue to be addressed in all domains. However, it is of even higher importance for Health domain where any missing information could prove crucial. Therefore, a common interoperability "language" should be defined in order to overcome linguistic barriers that could lead to possible misconceptions. The latter could be achieved by following equivalent integration profiles such as IHE, HL7, DICOM and Continua.
Considered requirements:
VICINITY-B&D-HLT05

VICINITY-BR-HLT060 A standard process for emergency cases need to be adopted and adhered
As one of the deployment scenarios, specifically assisted living at home, might possibly involve emergency incidents triggered by the participants, especially the elderly, a standard process of specific steps should be identified to serve the case. Ideally, the latter should be an override mechanism that follows "break the glass" principles. The suggested framework should be accepted by all sides involved and strictly followed by authorised third parties.
Considered requirements:
VICINITY-B&D-HLT03

VICINITY-BR-HLT070	Health and Home Monitoring devices
Access to health status and in-house conditions could be provided to caretakers for identifying abnormal behaviour with the supervised person.	
Considered requirements:	
VICINITY-OR039, VICINITY-OR036	

VICINITY-BR-HLT080	Blood pressure and walking monitoring
Affordable devices used for condition assessment using could be made available to elderly citizens and caretakers.	
Considered requirements:	
VICINITY-OR019	

VICINITY-BR-HLT090	Smart drug dispenser
Caretaker should have access to smart drug dispense usage statistics to be able to detect abnormal drug usages.	
Considered requirements:	
VICINITY-OR037	

VICINITY-BR-HLT100	Wearables
Simple wearable devices should be supported for elderly people when their ability to operate smart phones or other technical equipment are limited.	
Considered requirements:	
VICINITY-OR025	

VICINITY-BR-HLT110	Oven and Fridge usage monitoring
Household appliances usage data could be offered to healthcare providers in order to identify abnormal behaviour in elderly citizens' households.	
Considered requirements:	
VICINITY-OR016	

VICINITY-BR-HLT120	Weather Conditions for citizens
Weather data from scientific equipment to municipalities could be shared by providers, hence municipalities may recommend maximum time of sun exposure to citizens.	
Considered requirements:	
VICINITY-OR004, VICINITY-OR031	

VICINITY-BR-HLT130	Wind Speed and Air Humidity Monitoring
Information about the perceived temperature due to the influence of wind speed and air humidity could be offered to citizens.	
Considered requirements:	
VICINITY-OR032	

4.5. Common business requirements

This section includes business requirements identified for cross-domain applicability. It builds upon the findings presented in the domain specific requirements.

The business requirements are clustered in the following categories:

- Usability requirements;
- Implementation requirements;
- Security requirements;
- Privacy requirements;
- Legal & Ethics requirements.

4.5.1. Usability requirements

The main usability requirements

VICINITY-BR-USR010	Support of mobile devices and wearables
Younger population expect to have same user experience regardless of different type of mobile devices and wearables used, however different type of devices might have different set of features.	
Considered requirements:	
VICINITY-B&D-TEC01	

VICINITY-BR-USR020	Simple and affordable wearables for elderly people
Affects use case: UC 3.1, UC 3.2	
Elderly people expect use simple and affordable wearable devices while their ability to operate smart phones are limited.	
Considered requirements:	
VICINITY-OR025	

VICINITY-BR-USR030	Support for disabled persons
Affects use case: UC 1.2.5, UC 1.2.6, UC 3.1	
Building owners, managers and tenants expect that VICINITY enabled system should be operated by youth segment that needs special care, however are able to handle tasks. This would potentially create inclusion into the job market of the fastest growing special care group.	
Considered requirements:	
VICINITY-OR040	

4.5.2. Implementation requirements

VICINITY-BR-IMP010	Removing vendor locks from IoT eco-systems
Business domain owners expect cross-availability of IoT data that removes vendor locks from IoT eco systems.	
Considered requirements:	
VCNT-ISS-ENERGY-023	

VICINITY-BR-IMP020	Extensible ontologies
The ontologies should cover domains such as: • health (such as health monitoring devices, drug dispenser), • building (such as indoor environment quality measurement, building energy efficiency, resource usage and occupancy), • energy (such as energy consumption and production) and • transport (such as resource booking, parking space occupancy), • cross-domain interoperability setup (virtual neighbourhood management and IoT objects sharing rules), data ownership (data ownership attributes for each data resource) and generic domains time and space (location devices). The ontologies should be extensible to provide semantic interoperability for new devices.	
Considered requirements:	
N/A	

