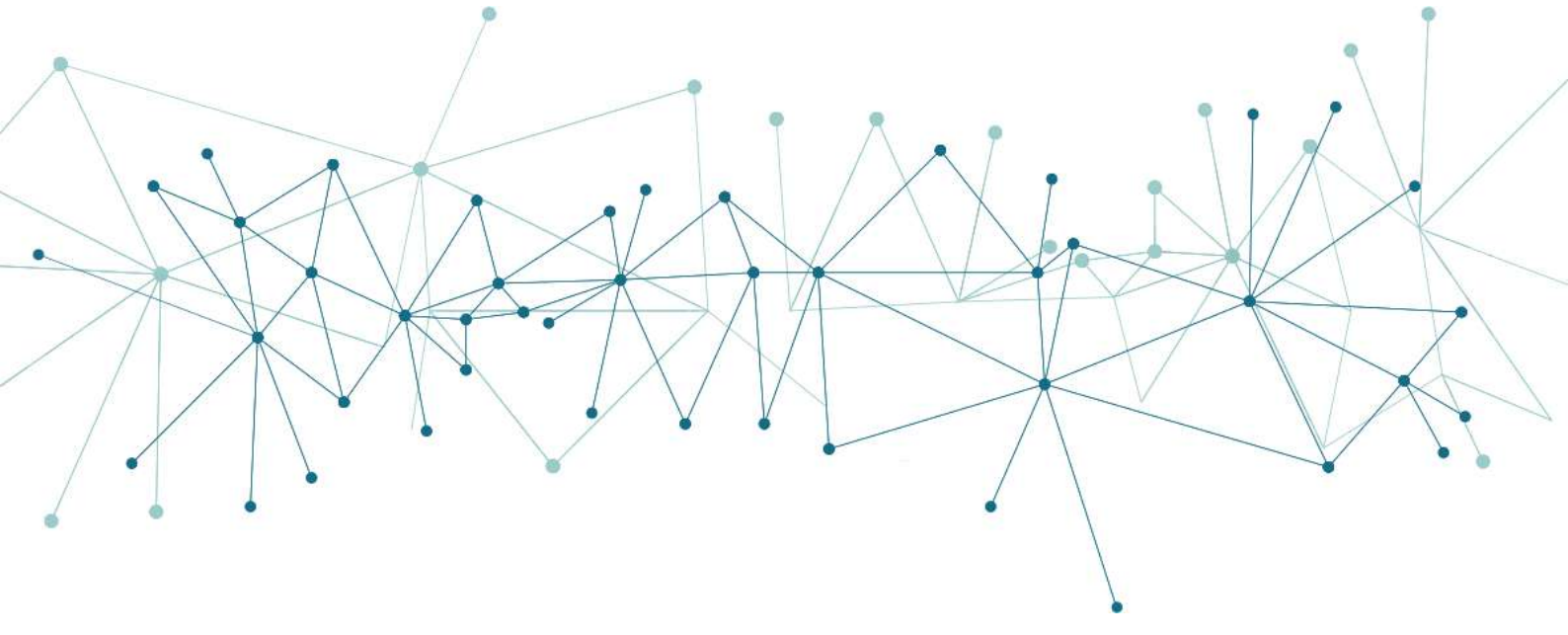
The eDREAM project is co-founded by the EU's Horizon 2020 innovation programme under grant agreement No 774478

enabling new Demand REsponse Advanced, Market oriented and secure technologies, solutions and business models

DELIVERABLE: D2.6 User group definitions, end-user needs, requirement analysis and deployment guidelines V2

Author: Giuseppe Mastandrea (E@W)



Imprint

User group definitions, end-user needs, requirement analysis and deployment guidelines V2, August 2019

Contractual Date of Delivery to the EC:	31.08.2019
Actual Date of Delivery to the EC:	31.08.2019
Author(s):	Giuseppe Mastandrea (E@W)
Participant(s):	Luigi D'Oriano (E@W), Giuseppe Rana (E@W), Giuseppe Raveduto (ENG), Vincenzo Croce (ENG), Mircea Bucur (KIWI), Ugo Stecchi (ATOS), Javier Gómez (ATOS), Juan Sancho(ATOS), Lourdes Gallego (ATOS), Francesca Santori (ASM), Tudor Cioara (TUC), Claudia Pop (TUC), Francesco Bellesini (EMOT), Giuseppe Millucci (EMOT), Andrei Ceclan (SVT), Radu Moldovan (SVT), Benjamin Hunter (TU), Paul van Schaik (TU), Antigoni Noula (CERTH), Dimosthenis Ioannidis (CERTH), Christina Tsita (CERTH), Giorgos Sfikas (CERTH)
Project:	enabling new Demand Response Advanced, Market oriented and secure technologies, solutions and business models (eDREAM) http://edream-h2020.eu/
Work package:	Wp2 – User requirements, use cases and system specification
Task:	2.1 – User and Business Requirements Definition
Confidentiality:	public
Version:	1.0

Legal Disclaimer

The project enabling new Demand Response Advanced, Market oriented and secure technologies, solutions and business models (eDREAM) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 774478. The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the Innovation and Networks Executive Agency (INEA) or the European Commission (EC). INEA or the EC are not responsible for any use that may be made of the information contained therein.

Copyright

Executive Summary

The deliverable D2.6 related to the Task 2.1 and entitled "User group definitions, end-user needs, requirements analysis and deployment guidelines V2", represents the updating of the Business and User requirements already released to the M8 in the first version of this deliverable.

The process of updating the requirements have guided eDREAM research and implementation work last year (M9-M20) providing them with the stakeholders' feedback.

The aim of this deliverable, that relies on the **definition of the Business and User Requirements**, is one of the crucial steps for the effective project design that is the main objective of the WP2 "User requirements, use cases and system specification".

Indeed, it is important not to overlook during the project the appropriate understanding of the needs and expectation of the main stakeholders (internal and external to the project) as it can offer an important perspective on how to address and review the project objectives.

To this end, starting from the aim of the eDREAM project to develop new solutions for DSOs, as well as improving decision making of aggregators and energy retailers, a detailed stakeholders elicitation plan has been defined in order to especially consider their needs from the very beginning of the project up to the release of the first consolidated prototype.

For these reasons, during the first phase of T2.1, in the Stakeholders elicitation plan, the necessity to start from the results of the internal elicitation phase has been considered, making possible to define the first set of requirements as a basis for activating the processes of external stakeholders' involvement through Interviews, Requirements workshops and Survey/Questionnaire.

In this second version of the deliverable, the focus was on external elicitation by introducing new tools and broadening the base of questioned stakeholders by leveraging both collaborations with other H2020 project consortia and the project website.

Thanks to the Participatory Design (PD), a continuous systematic formalization of all relevant stakeholders' requirements has been defined, leading also to a review of the set of relevant use cases and scenarios already defined in the D2.2, through its update in D2.7.

According to the schedule defined in the Stakeholders elicitation plan, the external elicitation process is implemented throughout the project, also through the organization of an international conference postponed to the period of the third release of this deliverable (D2.8) with the aim of utilizing conference to present requirements to stakeholders and receive feedback.

This process actively involves stakeholders in the design process to meet their requirements and consider them in drafting and revision of the system requirements and architecture of the eDREAM platform, with a focus on usability and accessibility.

Based on the functionalities directly corresponding to the requirements, a set of best practices for the deployment of eDREAM solution has been defined.

In the last phase of this Task (T2.1) related to Deliverable 2.8, during which the verification and refinement of the requirements along with the process of the prototype integration are addressed, the eDREAM prototype

will be used as design-probe and act as triggering-artefact to stimulate both the research and innovation processes. The feedback from the international conference and further exploratory and experimental user workshops and reports will refine the business and user requirements, while on the other hand the developers will gain insight into the needed technologies.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

BRs	Business Requirements
DR	Demand Response
DSO	Distribution System Operator
eDREAM	enabling new Demand Response Advanced, Market oriented and secure technologies, solutions and business models
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
ESCO	Energy Service COmpany
FD	Field Data
HL-UC	High Level Use Case
LL-UC	Low Level Use Case
MF	Macro-Functionality
PD	Participatory Design
PMBOK	Project Management Body of Knowledge
RE	Requirements Elicitation
RRI	Responsible Research and Innovation
StRS	Stakeholder Requirements Specification
TGs	Target groups
URs	User Requirements
UI	User Interface
VPP	Virtual Power Plant
WP	Work Package

1 Introduction

The purpose of this deliverable, as the technical output of the project, is **to describe the eDREAM continual business and user requirements elicitation process and the actions that have been taken during M9-M20 to update the requirements for the eDREAM environment and system**. The deliverable describes the steps and actions performed in Task 2.1 during M9-M20 of the project and can be considered as a key input for updating the use cases and application scenarios (T2.2) and for the update of the project architecture (T2.4) as well as for the activities of WP3, WP4, WP5, WP6 and WP7. The main stakeholders of the eDREAM platform are described in detail in this deliverable, identifying their needs and requirements to address the project objectives.

1.1 Scope and objectives of the deliverable and relevance in the eDREAM framework

The eDREAM project aims to develop innovative technologies in the field of DR management and the balancing of energy resources by exploiting new technologies such as deep learning and big data analytics for energy demand and production forecasts, blockchain secure distributed control for implementation of a peer-to-peer market of energy assets and a close DR verification, through the use of self-enforcing smart-contracts and consensus based validation to track energy transactions in a tamper-proof manner and determining financial settlement in a near real time fashion.

The components being developed will be integrated through a scalable Cross-functional Backbone Platform that will connect energy networks with diverse stakeholders, based on their requirements and the characteristics of three different eDREAM Pilot use cases. This platform can be seen as a complex system in which different kind of users can use the available tools, models and mechanisms in support of the Distribution Services.

In this perspective, the eDREAM ecosystem can be defined as the community of internal and external stakeholders of the project in conjunction with its core technology framework.

Understanding the needs and expectations of eDREAM's stakeholders, is of utmost importance as it may offer a fresh and valuable perspective on how to tackle the goals and objectives of the project.

This assessment goes beyond the development of the innovative solutions proposed and the expected integration of the eDREAM technologies (which is a mandatory achievement) and defines the eDREAM solution against the needs expressed by the stakeholders from the initial phase of the project up to the realization of the first version of the prototypes.

This deliverable pursues this direction and focuses on the elicitation of stakeholders, extrapolating their needs as well as their implementation priorities.

To this end, in the eDREAM project three versions of this deliverable have been planned in order to continually update the business and user requirements during all project phases.

The objectives and contents of these deliverables are defined in the Table 1, updated from D2.1:

Deliverable	Objectives
D 2.1: User group definitions, end-user needs, requirement analysis and deployment guidelines V1 [M8]	1. Definition of the methodology for the identification of the Target groups (TGs) 2. Definition of the overall approach and methodology for requirement elicitation 3. Definition of the first set of the Business and User requirements through internal elicitation 4. Refinement and validation of the first set of the Business and User requirements through the involvement and contribution of other H2020 project consortia, establishing a collaboration with them
D 2.6: User group definitions, end-user needs, requirement analysis and deployment guidelines V2 [M20]	1. Organization and participation in different events for meeting and discussing the requirements with the external stakeholders 2. Launch of a public consultation by sharing the questionnaire for the elicitation of stakeholders' needs on the project website 3. Collection of the needs and requirements coming from the identified TGs 4. Continual assessment of the Business and User requirements
D 2.8: User group definitions, end-user needs, requirement analysis and deployment guidelines V3 [M30]	1. Organization of the International Conference targeting more than 100 stakeholders in Europe 2. Continual Involvement of the identified TGs to assess requirements 3. Use of the prototypes as design-probes to refine the requirements 4. Final version of the Business and User Requirements

Table 1 Main objectives of the three versions of the deliverable for Business and User requirements definition

1.2 Structure of the deliverable

D 2.6 “User group definitions, end-user needs, requirement analysis and deployment guidelines V2” consists of six chapters, in which the adopted elicitation processes and the project requirements defined at the end of the second cycle of elicitation have been described, as follows:

- General description of the scope and objective of the deliverable [Chapter 1];
- Definition of the methods for the identification of the eDREAM target groups - updated based on the activities carried out in the M9-M20 project period [Chapter 2];
- Definition of the methods to be adopted for the elicitation and assessment of needs and expectations of stakeholders’ groups - updated based on the activities carried out in the M9-M20 project period [Chapter 3];

- Description of the Business Requirements (BRs) extrapolated at the end of the first cycle of elicitation through internal and external elicitation - updated based on the activities carried out in the M9-M20 project period [Chapter 4];
- Description of the User Requirements (URs) extrapolated at the end of the first cycle of elicitation through internal and external elicitation - updated based on the activities carried out in the M9-M20 project period [Chapter 5];
- Definition of the relationships of the business and user requirements with the use cases and application scenarios - updated based on the activities carried out in the M9-M20 project period [Chapter 6].