VICINITY-BR-IMP030	Preference of affordable devices
Affects use case: UC 3.2	
Caretaker and elderly citizens expect to use affordable VCINITY enabled devices.	
Considered requirements:	
VICINITY-OR019	

VICINITY-BR-IMP040	Development
Affects use case: UC 1.1.2.5, UC 1.1.2.6, UC 2.4, UC 2.5, UC 2.6, UC 2.7,	
The accelerator, incubators owners should have access to flexible VICINITY development environment to allow for third parties services building for demonstration purposes.	
Considered requirements:	
VICINITY-OR030	

4.5.3. Security & Privacy & Legal & Ethics Requirements

This section covers:

- legal & ethics requirements mostly from the GDPR point of view which addresses the current and future privacy issues;
- security requirements including security objectives and considered security threats.

Inputs considered for security & legal & ethics requirements are:

- D1.2: Report on business drivers and barriers of IoT interoperability and value added services;
- D2.1: Analysis of Standardisation Context and Recommendations for Standards Involvement;
- D9.2: Data management Plan
- EC Directive 2016/680;
- ITU-T Rec. E.408 (05/2004) - Telecommunication networks security requirements – version;

Concept of the solutions will be considered in D1.5 VICINITY Technical specification requirements and D1.6 VICINITY Architecture design.

4.5.3.1. *Legal & Ethics Requirements*

European Commission introduced the EU Data Protection Reform and adopted the Regulation 2016/679 and Directive 2016/680. Data protection reform defines the principles for collecting, processing and storing of the personal and sensitive data. Moreover, the regulation defines concepts of how the data protection should be maintained in the organisation processing private data.

VICINITY-BR-LEG010	Consider the principle ideas of data protection reform in Regulation 2016/679

The VICINITY[10] should consider the principle ideas such as:

- Data protection by design;
- The individuals' rights for protection of private data;
- Data transfer principles.
- Requirement consent [11]as described in the Data Protection directive no. 95/46/EC of 24 October 1995, the ePrivacy Directive No. 2002/58/EC of 12 July 2002 and in article 7 of Directive No. 46/1996, which is elaborated more on in Article 5/3 of Directive No. 58/2002

Considered requirements:

VICINITY-B&D-LEG01, VICINITY-B&D-LEG02, VICINITY-B&D-LEG03, VICINITY-B&D-LEG04, VICINITY-B&D-LEG05

4.5.3.2. *Security objectives and threats*

The means how the security is implemented and maintained needs to tailored to particular business context by identifying security objectives (what should be achieved by security?) and potential threats (what activities can threaten security objectives?). Security functional requirements need to be defined for each potential threat. Selection of the functional requirements need to balance the cost of the security measure and cost of potential security breach.

Considering security objectives, the following security objectives needs to be addressed in VICINITY:

- Confidentiality;
- System and data integrity;
- Accountability, including authentication, non-repudiation and access control;
- Availability;

[10] Technical requirement specification and implementation shall support local implementations of Regulation 2016/679 mostly in Slovakia (server and client components deployment), Greece, Norway and Portugal (pilot site locations)

[11] www.mondaq.com/italy/x/272114/Data+Protection+Privacy/EU+Privacy+Regulations+Consent+Requirements+In+An+OnLine+Environment

VICINITY-BR-SEC010	Provide level of confidentiality set by the security policies of the VICINITY and connected IoT infrastructures
When setting the level of confidentiality and privacy of the accessed or used assets the following policies needs to be taken in to account: • Security policy of VICINITY; • Security policy of connected IoT infrastructures which is the origin of the asset; • Security policy of connected IoT infrastructure which accesses or use the asset;	
Considered requirements:	
VICINITY-B&D-SEC04	

VICINITY-BR-SEC020	Only legitimate actors (e.g. users, administrators) should be able to access and use any VICINITY components or services provided by the VICINITY
The actor should have authorization to access services provided by VICINITY components;	
Considered requirements:	
VICINITY-B&D-SEC01, VICINITY-B&D-SEC04	

VICINITY-BR-SEC030	Only legitimate actors (e.g. users, administrators) should be able to access and operate on assets they are authorised to access within the VICINITY
The actor should have authorization to access the assets managed or facilitated by VICINITY. Authorization should be managed by the organization connecting to VICINITY.	
Considered requirements:	
VICINITY-B&D-SEC01, VICINITY-B&D-SEC04	

VICINITY-BR-SEC040	All actors should (e.g. users, administrators) be held accountable for their own, and only their own, actions in VICINITY components
Action performed in VICINITY should be traceable to actor who performed the action including evidence that it has been done so.	
Considered requirements:	
VICINITY-B&D-SEC02, VICINITY-B&D-SEC03	

VICINITY-BR-SEC050	In order to ensure availability, VICINITY components should be protected against unsolicited access or operations
The unsolicited access or operations in high-volumes can cause unavailability of the part or whole system.	
Considered requirements:	
VICINITY-B&D-LEG06	

VICINITY-BR-SEC060	Breaching security objectives caused by potential threat should be mitigated by security measures to acceptable risk

These security objectives might be threatened by the following threats:

- Masquerade when one entity pretends to be other entity;
- Eavesdropping is breaching of confidentiality by monitoring communication;
- Unauthorized access is to gain access to asset, service by unauthorized person;
- Loss or corruption of information;
- Repudiation attack is defined as one peer is involved in action performed on asset, however later the peer claims this action never took place;
- Forgery when an entity fabricates information and claims that such information was received from another entity or sent to another entity;
- Denial of service causes the temporary or permanent unavailability of one or several resources.

Each of these security threats needs to be addressed by one or several security measures to minimize the security risk to acceptable level.

Considered requirements:
N/A

5. Conclusion

The goal of the VICINITY business requirements specification is to derive stakeholder requirements in order to:

- Identify scope and overview
- Define the business environment where the systems will operate
- Describe goals and objectives towards an IoT interoperable system
- Describe business model by identifying methods to achieve the goals
- Describe information environment by project portfolio, long term system plan and database configuration
- Provide description of business processes
- Describe the business operational policies, rules, constraints, quality and operation modes and identify business structure
- Describe impacted operational concepts, scenarios and life-cycle concepts

The outcome of the task "VICINITY Platform User and Business Requirement Definition" (T1.3) is consolidated and documented in this report (D1.4): "Report on VICINITY business requirements";

- translating the existing business establishment from use cases (T1.2) as well as
- the user requirements (Task 1.1) into the features required in the VICINITY platform.

After Mile Stone 1 – "VICINITY requirements, barriers, pilot surveys and audits available", the requirements will be implemented into a tool (SysML) for easy definition and maintenance.

VICINITY Business requirements specification is an input to the VICINITY Technical requirements (D1.5) and Architecture design (D1.6) in for identification of:

- system components based on functional design,
- high-level information model (including abstraction of physical devices and services),
- the internal and external interfaces resulted from detailed analysis of VICINITY behaviour and
- selection of architecture patterns based on non-functional requirements in security, privacy, user experience, performance, availability and maintainability fields.

IoT ecosystems generate data that can be harvested to provide novel commercial services, or public services for the benefit of society. This review was designed to identify benefits and issues related to data sharing both within a single domain and across domains.

Achieving interoperability across domains is a key objective of VICINITY. In the context of VICINITY, interoperability is the ability of a system or a product to work with other systems or products without special effort on the part of the customer.

In order to collect and analyse business drivers and barriers in the context of IoT interoperability, a survey was conducted using a questionnaire to interact with stakeholders and visit to the pilot sites demonstration VICINITY solution.

The scope of the survey included several separate vertical domains (buildings, energy, transport and health) and several horizontal cross-domains (legal & ethics, security & privacy and the technical domain). Barriers which are similar across domains were identified, along with some more domain-specific ones. The potential for cross-domain synergies was identified which could maximise the use of clean energy and/or optimise the management of resources.

According to several stakeholder studies, security and privacy are some of the most common barriers to the interoperability of IoT. Other barriers identified are lack of standards and low level of product maturity from customer standpoint.

There are many IoT ecosystems with actors that operate within cross-domain areas. These ecosystems generates big data that could be harvested to provide novel commercial services, or services for the benefit of society. In many case the owners of these data sources are unwilling to share access to their data, especially if they do not have a business case, which enables them to benefit directly from the new services derived from their data.

At this stage of project development VICINITY system´s perceived strengths by the stakeholders in general are as follows: “Interoperability and integration of various standards and protocols which would allow for broad use of the product, allowing for rapid innovation”. The system is expected to provide efficient, time saving performance and value-added services from a business perspective, while minimising environmental impact and yielding cost savings. The overall goal of VICINITY is to deliver improved quality of life and open for innovative services that can be built on top of the architecture being offered by solution.