Finally, the templates proposed for the description of the Business and User Requirements and the questionnaire elaborated for the external Experts and Stakeholders are included respectively in ANNEX 1 (Business requirements template), ANNEX 2 (User requirements template) and ANNEX 3 (Questionnaire for External Elicitation of Stakeholders requirements).

2 Definition of stakeholders and user groups

The identification of the potential stakeholders is one of the most important phases of a project, since once grouped according to well defined categories to constitute the Target Groups (TGs), they are involved in the Requirements Elicitation (RE) process where business and user needs are identified and captured.

The success of projects depends heavily on designers' ability to meet the needs and requirements of stakeholders throughout the entire life cycle.

In the stakeholders' identification all the possible categories have to be considered, such as energy users, grid operators, organization decision makers, regulatory bodies and society as a whole in the context of the business and the proposed solution.

A stakeholder is any entity (individual or organization) with a legitimate expectation from the system, in other words, the stakeholders are all those who may be influenced or who would be able to influence the system in general [1].

These stakeholders are the source of the requirements during requirement elicitation. The identification of stakeholders are not a simple and information on stakeholders is not readily available. Most developers are faced with problems of finding the right stakeholders with the appropriate time, interest and knowledge for the project.

Therefore, it is essential at a very early stage of the project to think on potential stakeholders and TGs, as an effective RE process requires active participation throughout the project lifecycle by stakeholders who may be affected by the project or who could influence it.

The influence of the stakeholders on a project can vary greatly from one to another, so the possibility of involvement can be immense. For example, RE processes could involve people who pay for the system, customers, people who design the components and system users. This demonstrates the necessity to start with a categorization procedure in stakeholder analysis, in order to manage the RE in an appropriate manner.

In accordance with the stakeholder analysis methodology defined by the PMBOK [1], in the stakeholder identification phase we have to consider the following tools and techniques:

- **Stakeholder analysis**: collection and evaluation of information to determine what interests should be taken into account for the project;
- **Expert Rating**: technical and / or managerial expert judgment (from any qualified source);
- **Meetings**: profile analysis meetings to develop understanding of major project stakeholders.

In particular, a useful tool to determine the impact of a potential stakeholder on the project can be the Power/Interest Grid, which also provides support in the selection of the proper communication approach for each stakeholder or stakeholder group. The "power/interest grid" classifies stakeholders based on their power and interest in the project, allocating the stakeholders to one of the following categories:

- **High power, highly interested people** (manage closely): stakeholders should be fully involved and maximum effort should be made to satisfy them;

- **High power, less interested people** (keep satisfied): stakeholders must be involved and kept satisfied, but not so much to make them bored;
- **Low power, highly interested people** (keep informed): stakeholders should be properly informed, talking to them to make sure that no major issues are arising. Their advice can be very useful for the details of the project;
- **Low power, less interested people** (monitor): stakeholders should be monitored, but not excessively in order to avoid the risk of getting bored.

Figure 1 Power/Interest Grid

The main advantage of allocating stakeholders according to this grid is that of discovering quickly where the real power is located and therefore helping to make better project decisions and to find the right means of communication with the interested parties.

Once the best communication strategy for each category of stakeholders has been defined, they are grouped considering the different typologies based on their characteristics in order to define the TGs. This allowed equilibrating their selection in an appropriate manner during the stakeholders' identification process. This is useful for the involvement of the external stakeholders and in particular for the workshops, conferences and meetings held in the second phase of this task and in those to be held in the third phase, including the international conference with more than 100 stakeholders in Europe to adjust the requirements and collect additional needs and requirements also on the base of the first progress of eDREAM platform development.

The key stakeholders of the eDREAM target audience have been regrouped in two TGs following two different typologies as reported in the Table 2:

Energy Sector	End users
• Energy retailers • DSOs • Distributed Generation Providers	• Prosumers • Facility managers & owners • System operators

• Energy Aggregators and brokers • ESCOs • Technology Providers • Scientific community	• Commercial and Residential Customers • Stakeholders at the Pilot Sites • General Public

Table 2 Key stakeholders group identified as target audience of eDREAM

It is important to pay attention to the role of these different groups of stakeholders within the eDREAM project, as to achieve the project objectives it is necessary to understand the individual actors potentially affected and envisioned by the system and project results, identify their needs and recognize synergies among them.

The Stakeholder Register (Table 3), which includes the classification of stakeholders, and then the assessment of stakeholders as a result of the stakeholders' analysis, is elaborated in the different eDREAM stakeholder management processes to gather useful requirements for the project.

Stakeholder ID / Name	Stakeholder Group	Power (H/L)	Interest (H/L)	Needs	Observations, concerns and opportunities

Table 3 Stakeholders Register

3 Requirements Engineering and Elicitation

3.1 General Approach

The elicitation of the requirements is one of the most important parts of the System Life Cycle Processes and must be tackled with extreme care, since many systems fail due to wrong or inefficient elicitation practices.

A requirement can be defined as a stakeholder need. Requirements elicitation involves identifying these needs. It provides a success basis for a project and the delivery of the expected system and often reduces the gap between developers, stakeholders, and end users [2].

The Requirements elicitation is a process to discover the stakeholders' needs and collect the relative requirements. It addresses problems such as user involvement and perfect documentation. Wrong or missing requirements lead to different system expected from these, that are unreliable or more expensive than alternative solutions.

The quality of the requirements elicitation phase affects the overall quality of the entire software production cycle and therefore the platform that is developed. Thus, it is essential to write a good Stakeholder Requirements Specification (StRS) [3] defining the system capabilities clearly and correctly.

Therefore, it is worth mentioning that the requirements should be managed throughout the project lifecycle. In the eDREAM project, an iterative approach to elicit and assess the requirements over the project duration has been defined as depicted in Figure 2:

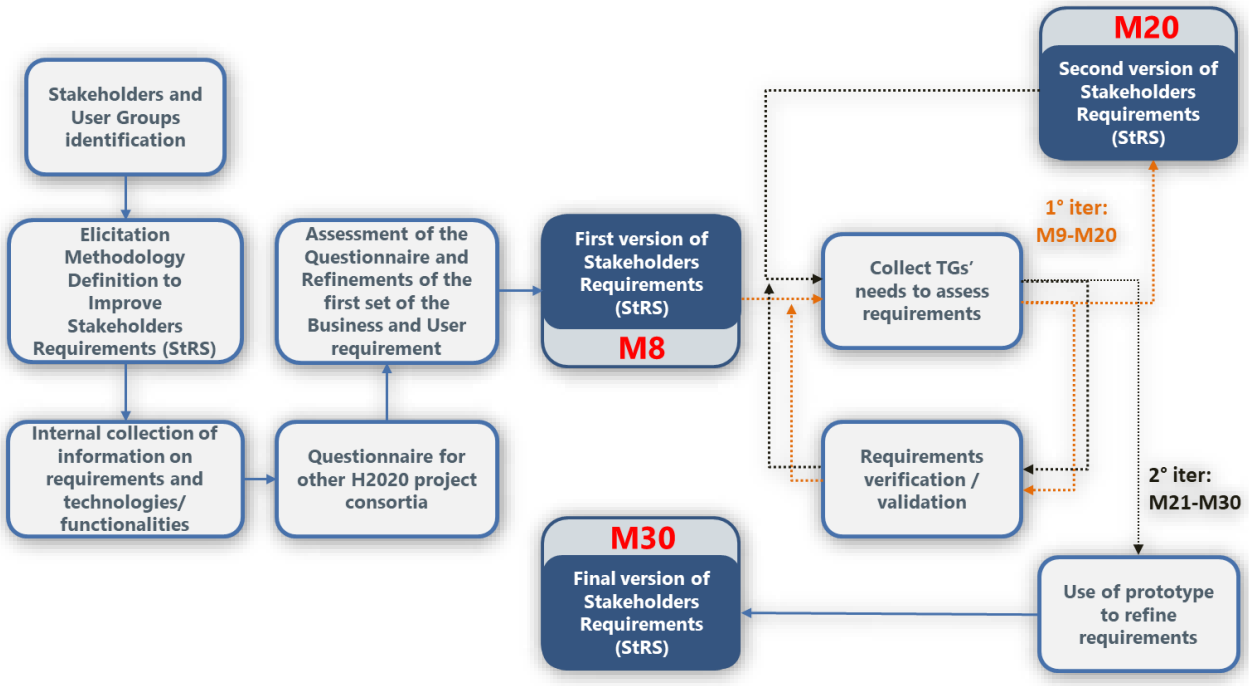


Figure 2 Flow of the Requirements' Elicitation over the life of the eDREAM project

The essential eDREAM Requirements Elicitation process is driven by stakeholders' needs along the project's life, involving them according to the approach defined in Chapter 2. Elicitation is not just a step or a task that must be done at a certain point, it is a set of techniques that are applied throughout the entire project.

The functionalities expected by the eDREAM platform are continuously compared with the different stakeholders' requirements. Therefore, the involved stakeholders and end users of the set of eDREAM technologies and components are at the core of the project in all its phases, for which it is important to use a common method and elicitation techniques and to provide a set of clear requirements for the developers of the system.

Within the eDREAM project, the RE process is structured in three phases as shown in the Figure 2.

In the first phase (Table 4) related to D2.1, the methodologies for identifying the stakeholders and elicit the requirements have been defined. In this phase, the activities have focused on the use of the following tools for the recovery of information: study of the literature, the definition of a first set of requirements through the internal interrogation of the pilots by the internal technology providers, the creation of a project presentation for the external stakeholders and the definition of first version of survey / questionnaire for the external stakeholders.

The work done has been validated through a first round of external consultation in which other H2020 project consortia have been involved in order to create the requirements' base for subsequent activities, i.e. definition of the use cases and system specification (WP2), system implementation (WP3, WP4, WP5), deployment (WP6) and validation (WP7), and the requirements assessment procedures the use of which is expected in the following two phases of this task.

Phase 1: Elicitation preparation and definition of the first set of requirements
• Definition of the methodology for the identification of the potential stakeholders; • Definition of the elicitation methodology to retrieve information for the compilation of the StRS; • Internal elicitation for the identification and categorization of the first set of business and user requirements in order to facilitate the external elicitation; • Preparation of a short, clear and informative presentation of the project for the stakeholder groups identified; • Preparation of the first version of survey/questionnaire to retrieve needs from external stakeholders; • First round of external Stakeholders' Requirements Elicitation exploiting the collaboration with other H2020 project consortia; • Release of the first version of the StRS.

Table 4 Steps of Phase 1 of the RE process

The second phase (Table 5) is the object of this deliverable. The aim has been to provide the consolidated version of business and user requirements after the second round of external stakeholders' requirements elicitation which directly affected on the first phase of component development.

Phase 2: Consolidation of the external requirement elicitation process
• Use of different RE techniques to involve external stakeholders; • Organization of and participation in different events for meeting and discussing the requirements with the external stakeholders; • Online sharing of the questionnaire for the elicitation of stakeholders needs; • Release of the second version of the StRS.

Table 5 Steps of Phase 2 of the RE process

In the third phase (Table 6) related to D2.8, the requirements will be consolidated through the organization of further events including an international conference, postponed to this stage with the aim to utilize the conference to present to stakeholders also the first progress of development in order to get feedback on requirements also on the basis of these advances. The requirements will be validated also using the project prototypes as design-probes in order to produce the final version of StRS.

Phase 3: Requirements final processing and validation
• Continuous Involvement of the identified external stakeholders to assess requirements also through the organization of an international conference to consolidate the requirements through the involvement of the external stakeholders; • Validation/processing of gathered information through the continuous comparison with the project prototype; • Creation of final StRS.

Table 6 Steps of Phase 3 of the RE process

The eDREAM RE process follows an iterative approach in which the repetition of the consultation steps is carried out along the three phases.

The same process for requirements analysis and definition is repeated on the same level of the system definition procedures, providing specific requirements outcomes for the other part of the iteration, i.e. the architectural design process, and for the definition and implementation of the eDREAM system following the methods and the specifications defined in [3] and [4].

Only in the last iteration cycle, when the first versions of the prototypes will be available, the process will exploit these prototypes to study and use the feedback from the first prototype tests that will be carried out with a set of potential users in order to help the final refinements process of the requirements (T2.1), use cases (T2.2) and Architectural and System Specification (T2.4) and to avoid some problems in the last phase of the system implementation (WP3, WP4 WP5), deployment (WP6) and validation (WP7).

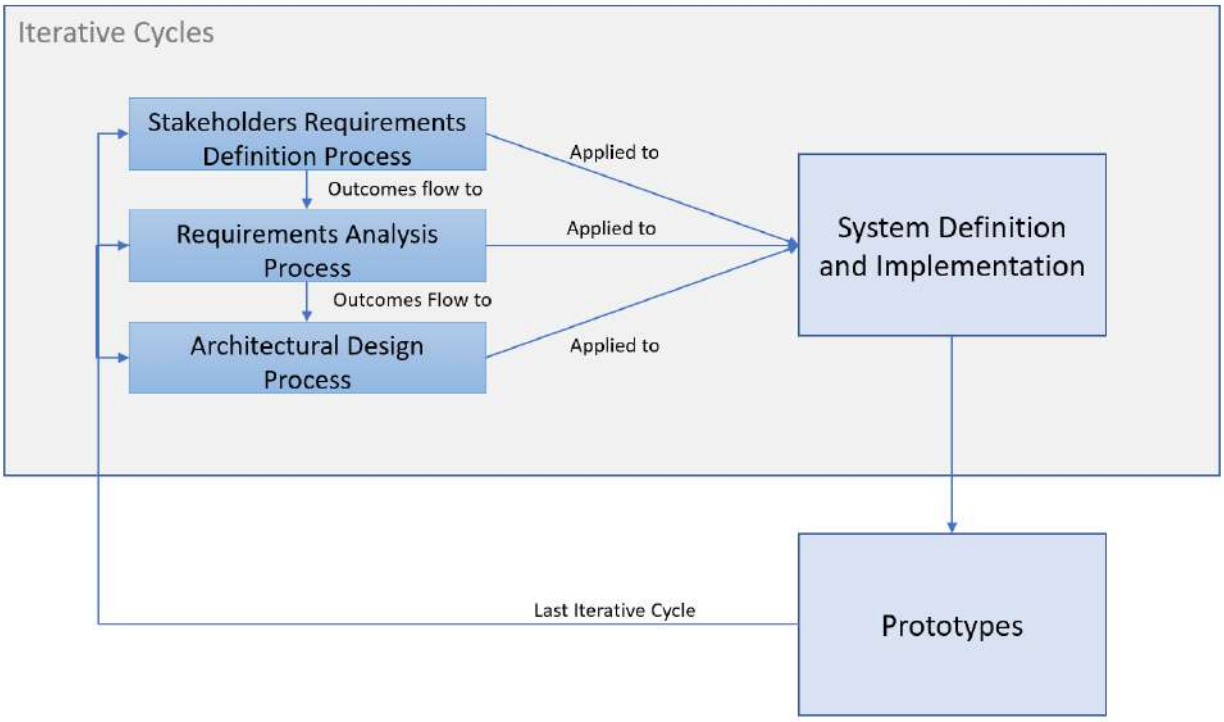


Figure 3 Iterative application of processes for the Requirements Definition and System Specifications

3.2 Techniques and Approaches for Requirements Elicitation and Engineering

Following the iterative process for the requirements definition and system specification already defined in the previous subsection (techniques for gathering and engineering of the needs) the interactions with other project tasks and WPs were always taken into consideration.

This kind of approach will allow us to move from the problem domain, represented by the user needs discovered through in this task, to a definition of a system that will constitute the solution domain, represented by the features of the system and the software requirements that will drive its design and implementation.

The iterative approach also allows us to do so in a logical, stepwise fashion, ensuring an understand of the problem and the user's needs before we define the solution. This road map, along with its important distinctions, is very important also for the subsequent tasks of the project.

In this way, the gap from the problem domain (understanding user needs) to the solution domain (specific requirements intended to address the user needs) is bridged through the application of a "pyramid" approach [5] [6] (Figure 4).

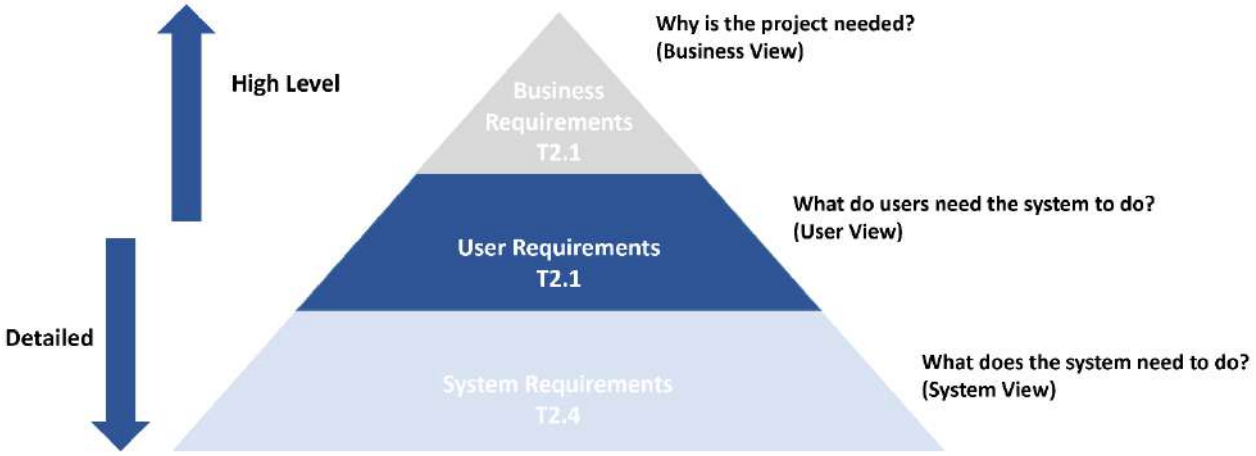


Figure 4 "Pyramid" Diagrammatic representation of the different types of requirements and their eDREAM reference Tasks

The needs pyramidic gathering processes was placed at the top of the pyramid because they are considered high-level requirements in the measure of how much closer the users are. Going down into the pyramid we move away from the user, approaching the design and development phase of the system for which is necessary to detail and deepen the requirements defined at a high level in order to obtain a consistent definition of the system requirements.

Therefore, each level of the pyramid must provide details about a type of requirements to provide answers to the following questions:

- **"Why is the project needed?"** a consolidated set of Business Requirements for the definition of the User and System Requirements;
- "**What do users need the system to do?"** a consolidated set of User Requirements for the definition of System Requirements;
- "**What does the system need to do?"** a consolidated set of System Requirements.

System requirements are clearly articulated statements of what a system must be able to do and satisfy stakeholder needs and requirements. They are derived from business requirements and user requirements.

Focusing on the aims of this deliverable, i.e. business and user requirements definition, the best techniques for eliciting the requirements at the business and user requirements level, were determined as presented in Figure 5[7] and [8]:

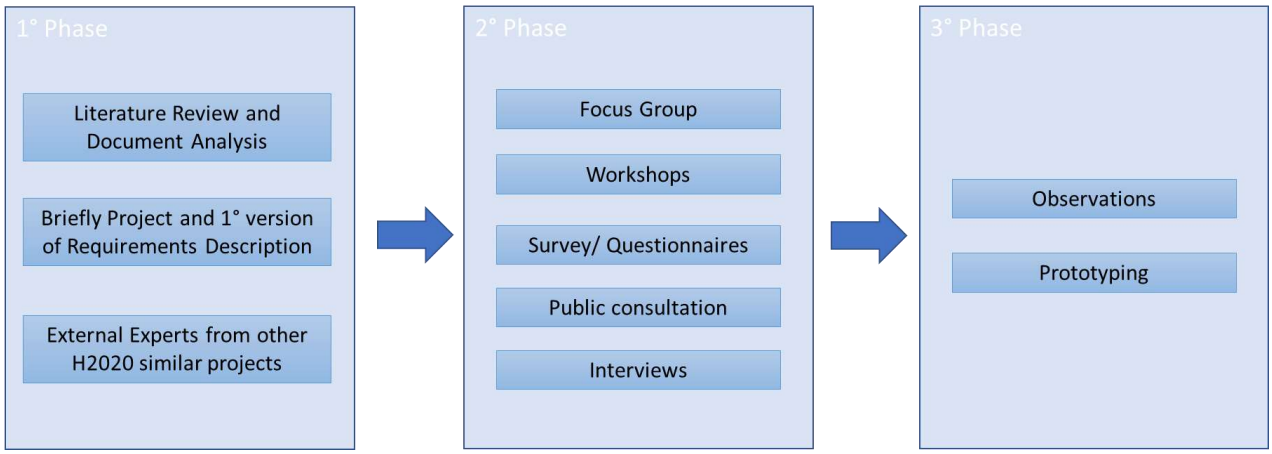


Figure 5 Requirement elicitation techniques and their start in eDREAM project

The tools and techniques selected for the RE process were distributed over the three phases of the process. Each tool was employed in the most appropriate iteration cycle. In consideration of the iterative process, once a tool is introduced it is be used through all subsequent iterative cycles.

Literature Review and Document Analysis: the analysis of existing literature and documentation is an activity focused on the collection and the revision of all the existing appropriate documentation for the project objectives that can contain data related to a relevant solution. Useful documentation could be anything written about the project objectives (e.g. manuals, scientific papers and existing procedures). This type of elicitation is particularly useful when the goal is to upgrade an existing system or when an understanding of an existing system will improve a new system. The analysis of the documentation should not be used as only source. It is often not sufficient to completely extract all the requirements for a given project.

In eDREAM, it has been used as a support activity for the definition of the first set of requirements as a valid base for the subsequent elicitation activities in which more involvement of the stakeholders is expected. As a continuous refinement of the requirements, this activity will be updated along the three phases of the process and will consider new contributions from the literature.

Briefly Project and 1° version of Requirements Description: The definition of the summary of the project and the first version of the requirements by the internal design and development team can be useful to provide greater support to the elicitation activities in which the involvement of the stakeholders is expected.

In eDREAM, a project presentation for external experts has been made. In addition, the first set of requirements has been made through the interaction between the internal partners responsible for the pilots and the design and development team.