Among weaknesses, resistance to change can be expected from strong market players with existing proprietary products. On consumer side, potential loss of privacy and security, compatibility, complexity and legislation are voiced as potential weaknesses.

These strengths and weaknesses identified from stakeholders’ interactions also known as drivers and barriers are analysed in vertical domains energy (section 4.2), health (section 4.4), transport (section 4.3) and building (section 4.1) and horizontal domains (section 4.5) legal & ethics, security & privacy domain.

Stakeholders perceive VICINITY as a project, which has the potential to integrate various disparate standards and protocols.

This report constitutes one of the components of the VICINITY project. The approach and philosophy employed by VICINITY takes into consideration stakeholders’ opinions in order to build solutions focused on meeting their requirements whilst tackling issues they have identified.

The deliverable uses information derived from the representative list of stakeholders and pilot site operators.

Further deliverables in Work Package 1, such as D1.5 and D1.6, will identify functional and technical requirements, resulting in a system architecture, thus completing the knowledge base upon which the VICINITY solution will be developed, tested, deployed and demonstrated.

6. References

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ANNEX I: Business Requirement Specification (BRS) document

This annex will be used in development of concrete business plans that will look to maximize the exploitation potential of identified assets results as well as address stakeholders' needs and expectations. Exploitation Strategy and Business Plan Development (WP9 Task 9.5) will monitor and compile the partners' exploitation activities and seek maximum synergies from them. One major part of the exploitation planning will be the identification of potential target groups and business cases based on the outcome of the project. Moreover, market requirements and future application areas will be captured. Each exploitable result's related target group will be identified to make sure each target group is informed about the relevant information / activities within the project. Definition of both individual & consortium exploitation/business/financial plans for each exploitable result. An annual report will detail exploitation status and perspectives, at partner's and Consortium's levels. The results will be presented in D9.5 in two issues of the document during the second half of the project (M24, M36 and M48).

This annex defines the normative content of the business requirements specification (BRS) document for VICINITY. The project shall produce the following information items in accordance with the project's policies with respect to the business requirements specification document. Organisation of the information items in the document such as the order and section structure may be selected in accordance with the project's documentation policies.

1.1 Business purpose

Describe at the organisation level the reason and background for which the organisation is pursuing new business or changing the current business in order to fit a new management environment. In this context it should describe how the proposed system will contribute to meeting business objectives.

1.2 Business scope

Define the business domain under consideration by

a) Identifying the business domain by name.

b) Defining the range of business activities included in the business domain concerned. The scope can be defined in terms of divisions in the organisation and external entities that relate directly to the business activities, or functions to be performed by the business activities. It is helpful to show environmental entities which are outside of the scope.

c) Describing the scope of the system being developed or changed. The description includes assumptions on which business activities are supported by the system.

1.3 Business overview

Describe major internal divisions and external entities of the business domain concerned and how they are interrelated. A diagrammatic description is recommended.

1.4 Major Stakeholders

List the major stakeholders or the classes of stakeholders and describe how they will influence the organisation and business, or will be related to the development and operation of the system.

1.5 Business environment

Define external and internal environmental factors that should be taken into consideration in understanding the new or existing business and eliciting the stakeholder requirements for the system to be developed or changed. The environmental factors should include possible influences to the business and consequently the system from external conditions like market trends, laws and regulations, social responsibilities, and technology base.

1.6 Mission, Goals and Objectives

Describe the business results to be obtained through or by the proposed system.

1.7 Business model

Describe methods by which the business mission is expected to be achieved. The description should be concentrated on the methods supported by the system to be developed or changed with the items such as product and services, geographies and locales, distribution channels, business alliance and partnership, and finance and revenue model.

NOTE Detailed discussions and definitions of the business model elements can be found in Business Motivation Model (BMM) Specification by OMG.

1.8 Information environment

Describe the overall strategy for the organization level decisions on common bases for multiple information systems. It should include the following items:

a) project portfolio – when multiple system projects are running or planned to pursue the same business goal, the priority, relative positioning, and possible constraints come from the portfolio management strategy.

b) long term system plan – when common system infrastructure or architecture has been decided or planned, it should be described as constraints on possible design decisions.

c) database configuration – an organization level database configuration plan and possible constraints on availability and accessibility of organization global data should be specified.

1.9 Business processes

Provide description of the procedures of business activities and possible system interfaces within the processes. The purpose of this information item is to represent how and in which context the system supports the business activities. In general, business processes make a hierarchical structure with decomposition and classification. Each business process should be uniquely named and numbered in the hierarchy. The description of the individual business process should be represented as a diagram representing a sequence of activities.

1.10 Business operational policies and rules

Describe logical propositions applied in conducting the business processes. The propositions will be conditions to start, branch and terminate the sequence of the business activities in the business processes; criteria for judgment in the business processes; or formula to evaluate a quantity, which will likely be addressed in functional requirements in the SyRS and SRS. The policies and rules shall be uniquely named and numbered, and shall be referenced in the description of the business processes.

1.11 Business operational constraints

Describe conditions to be imposed in conducting the business process. The conditions may be on a performance constraint (e.g., the process shall be finished within a day after the triggering event occurs), or may be from a management requisite such as 'every occurrence of the process shall be monitored and recorded'.

1.12 Business operation modes

Describe methods to conduct the business operation in an unsteady state, for example, a state when business operations might be extremely busy due to some intensive occurrence of events. An unsteady state of business operation includes a manual operation mode when the proposed system is not available due to some unexpected situation like an accident or natural disaster.

1.13 Business operational quality

Define the level of quality required for the business operation. For example, a business process may address required urgency with higher priority than the reliability of the business process.

1.14 Business structure

Identify and describe the structures in the business relevant to the system, such as organizational structure (divisions and departments), role and responsibility structures, geographic structures, and resource sharing structures. There may be a need to alight the system functions to these structures, and to support future structural changes.

1.15 Preliminary operational concept

Describe the proposed system in a high-level manner, indicating the operational features that are to be provided without specifying design details. The following information should be included:

d) Operational policies and constraints

d) Description of the proposed system

e) Modes of system operation

f) User classes and other involved personnel

g) Support environment

1.16 Preliminary operational scenarios

Describe examples of how users/operators/maintainers will interact with the system (context of use). The preliminary (upper-level) scenarios are described for an activity or a series of activities of business processes supported by the system. The scenarios should be uniquely named and numbered, and should be referenced in the description of the business processes in 6.1.9.

NOTE – More information for the context of use and the usability requirements can be found in ISO/IEC TR 25060 and ISO 9241-210.

1.17 Other preliminary life-cycle concepts

Describe how the system of interest if to be acquired, deployed, supported and retired.

1.18 Project constraints

Describe constraints to performing the project within cost and schedule.

ANNEX II: Transport – market and demands

The core of the smart parking case is to offer interoperability of various suppliers to demonstrate how to provide the same service, with a specific focus on real time occupancy and transaction data in the standard data format DATEX II.

Smart parking is a concept that can be assigned for different kind of areas. Examples like sites near apartments, parking sites near work places or public buildings, parking sites on industrial areas or for commuters, sites for disabled people, indoor sites, outdoor sites, street based parking sites, road side parking, parking sites for cars or trucks, electrical vehicles (EVs) can be envisioned.

The smart parking use case is based on certain criteria;

- Parking space is a resource that is on-demand, and where is usually is a shortage. Different uses have different needs, either because of the vehicles, or because of disabilities or other concerns with the passengers/drivers/owners.
- Smart parking opens for several new business opportunities through ownership models, access to specific outlets and integration with other surrounding services
- It has positive effects on the climate footprint, as smart parking offers for predictability and time efficiency, thereby reducing the amount of time spent driving around looking for available parking space.
- Cost efficiency is an issue, and introducing parking space sharing, as it makes it possible to ensure that neither private nor public parking sites are left with unused space. At the same time it makes it possible to exploit areas that otherwise would have been assigned for a specific usage, as real time information about vacancy opens the door for temporarily assigning the parking space for other purposes.

The situation today is that city managers and agencies, municipalities and counties, governments, site owners and other of the key actors referred to in “Table 4: Key actors in smart parking ecosystem” are experiencing pressure from commuters, residents and their own departments to reduce congestion and improve the conditions of those who are dependent on cars or are living in cities. The mobility sector affects all city users; commuters, business owners, blue light agencies and other departments that are triggered in emergency situations.