External Experts involvement from other H2020 similar projects: The interaction with external experts can be useful for the preparation of the base requirements before starting the activities for the large-scale involvement of the relevant stakeholders.

In eDREAM, the interaction with different consortia of similar H2020 research projects has been started since the first phase of this task through the collaboration with ELSA, DR-BOB and InteGRIDy H2020, continuing in the second phase through the organization of a joint workshop with the project DELTA H2020 and

participation at the Responsible Research and Innovation (RRI) workshop of the RE-COGNITION H2020 project.

In the first phase, the feedback from the other H2020 projects has been used to refine the first set of requirements, while in the second phase the new collaborations have allowed reviewing the requirements also through the use of new methodologies acquired from these other H2020 projects.

Focus Group: Focus groups are made up of a mix of stakeholders who come together to provide input on business needs. Focus groups are particularly useful when key stakeholders are not particularly enterprising or available. They are also a good way to get a lot of information in a short time. Focus groups are also appropriate for establishing a consensus view and highlighting areas of conflict and disagreement during requirement activity.

The eDREAM project started to familiarize with this technique during the second phase of T2.1 thanks to the collaboration with the RE-COGNITION project, understanding its benefits through a dedicated test session during the RRI workshop. In the International Conference to be held in the third period, a specific session will be dedicated to the use of this technique to capture stakeholders' perceptions on the development of eDREAM project.

Workshops: Requirements workshops are meetings in which the collection of information of interest is expected to take place involving previously identified groups of stakeholders. The goal is to obtain, refine and modify the requirements. In order to be successful, the requirements workshop need a moderator to direct the discussion in the needs elicitation workshops, and the input of the participants must be recorded. Participants can also brainstorm together and listen to each other's contributions; they can provide immediate feedback and improvements to identified business needs, which can ensure the quick and effective elicitation of requirements.

In the second period of the T2.1, a joint workshop has been organized together with DELTA project in order to discuss the common elements such as improvement of Demand Response programs currently available, the exploitation of the potential value of the blockchain technology for energy users and the commitment to engaging with stakeholders, establishing impactful two-way communication also through a specific open discussion session that has allowed attendees to ask the questions which mattered to them.

On the other hand, participation in the RRI Workshop of the RE-COGNITION project allowed to deepen the use of specific RRI techniques for the elicitation of information from stakeholders.

Survey/Questionnaires: Questionnaires are mainly used during the early stages of requirements processing and can be structured to offer a series of finite choices for each question or they can offer open-ended input, depending on the needs of the project. Open-ended questions are useful for a broader discovery of business needs. However, open-ended questions are more difficult to analyse than closed questions when the number of participants becomes significantly large.
To be effective, the terms, concepts, and boundaries of the project domain must be well established and understood by the participants and by the designer of the questionnaire. Questions must be focused to avoid gathering large amounts of redundant and irrelevant information. Therefore, questionnaires are useful for quick data gathering from a large group of well-chosen stakeholders. Questionnaires are generally be

considered useful as informal checklists to ensure that key elements are addressed in advance and to establish the basis for subsequent elicitation activities.
Questionnaires should be paper-based or web-based structured forms, with instructions for completion. For a successful questionnaire, it is essential to require to the participants to provide the relative feedback within a reasonable deadline and to keep confidential company information confidential.

Taking full advantage from the questionnaire already prepared in the first iterative cycle for the consultation of other similar H2020 project consortia, a refined version of the questionnaire has been used during the second period to retrieve useful information for updating requirements. In particular, in the second period of this task, the questionnaire has been shared in several events and it was also shared online at the following link: https://edream-h2020.eu/questionnaire-for-the-elicitation-of-stakeholders-needs/.

Public consultation: It consists on acquisition of the opinions of stakeholders and other interested parties (EU citizens, public and private organizations etc.), in order to gain quantitative evidence on their requirements.

A first public consultation has been launched through the sharing of the questionnaire for the stakeholders on the eDREAM website at this link: https://edream-h2020.eu/questionnaire-for-the-elicitation-of-stakeholders-needs/.

Interviews: in the RE phase is important for the design and development team to meet the stakeholders and, at the same time, it is important to let feel them involved. For these reasons, interviews are the most popular and common technique used for RE. They offer the opportunity to discuss the thoughts and feelings of stakeholders and get their perspectives on the business needs and the feasibility of potential solutions providing an efficient way to quickly collect large amounts of data.
Because interviews are essentially social activities based on human interaction, they are intrinsically informal and their effectiveness depends a lot on the quality of interactions among the interviewees. The interviews results, such as the usefulness of the information collected, may change significantly depending on the interviewer's skills. There are different ways to conduct interviews. In particular, there are three most common types, i.e. unstructured, structured, and semi-structured.
Structured interviews present predefined questions while the unstructured interviews are usually free-flowing conversation in which the interviewer applies only limited control over the direction of the discussions. Semi-structured interviews represent generally a combination of the former two. In each case, at the end of the interviews, it is important to share the notes with the interviewees in order to make sure that there have been no misunderstandings.

In eDREAM, interviews has been used to validate and consolidate the results obtained through the questionnaire-based consultation.

Observations: observation is useful when considering a project that will change or improve current processes. It consists of the observation from the analyst of the actual execution of existing processes by the users without direct interference. This technique is often used in conjunction with others such as interviews and task analysis. There are two basic types of observation, direct and indirect observation. Direct observation is used to understand the nature of tasks and the context in which they are performed. In direct observation, the participants are observed directly in their natural setting in order to understand the nature of the tasks

and the context in which they are performed. The observer, that could be a member of the design team or not, record their findings and report them back to the design team carry out the observations. Indirect observation is used less often within the required activity, e.g., Interaction logging on an existing system can be used to provide data on how an activity is performed at the moment, but the information is too closely related to the details of the existing IT support to be particularly useful if a completely new system is planned.

In eDREAM, direct observation will be used starting from the third iteration cycle of the RE process, taking full advantage by the presence of internal stakeholders in the project consortium, involving them in validation activities in order to obtain the first feedback from these activities. This feedback will simplify the use of the prototypes as a design probe.

Prototyping (storyboard, navigation flow, paper prototyping, screen flows): Prototyping is particularly useful for stakeholders, such as business owners, and end users who may not understand all the technical aspects of the requirements, but can better understand a visual representation of the final product. To quote BABOK [8], "Stakeholders often find prototyping to be a concrete means of identifying, describing and validating their interface needs". The prototyping process is normally iterative, improving as stakeholders gather more inputs and assessments. Prototyping can be an interactive screen (normally consisting of hypertext only without real data behind it), a mock-up (like a PowerPoint), a navigation flow (like a Visio diagram) or a storyboard. In the early stages of the discovery, it is possible to make simple and loss-free prototypes (such as pencil sketches) and create more detailed interactive prototypes once the business requirements have been identified. In the latter case, a more detailed prototype phase, the functionality of the prototype must meet the business needs previously identified as indicated in the requirements.

In the eDREAM context, the first version of the prototypes will be used to assess the requirements already defined in the previous stages by verifying the prototypes adherence with what was expected according to the requirements.

3.3 Feedback from Stakeholders Requirements Elicitation process

3.3.1 Focus Group

Taking advantage of the collaboration with the RE-COGNITION project, it was possible to investigate the peculiarities of this instrument and its use to obtain useful information from stakeholders.

Several kinds of activity based on the focus group method have been used with particular focusing on energy projects.

In particular, the focus groups held jointly with the RE-COGNITION project consortium gave the opportunity to deepen various aspects such as (1) future thinking (comparison on hopes about the energy projects impact at 5, 20, 100 years), (2) comparison of the different standpoints (reflections on collective standpoints of group, similarities and differences between the standpoints, interest in innovation and missing points), (3) Realms of responsibilities (analysis of the actors involved and comparison of the responsibilities towards them of energy projects), (4) Hippocratic Oath (identify statements to be included in a hypothetical Hippocratic oath related to energy projects).

These activities have been especially useful for the elicitation of requirements related to the long-term perspectives of the energy projects.

These long-term perspectives refer essentially to many aspects of project collaboration, enabling the description of the problem and the related processes and stages of its development, recognizing the usefulness of long-term information and the value of informal learning, clarification and consensus over societal goals and challenges as well as the means to meet them.

Figure 6 RRI Recognition Workshop - joint Focus Groups to deepen some aspects of energy projects

3.3.2 Workshops

In the second period of the T2.1 a joint workshop has been organized together with DELTA project in order to discuss the common elements of the two projects and establish impactful two-way communication.

In particular, some networking activities for the attendees has been conducted with the aim of encouraging their involvement and confrontation with the project consortia. Both projects have presented their progress, offering an interesting contrast with eDREAM and DELTA at slightly different stages of their lifecycle.

The DELTA consortium has presented early progress focusing on:

- The overall aims, objectives and motivations for the project;
- The project architecture including the fog-enabled intelligent device and DELTA Virtual Node;
- Some of the already identified business requirements and use cases.

The eDREAM consortium has presented an overview of the project and some of the key innovations which have been progressed over the first 11 months of the project, such as:

- Blockchain as an enabler for managing energy grids;
- Demand response potential forecasting;
- Drone surveys for evaluating asset potential.

The presentations allowed to have a specific open discussion session during which the stakeholders have discussed the key innovations of the projects and asked the questions which mattered to them.

This open format was one of the most important elements of the joint workshop. Feedback was positive and a discussion followed, with the strengths of each project on show. Particularly encouraging was the appreciation from many stakeholders of the potential of digitalization in all levels of the energy market. With both projects having blockchain technology as integral elements of their innovation, the opportunity to discuss wider digital trends was important for the two projects and to update the requirements of both projects.

Figure 7 Joint Workshop eDREAM & DELTA projects

On the other hand, participation in the RRI Workshop of the RE-COGNITION project allowed to deepen the use of specific RRI techniques for the elicitation of information from stakeholders. This allowed the sharing of methods and objectives with other energy projects such as RE-COGNITION and to experiment the RRI techniques to update the project requirements participating in different sessions devoted to thinking about the legacy the project could have in 5, 20 or 100 years' time, anticipate what positive and negative impacts the projects might have on people and nature, and agree on an RRI pledge that will help to align the projects work to the RRI framework. The training will be followed up by regular focus groups with attendees to continue discussions and reflections on RRI throughout the projects.

3.3.3 Questionnaire and Public Consultation

During the first phase of RE from the stakeholders, we have established a close collaboration with other three similar H2020 European projects. Thanks to this, we were able to involve several external experts and stakeholders since the first phase of the project. In particular, the involvement of experts from these projects has represented the first step of the continual requirements updating process based on the feedback from external stakeholders.

The three projects are:

- ELSA, https://www.elsa-h2020.eu/

  The project Energy Local Storage Advanced system (ELSA) brings distributed storage solutions to maturity. Its objective is to enable their integration into the energy system and their commercial use. ELSA addresses existing development needs by combining 2nd life batteries with an innovative local ICT-based Energy Management System in order to develop a low-cost, scalable and easy-to-deploy battery energy storage system.

- DR-BOB, https://www.dr-bob.eu/

  The key functionality of the DR-BOB Demand Response energy management solution is based on aggregating blocks of buildings and performing real-time Demand Response events and optimisation of the local energy production, consumption and energy storage. The optimisation can be adjusted to maximise economic profit or to minimise CO2 emissions according to user requirements. The solution is and can adapt to fluctuations in the energy demand or production, subject to dynamic price tariffs and changing weather conditions.

- inteGRIDy, http://www.integridy.eu/

  inteGRIDy aims to integrate cutting-edge technologies, solutions and mechanisms in a scalable Cross-Functional Platform connecting energy networks with diverse stakeholders, facilitating optimal and dynamic operation of the Distribution Grid (DG), fostering the stability and coordination of distributed energy resources and enabling collaborative storage schemes within an increasing share of renewables.