Smart mobility solutions, of which smart parking is a part, is considered being a way of solving some of these challenges. By allowing people to receive relevant data, the user is enabled to make more choices that are informed. This provides them the option of deciding how to ride, when and where to ride. It opens for integration from different domains, and facilitates efficient movement of goods and people, thus ensuring logistics supporting the city.

Key actors are:

Municipalities and counties	These are often owners of the parking sites and are responsible for assigning budgets and managing the criteria that governs cities and infrastructure. The departments that will benefit the most are located in these governmental bodies. They spend many resources on transporting people and goods, and health care personnel and blue light agencies represent a large part of their budget. Solutions that will assist in reducing the pressure on the operational agencies will have a large impact and therefore gain a lot of interest.
City Management	Personnel responsible for managing mobility solutions within cities. These are the key buyers in the smart mobility domain. City Managements are coming under increasing pressure from commuters and businesses to reduce congestion, improve the quality of life of those living and working in cities.
Transport Information Integration	These are companies involved in data collection and interpretation to provide traffic management solutions to City Management. These are the key sellers and potentially the innovators and integrators in the smart mobility domain. The products produced by companies operating in this sector aim to optimise parking, improve safety and reduce congestion and emissions.
IT & Traffic Infrastructure	Companies who manufacture technology related to traffic and parking management solutions. These are the innovators within the smart mobility domain. Their products are primarily aimed at companies involved with Transport Information Integration and with City Management.
Mobility Service Providers	Provide tailored mobility solutions to city inhabitants. These are a small, but growing player in the industry offering services to commuters in need of parking space.
Automotive Industry	Companies who operates in the automotive industry (manufacturing, insurance, repair, recovery) and interested in providing commuters with a more comprehensive transport solution. Their smart mobility products are aimed at making transport more sustainable, greener and safer.
Design & Engineering	Develop transport strategy, policy and compliance. They design and manage the procurement processes and install the infrastructure network. These companies advise commuters, city management and transport information integration companies. The goals of these companies are to design and build mobility solutions that are optimally designed, incorporate best practises to reduce congestion, improve quality of life, lower emission and optimise use of urban areas and mass transport.
Location Based Services	Companies involved in this sector provide services such as beds, food, fuel, transportation to commuters. Commuters are informed of available services before, during or after their commute, through the use of smart technology which recognises their route or current location via GPS.
Marketing,	Advertising companies will use the smart technology medium like smart

Advertising, Social	phones, iPad to connect with commuters and parking site owners to sell or provide a service. Commuters are targeted by tailored advertising techniques depending on their mode of transport, location or smart phones setup of companies or services which could strike a chord with commuters in that location. Revenues provided by advertising companies could greatly reduce the cost of development and installation of smart transport solutions for city management.
Communication Industry	Companies whose technology will be used to relay data to transport information integration companies, city management, and marketing information from advertising companies. Additional means of communication (data to and from measuring devices, transport information integrators and advertising companies) will be required.

Table 4: Key actors in smart parking ecosystem

In order to lay down a common ground work for testing the use cases, there are a number of requirements that needs to be fulfilled;

- Sensors that can detect occupancy of a parking space needs to send real time data.
- A gateway will have to be able to transmit the information further into the network.
- An administrative system to monitor the status of the parking spaces that are currently assigned to the group, and
- Information must be accessible to interested parties through relevant platforms.

Additionally other sources of feedback, most notably smart light and monitors displaying information will improve usability factors and reduce risks for occupying the wrong parking space, or drive in the wrong direction.

Real time transactions and security and privacy issues related to initial authorisation, authentication and access will have to be integrated in the smart parking system. This opens for other challenges that needs to be addressed; Who are responsible for handling authorisation and access, who will be liable for parking/damages or theft when occupying parking space. Who will handle payment or other kind of transactions that function as transferring value. How to handle long term and short-term ownership/rental of parking space – and customisation that may take place without consent from other owners. How to handle booking and verification, rating and other activities that directly may influence the worth of a given parking space. This may be considered even more important for underground parking facilities, where the entire facility may be affected by choices that are made in regards to just one parking space.

Finally – the core part of smart parking is based on optimizing the usage of areas in and around the parking facility. Not just based on available space, but also on specifications that ranges from disabilities to time slot, from location of entrances to nearby services.

Smart parking will offer cross-domain support through interoperability supported through the VICINITY platform. Table 5: Interoperability internal requirements describes the requirements that has to be met in order to achieve the goals.

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 5: Interoperability internal requirements