The eDREAM project questionnaire has been used to retrieve feedback from experts and stakeholders. In particular, 33 experts and stakeholders provided answers to the questionnaire: 7 from ELSA project, 16 from DR-BOB project and 10 from inteGRIDy project.

In the second phase of the Task (M9-M20) the process for the assessment of the requirements has continued through the proposition of the questionnaire to the external stakeholders during the events both those organized by the eDREAM consortium and those in which eDREAM partners have taken part and through online public consultation.

In particular, the questionnaire has been shared during the following events:

- Joint Workshop eDREAM and DELTA H2020 European projects - “Solution for next generation demand response services”, London (UK), November 2018;
- “Energy Efficiency - an essential condition for sustainable development” conference, Bucharest (RO), May 2019;
- RE-COGNITION H2020 Workshop - “Exploring Responsible Research and Innovation”, Bristol (UK), July 2019.

In the second phase, a close collaboration has been established with other two H2020 similar projects and there were 20 stakeholders who provided answers to the questionnaire.

The two projects are:

- DELTA, https://www.delta-h2020.eu

  DELTA proposes a Demand-Response (DR) management platform that distributes parts of the Aggregator’s intelligence into a novel architecture based on Virtual Power Plant (VPP) principles. It will establish a more easily manageable and computationally efficient DR solution and will deliver scalability and adaptiveness into the Aggregator’s DR toolkits.

- RE-COGNITION, https://re-cognition-project.eu/

RE-COGNITION aims to pave the way for large-scale deployment of building-level Renewable Energy Sources and increase their share in the energy mix of EU in a safe and secure way for the grid. The main ambition of the RE-COGNITION is to develop a future and technology-proof integrated solution aiming to maximise the utilisation of the energy that is locally produced by building-level renewable energy technologies and to reduce implicitly and explicitly induced costs, towards Zero Energy Building's realisation. Combined applications of different Renewable Energy Technologies resulting in carbon-neutral buildings.

Furthermore, again in the second phase of the project, a public consultation has been launched through the questionnaire sharing on the project website. The public consultation was carried out in order to get more feedback, facilitating the interaction with the network of experts and stakeholders in contact with the eDREAM project consortium members and, in general, giving the possibility to provide feedback to the website visitors interested in contributing to the project.

Thanks to the public consultation, it was possible to collect feedback from other 10 stakeholders who have provided their answers to the questionnaire via the project website.

Therefore, at the end of the second phase of this task (M9-M20), more than 60 stakeholders from all over Europe have provided feedback by answering to the project questionnaire.

Following is reported a detailed analysis of the feedback received from these stakeholders, that allowed releasing the second version of the business and user requirements.

Q1. What is your background?

The stakeholders who provided answers to the questionnaire have been in total 63. The distribution based on their background shows a strong presence of stakeholders belonging to the scientific community, the general public, commercial and residential customers and technology providers, many of which have been managed closely according to the Power/Interest Grid defined in chapter 2, fully involving them in all phases of the elicitation process and trying to completely satisfy their needs in defining the project requirements.

Moreover, the percentage of respondents in categories not considered in the stakeholders' definition phase was high, in fact, 11% of the respondents have indicated "Other" as their own background.

In particular, 4 of the respondents in the second phase of the project have indicated "other" as their own background, belonging to categories such as regulatory authority, non-governmental agency for energy efficiency and environmental protection and water utility. According to the Power/Interest Grid defined in chapter 2 of this deliverable, also the feedback from these categories have been monitored.

The total of the stakeholders who provided answers to the questionnaire is distributed as follows:

DSOs	5%
Aggregators	3%
ESCOs	5%
Technology Providers	8%
Distributed Generation Providers	5%
Energy retailers	5%

Scientific community	22%
Prosumers	5%
Commercial and Residential Customers	9%
Facility managers	5%
System operators	1%
Stakeholders at the Pilot Sites	3%
General Public	13%
Other	11%

Table 7 Percentage distribution of the categories of external stakeholders who provided answers to the questionnaire

Q2. Do you use Demand Response programs?

The analysis of the responses shows that a third of the experts questioned already use DR programs. While despite the two thirds of the respondents are not involved in the use of DR programs, it is important to note that about half of them would still be interested in DR programs.

Following the Power/Interest Grid defined in chapter 2, the feedback coming from the stakeholders who use or would like to use the DR programs were managed very carefully in all phases of the elicitation process, taking into consideration also the feedback from the respondents who never used DR programs as their advice can be very useful for the details of the project.

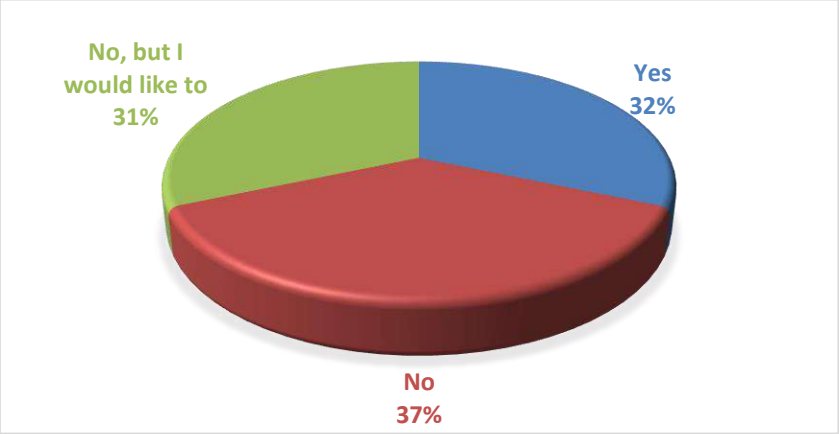


Figure 8 Pie Chart representing percentage distribution of the usage of DR programs by external experts

Q3. Which type of Demand Response programs do you use or know?

With this question, we wanted to ask external stakeholders that use or know DR programs to tell us what kind of program they currently use or know. This type of knowledge has helped us in defining the project objectives and the related application scenarios with consequent effects on the definition of the requirements.

The DR programs used or known by the external experts are different and their intensity of use can be summarized as follows:

Time-of Use (TOU)	16
Real Time Pricing (RTP)	4
Critical Peak Pricing (CPP)	9

Direct Load Control	7
Interruptible/Curtailable (I/C) Service	4
Demand Bidding/Buy Back (DB)	1
Emergency Demand Response Program (EDRP)	7
Capacity Market Program (CAP)	4
Ancillary Service (A/S) Markets	7

Table 8 DR programs intensity of use

The following types of Demand Response programmes are distinguished:

- **Time-of-use (TOU) Rate:** a rate with different unit prices to be used during different periods of time, generally defined for a 24-hour day. The TOU rates reflect the average cost of generating and supplying energy during those time periods. Daily price blocks could include an on-peak, partial-peak and off-peak price for non-holiday weekdays, with the on-peak price as the highest price and the off-peak price as the lowest price;
- **Real Time Pricing (RTP):** a retail tariff where the price of electricity fluctuates generally per hour reflecting changes in the wholesale price of electricity. RTP prices are generally known to customers on a day-ahead or hour-ahead basis;
- **Critical Peak Pricing (CPP):** hybrid of the TOU and RTP design. The basic tariff structure is TOU. However, it is planned to replace the normal peak price with a much higher CPP event price under certain trigger conditions (e.g., when the reliability of the system is compromised or the supply prices are very high);
- **Direct load control:** allows the utility a certain degree of control over certain equipment, such as switching off non-critical loads or changing device parameters (e.g., increasing the temperature in centralized AC generators) in order to reduce the electrical load in the network;
- **Interruptible/Curtailable (I/C) Service:** customers receive a discounted rate for agreeing to reduce the load on request;
- **Demand bidding/Buy Back (DB):** close to dynamic pricing, customers can offer bids to reduce loads when wholesale market prices are high;
- **Emergency demand response programs (ERDP):** customers receive incentives for load reductions when needed to ensure reliability;
- **Capacity market programs (CAP):** customers offer load reductions as system capacity to replace conventional generation or delivery resources. Customers generally receive day-of notice of events and face penalties for not having reduced the request when called upon to do so. Incentives generally consist of advance booking payments;
- **Ancillary Service (A/S) Markets:** customers receive payments from a grid operator for having committed to limit the load when necessary to support the operation of the electricity grid (i.e., auxiliary services);

Q4. Do you apply DR programs in both residential and commercial buildings?

A large part of the respondents uses DR programs in the commercial sector, including public buildings (83% of total respondents and 100% of the stakeholder respondents during the second phase of the task) and a minority part of the respondents use the DR programs in the residential sector (17% of respondents).

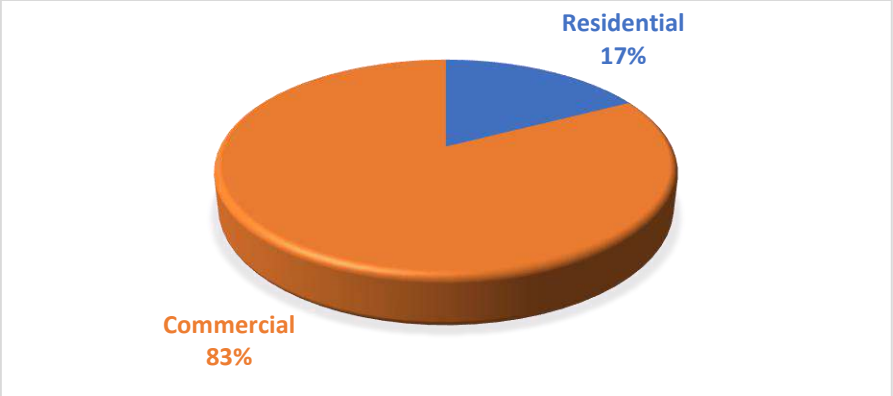


Figure 9 DR programs - domain of application by external stakeholders

Q5. In which case do you apply the DR programs?

There are different cases in which the respondents are engaged with the application of DR programs. In particular, some of the respondents use DR programs on an experimental basis as a pilot for EU project. Others are involved in the management of a grid portion balancing supply and demand in the islanding niche of distribution grid context.

Among the respondents there are also who use DR programs in the manufacturing process (e.g. switching according to the load, or in the dispatching from National Grid/DNO). The Technical University of Cluj-Napoca and Teesside University, as a member of the DR-BOB projects and other research and innovation projects such as RE-COGNITION, experiments with the application of demand response policies using their university block of buildings as a demo lab.

Other stakeholders use DR programs in contexts like the verification of asset availability and others have included DR programs in contracts with ESCO in order to reduce costs.

Finally, in the second phase of the task (M9-M20) and especially during the joint workshop with the Delta H2020 project, it was noted that many of the respondents apply demand response programs for Short Term Operating Reserve (STOR) balancing services and for capacity market giving the possibility to deepen how these services will be implemented as a part of the third use case of the eDREAM project.

Q6. What are, in your opinion, the users' limitations on applying DR programs?

In order to assess the obstacles to the application of the DR programs in defining requirements, we asked the external stakeholders to give an opinion on the main limitations of the DR programs.

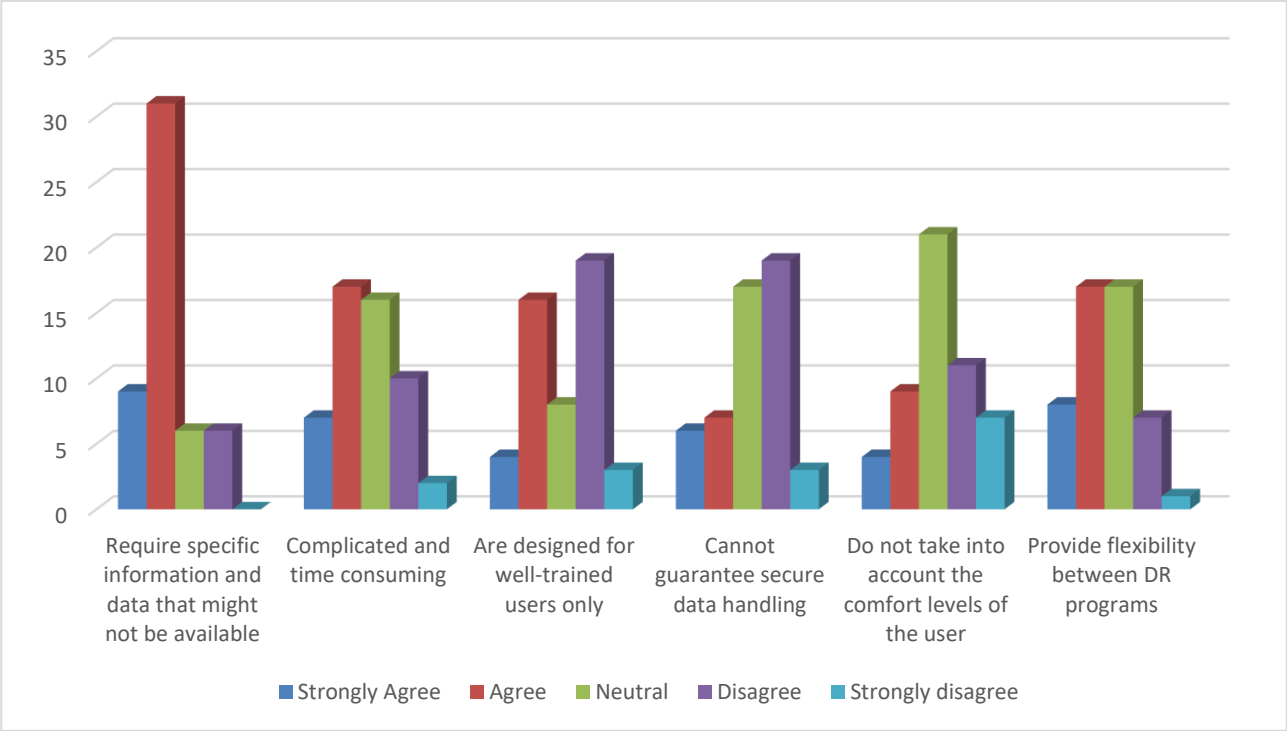


Figure 10 External Stakeholders opinion about the limitations on applying DR programs

Q7. What tools do you use for the implementation of the DR programs?

The following pie chart (Figure 11) summarizes the answers obtained from this question, thanks to which it was possible to obtain information on the state of the art of the application of DR programs among eDREAM stakeholders. This information was very important in order to understand the usefulness of the functionalities that eDREAM plans to develop.

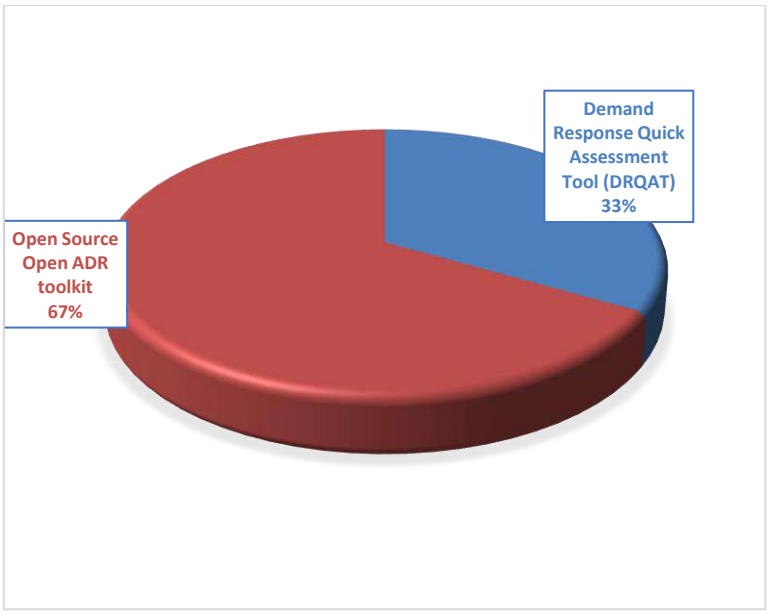


Figure 11 Tools used for DR programs by the External Experts

Regarding those who indicated the use of other tools for the implementation of DR programs, most of these respondents specified to use tools developed in-house to provide several functionalities such as:

management of local energy storage, DR potential analysis, DR platform and tool to monitor, analyse, optimize and predict energy consumption, DR programs for the participation on the flexibility market, usage of HTTP based DR messaging REST API and usage of BEMS.

Q8. Could you please indicate the specific standards or methods used during the application of DR programs (i.e. for data standards)?

Thanks to this question it was possible to verify the interoperability needs on the base of the systems used by the stakeholders, verifying how at the moment the problem is faced and having the opportunity to evaluate the distribution of the open standards and of the solutions based on proprietary standards.

The technologies and standards indicated, mainly for data standard, from the external stakeholders are the follow: (1) Open ADR, (2) Rest API, (3) Metering Data provided in formats requested by national grid; (4) Sensors Mesh network communication standard based (Zwave, Zigbee, WiFi), openHAB "agnostic" protocol, API, other (e.g. CSV or other metering data format).

The general methodologies mainly used by the stakeholders are: (1) user profiling engine, (2) flexibility estimation engine and (3) visual analytic engine, all part of the objectives of the eDREAM project

In the Figure 12 is reported the distribution represented with pie charts:

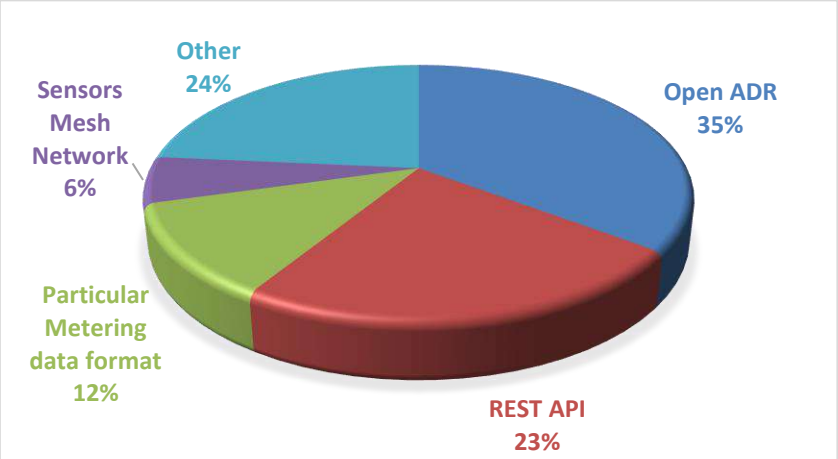


Figure 12 Distribution of the specific standards or methods used by the stakeholders during the application of DR programs

Q9. In your opinion, what are the aspects that are not currently taken into account during the application of DR programs (e.g. comfort level)?

In defining the requirements, this question helped us to identify and understand the main problems that a project about Demand Response has to solve according to the opinion of the experts and stakeholders' groups. The answers are presented in Tables 9-15:

ELSA
Internal processes of the production
Comfort Level: In case of set-point actuation for load control there are two option: (1) to stay in comfort range, (2) to leave the comfort range. Data security is still a challenge specially in case of flexibility services

Flexibility protocol

Table 9 Aspects not yet addressed by DR program - ELSA experts' opinion

DR-BOB
Comfort level in terms of objective KPIs, energy capacity of the users, motivation to participate (rewards), talking about energy savings itself isn't really interesting so way to find a way to better engage people
Flexibility indicator, impact on the national infrastructure of electricity distribution and production
Feedback to consumers
For blocks of buildings the aggregation of the energy data leads to an energy profile over several peaks
At the moment there is no real available DR offer for residential in France
At the moment there is no real available DR offer for residential in Romania
Comfort
Comfort level of the end users, baseline to take into consideration
Comfort level of the end users
Comfort level, occupants' engagement
User interaction
Load variation, comfort level

Table 10 Aspects not yet addressed by DR program - DR-BOB experts' opinion

inteGRIDy
Comfort level
Cultural differences: young democracies insist on real-time monitoring; they are afraid that these data are not secure
Customer involvement
Specific equipment required and associated costs
Comfort level, flexibility for the application of the DR programs
Comfort level
Level of power available (or not) to operate DR, end user comfort
Simpler pricing schemas

Table 11 Aspects not yet addressed by DR program - inteGRIDy experts' opinion

Joint Workshop eDREAM and DELTA H2020 European projects

Comfort level, Weather Information
DSO Grid reinforcement - Connection agreement
Minimum business limit of operation
Industry specific data security issues
Double remuneration
Complexity arises ensuring that commercial processes are protected and are not switched at process critical stages
Comfort level, monetary and environmental gain information, real time DR effectiveness visualization

Table 12 Aspects not yet addressed by DR program – Feedback from the stakeholders participating in the joint workshop eDREAM and DELTA project

Energy Efficiency - an essential condition for sustainable development conference
Comfort level, Weather Information
Decrease Consumption

Table 13 Aspects not yet addressed by DR program - Feedback from the stakeholders participating in the Energy Efficiency: an essential condition for sustainable development conference

RE-COGNITION
Equipment costs
Comfort level
Customer engagement
RES integration

Table 14 Aspects not yet addressed by DR program – RE-COGNITION experts' opinion

Public Consultation through project Website
Occupants are not very involved because they don`t understand the benefits.
Comfort level and training people to understand the system load curve and the production needed to cover the peak demand
Reality in correspondence with papers
Indoor comfort, rational use of energy
Comfort level
Occupants involvement, laptops batteries management
Real participation of average users, real environmental concerns

Table 15 Aspects not yet addressed by DR program - Feedback from the stakeholders who provided feedback via the project website

Q10. In your opinion, what type of tool can improve the performance of DR programs?

During the requirements definition, this question can help to keep in mind the priorities in terms of functionality to be provided. In this regard, bar chart are presented in Figure 13 to summarize the results of the preferences in terms of tools that could solve the problems of application of the DR programs.

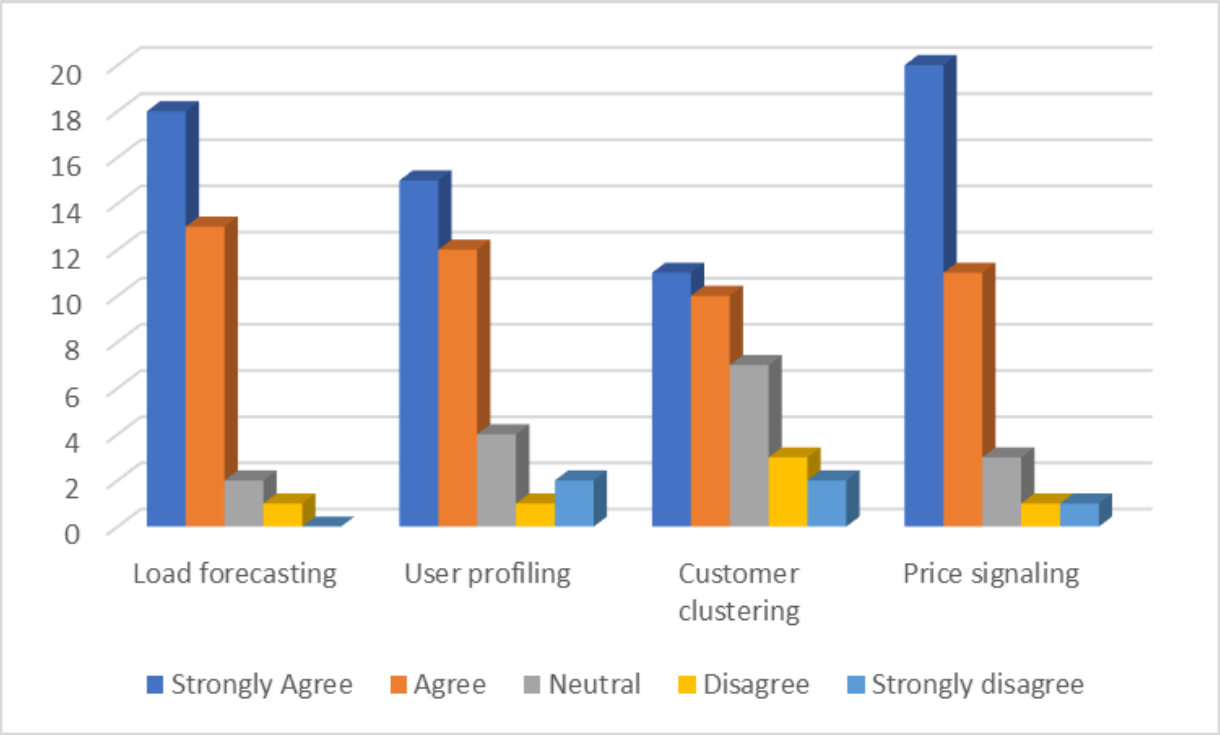


Figure 13 External Stakeholders preferences in terms of tools to improve the performances the DR programs

Q11. Which aspect of the demand response forecast and energy flexibility assessment phase would you like to improve?

The most frequently mentioned assessment phase aspects to be improved were load and production forecasting also through the use of the information about weather and building occupancy, and the generation and evaluation of the baseline.

In this regard, the attention of the stakeholders interviewed focused on the need to improve the accuracy of the measurements and to use appropriate timing in order to guarantee high-frequency updates and improve the prediction accuracy to allow to better manage the cases in which data is missing.

Other aspects mentioned were capacity market and incentivizing, what-if scenario and cost/benefit simulation forecast.

Finally, some of the stakeholders suggest defining some KPIs for evaluating the demand response forecast and energy flexibility assessment phase.

Q12. Using drones for aerial surveying in combination with thermal imaging and laser scanning can assist in assessing demand response potential. Would you be interested in using drones for estimating the demand response of potential prosumers?

They were 36 stakeholders who have provided an answer to this question, of these, 19 gave a positive response while 17 gave a negative response.

Then, the 53% of respondents showed interest in the use of the drones for aerial surveying in combination with thermal imaging and laser scanning in the assessment phase of DR application for estimating the demand response of potential prosumers. Considering the composition of the respondents (see Question n. 1) we can say that this was an important result which was taken into account during the definition of the requirements.

Q13. What methods currently do you use for load forecasting?

The knowledge of the methods used by external experts for load forecasting can be important both in the project requirements definition phase and in the subsequent phases in which this specific functionality will be developed in the context of the eDREAM project.

Through this information, it is possible to understand how the different methodologies for load forecasting are consolidated and how the new artificial intelligence technologies, such as deep learning, are spreading.

In Figure 14 are summarized the answers obtained from the external stakeholders:

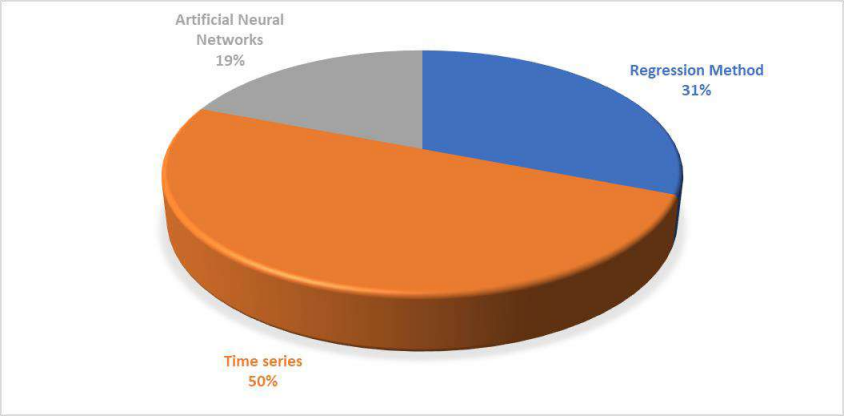


Figure 14 Methods used for load forecasting by the External Stakeholders

Regarding the methodologies based on the time series and those based on artificial intelligence, stakeholders were asked to provide details about the specific methodologies used.

In Figure 15 is reported the distribution of the time series based methodologies used by the stakeholders who provided this detail, while in Figure 16 is reported the details about the artificial intelligence methodologies used by the respondent stakeholders.

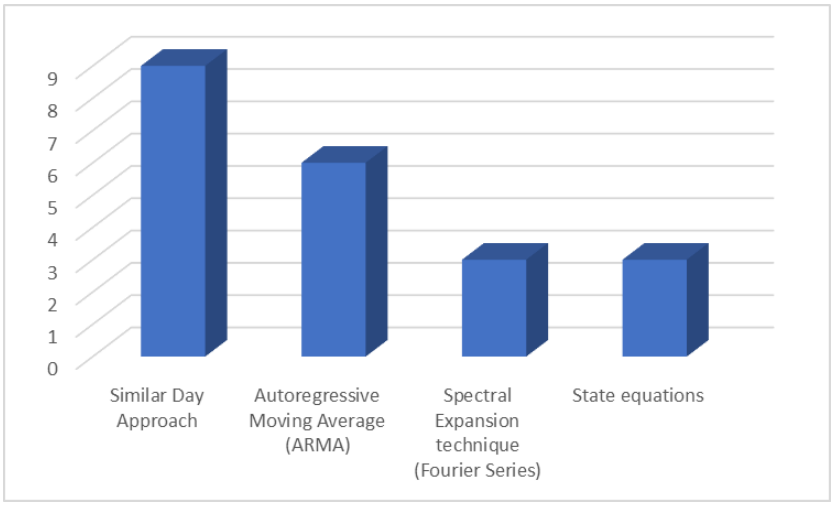


Figure 15 Distribution of the time series based methodologies used by the respondent stakeholders

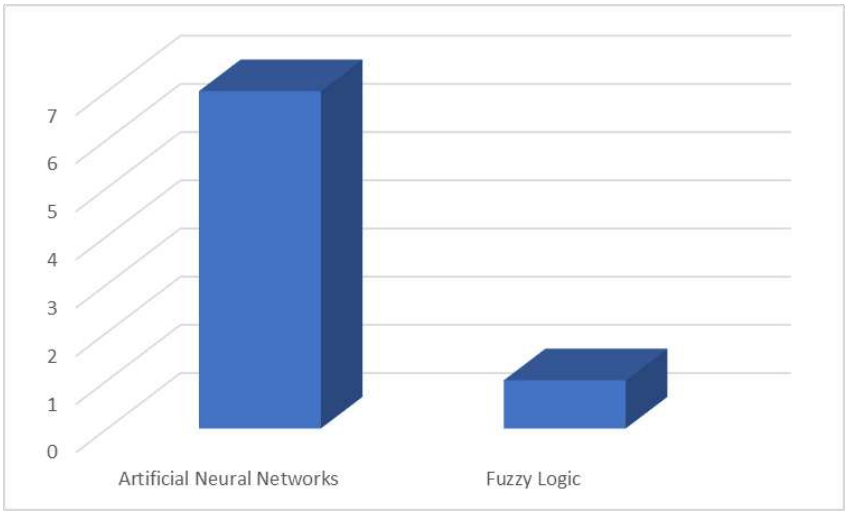


Figure 16 Distribution of the artificial intelligence based methodologies used by the respondent stakeholders

Q14. Which aspect of load forecasting would you like to improve? (e.g. improve accuracy; use of separate forecast model for each of the metering systems; consideration of PV/RES degradation)

Besides knowing the methods used for load forecasting, it is also important to know what the problems related to this functionality are in order to define the specific needs of the stakeholders for the definition of the requirements.

The aspects to improve the load forecasting are the following according to the external experts:

- PV/RES degradation;
- Ensure the use of other methods adopted for building profiles;
- Consideration of the number of devices (loads) in buildings and the number of occupants in real-time;
- Consideration of user behaviour and occupancy;

- Improving load forecast accuracy and peak values;
- Using a separate forecast model for each metering segment;
- Monitoring power in order to identify peak times (under a minute frequency);
- Consideration of weather forecasting.

In particular, in the second phase of the task (M9-M20) the respondent stakeholders have emphasized the need to improve the accuracy of load forecasting with particular attention to modelling at asset level, building level and groups of building level. Other aspects mentioned in the second phase of the task have been the necessity to consider the following aspects: (1) building occupancy, (2) weather forecasting, (2) PV/RES degradation and (3) usage of separate forecast models for each metering system.

Q15. Which aspect of customer clustering and segmentation would you be interested? (e.g. facilitate billing strategies definition based on the specific operational profiles)

The aspects of customer clustering and segmentation for which external stakeholders have indicated interest in the first phase of the task are:

- Facilitating billing and deployment strategy;
- Consideration of Block of Buildings;
- Splitting assets by profile;
- Clear regulation on the aggregator role;
- Consideration of flexible appliances in place, battery and thermal storage;
- More stable load;
- Easier forecasting causes the user behaviour is less influential;
- Data security;
- More flexibility;

These aspects have already considered in the definition of specific requirements and also in the definition of the application scenarios and use cases defined in Deliverable 2.2.

In second phase of the task, the respondent stakeholders have emphasized the interest for mechanisms able to guarantee customers flexibility in terms of economic gains and comfort and different tariff for the peak period, providing profit for customers and other types of benefits for customer clustering. These aspects have been considered to update both the requirements reported in this deliverable and the first two high-level use cases in deliverables D2.5 and D2.7.

Q16. Does your current trading system guarantee secure transactions, if any?

Only 37% of external stakeholders believe that their trading system guarantees secure transactions and this percentage drops down to 22% if only the respondent stakeholders of the second phase of the task are

considered. This information highlights how important it is to take this aspect into account during the requirements definition and updating phases. For this reason, this aspect has been carefully considered in the definition and updating of requirements relative to the 3rd macro-functionality.

Q17. Are you interested in secure personal data handling during the DR programs' procedures?

As for the first phase, also for the second phase of this task, 100% of the respondent stakeholders expressed interest in secure data handling during the DR programs' procedures, therefore this is an aspect which has been taken into great consideration in the requirements definition and continues to be so even in the phase of updating the platform requirements. Indeed, this aspect has been carefully considered in the definition and updating of requirements relative to the 3rd macro-functionality.

Q18. What issues do you want to address and ameliorate through secure DR programs in the grid side as a DSO? (question for DSO)

Considering the DSOs were just a little more than 5% of respondents, it has been important to find out the issues to address and ameliorate through secure DR programs in the grid side from the point of view of the DSOs to define and update the requirements and the use cases involving this aspect.

In the first phase of the task, the DSOs interviewed emphasized the necessity to reduce peak load and the peak demand mitigation during certain periods of the year while in the second phase of the task the DSOs interviewed pointed out the following issues to be addressed: (1) grid reinforcement, (2) secure data channel and (3) peak reduction and optimisation load forecasting.

Q19. Are you interested in automatic financial settlement through the use of smart contract?

As shown in the following figure, the 75% of the external stakeholders interviewed are interested in automatic financial settlement through the use of the smart contract.

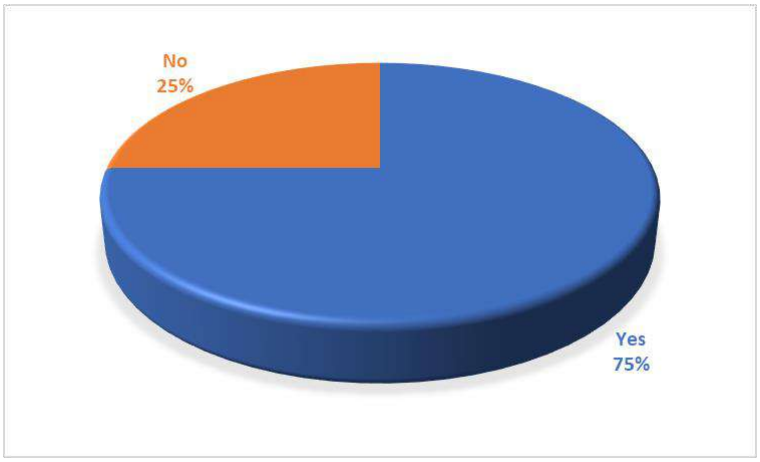


Figure 17 Interest in automatic financial settlement through the use of the smart contract from the external stakeholders

This indicates the stakeholders' great interest in this method of managing financial transactions, confirming the validity of the approach proposed by the eDREAM project. This aspect has been carefully considered in the definition and updating of requirements relative to the 3rd macro-functionality.

Q20. Do the current tools provide interactive user visualization?

Having an interactive user visualization interface is very important for a DR service platform. The 65% of the experts interviewed already use a tool for DR program equipped with a graphical user interface which allows platform users to interact with the platform. The remaining 35% do not use tools with a graphical interface because, for the moment, they use the software internally in their organization or only for academic reasons. Many of the stakeholders interviewed have expressed the necessity to have interfaces able to provide more accurate analytics, as the eDREAM project proposes, through tools such as the multi-level visualization tool. In the description of answers to the next question, the specific needs in terms of user visualization defined by the respondent stakeholders have been reported.

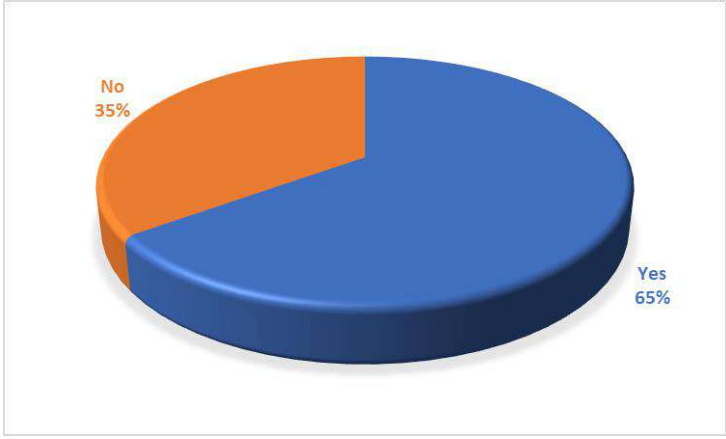


Figure 18 Percentage of external stakeholders applying DR programs with or without a GUI-based platform

Q21. What do you expect from interactive multi-purpose visualization tool for the application of DR programs?

In defining the requirements, this question helped us to identify and understand the main needs in terms of visualization that a project on Demand Response has to satisfy according to the opinion of the external experts and stakeholders' groups. The following are the different answers provided by the experts:

ELSA
Helpfully for customer
Improve the visualization also through tools for the user involvement such as the gamification. Tools for error diagnosis

Table 16 Expectation from visualization tool for DR programs - ELSA experts' opinion

DR-BOB
More analytics
Motivate the end users to involve

BMS/EMS connected to real DR programs allowing automatically manage assets and send the data in secured way to DNO/DSO. Based on BIM probably to allow exploitation of building during the whole lifecycle.
A real time and historical analysis at asset, building and site level. A comparison with similar clients' profiles
Portfolio view and asset view, line, baseline forecast, potential earnings

Table 17 Expectation from visualization tool for DR programs – DR-BOB experts' opinion

inteGRIDy
Real Time update of consumption prediction based on consumer history behaviour and profile
Enhance adoption by offering easier to use tools and programs
Analytics of various KPI based on the historical data per asset/district whole portfolio. Asset vs portfolio performance in various KPI (energy consumption, CO2 emission, flexibility, etc.). DR dispatch module

Table 18 Expectation from visualization tool for DR programs - inteGRIDy experts' opinion

Joint Workshop eDREAM and DELTA H2020 European projects
Decision support to the user
High level of information accuracy and ease of understanding for the user
An integrated package that captures the company's overall demand and the assets that have been switched also to see market pricing to show the size of opportunities
Real-time monitoring availability
Complete information regarding the effect of taking part in DR program

Table 19 Expectation from visualization tool for DR programs – Feedback from the stakeholders participating in the joint workshop eDREAM and DELTA project

Energy Efficiency - an essential condition for sustainable development conference
User friendly feedback and decision-making trends
Real-time monitoring availability

Table 20 Expectation from visualization tool for DR programs - Feedback from the stakeholders participating in the Energy Efficiency: an essential condition for sustainable development conference

RE-COGNITION
Improve the visualization also through tools for the user involvement such as tools that inform the user of improvements in terms of environmental impact
Complete information regarding the effect of taking part in DR program

Table 21 Expectation from visualization tool for DR programs – RE-COGNITION experts' opinion

Public Consultation through project Website
Possibility to view in real-time the consumption of the building in which one is operating and an easy-to-read interface
Visualization of results in terms of technical and financial gain on the base of KPI`s, number of participants, etc.

Table 22 Expectation from visualization tool for DR programs - Feedback from the stakeholders who provided feedback via the project website

3.3.4 Interviews

In order to validate the requirements collected via the questionnaire shared during the events both those organized by eDREAM consortium and those which eDREAM partners have taken part and through online public consultation, some interviews with people from the identified stakeholders' group have been carried out.

The interviews allowed us to refine the information already collected, thanks to questions that were focused on the specific experience of the interviewees and on the challenges and problems identified during the sharing of the eDREAM questionnaire.

In particular, during the course of the last year (M9-M20), project consortium partners had the opportunity to join different energy industry meetings and conferences. From quick interviews held during these meetings, small aggregators resulted very interested in innovations for DR programs. This is true especially for companies already involved in research and innovation programs.

Specifically, among the products and services to be developed by the project, respondents considered the dynamic coalition of VPP customers and the aerial survey technique useful to help the aggregators realise their objectives and minimise the business pain: the enrolment process for new customers can be one of the most time consuming activities and the use of drones can help reduce significantly this phase.

The joint workshop with Delta project gave us the opportunity to have a specific interview session in the afternoon where we could also hear the advice of energy consultants. Energy consultants emphasized the need to improve user awareness making DR programs easily understandable for customers and to demonstrate their benefits. Another aspect emphasized is the maintenance of user comfort that these programs must be able to guarantee in order to be more easily disseminated. The improvement of metering systems and control infrastructures is important to ensure a fast system response time and real-time metering in order to increase revenues from DR programmes.

3.4 Definition of the Requirements

With the aims to facilitate requirements engineering and use cases definition for the eDREAM platform implementation, in the consideration of the three pilots' sites of the Project (the first one related to the microgrid, the second one simulated in the laboratory and the third one related to the VPP), ten different functionalities grouped under three macro-functionalities has been identified. These functionalities are essential for the realization of the project objectives with the reference on the three expected High-Level Use Cases (HL-UCs): Prosumer DR flexibility aggregation via smart contract, Peer-to-peer energy trading market and VPP in Energy Community.

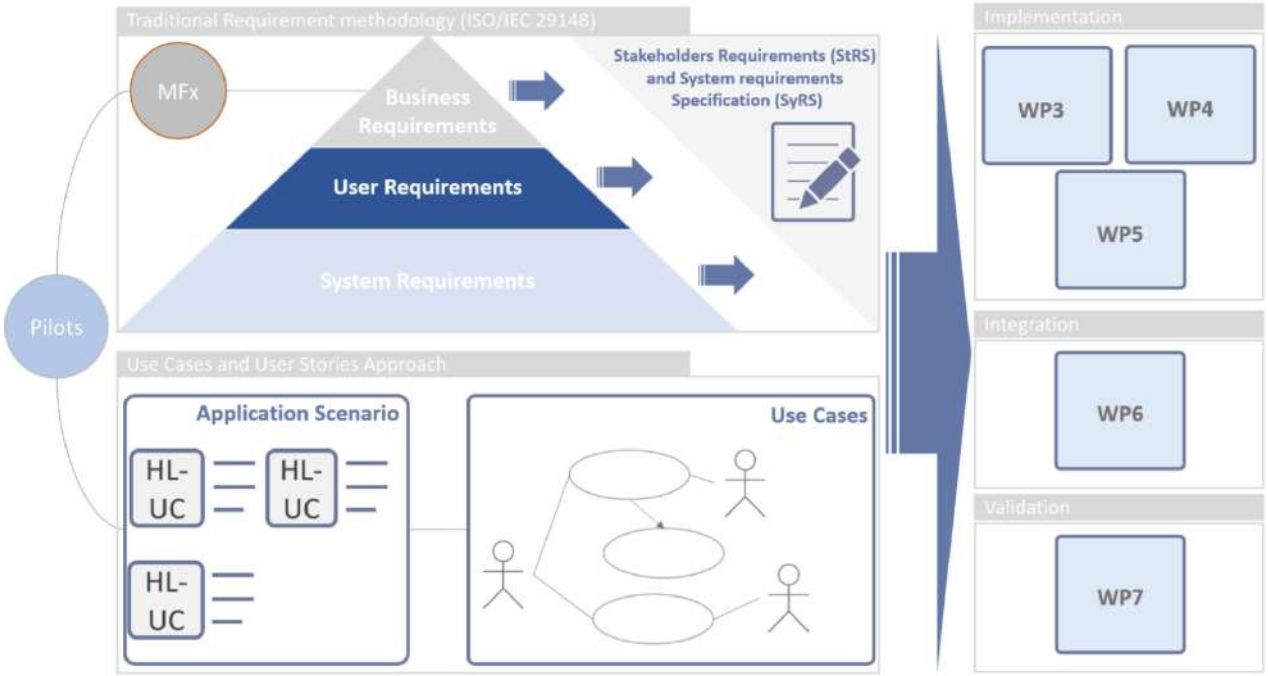


Figure 19 Requirements identification and Use Cases definition in the eDREAM project

The three identified macro-functionalities go through the entire process needed for the provision of advanced demand response services and optimization of the output of multiple local generation assets in the context of VPP.

For each of the identified macro-functionality, some functionalities have been defined with the reference to the necessary services to be implemented, these functionalities have been updated after the second round of stakeholders' requirements elicitation, based on feedback obtained through the implementation of the requirement elicitation tools described in the previous section.

MF1: DR optimal design
• **DR potential pre-assessment:** The aggregator will be able to use drones to assess the potential application of Demand Response in a specific zone (i.e. a district). • **DR strategies assessment**: Aggregators are able to provide energy consumption/production patterns for each prosumer belonging to his/her portfolio, forecast the production/consumption of each prosumer, evaluate their flexibility on different scales, as well as the reward mechanisms for the clients, with the aim to dynamically formulate and validate their DR strategies and their business models, and show cost and benefits to potential clients.

Table 23 MF1: DR optimal design

MF2: DR Services and big data technologies for optimizing flexibility
• **Load and Generation profiling:** The system will allow the main actors (i.e. Retailers, Aggregators, DSO etc.) to profile the load, as well as the generation of the registered prosumers at different time intervals and levels of granularity. For instance, an aggregator can estimate the load profile for each prosumer based on historical data for consumption. Then, the aggregator can assign the prosumers to the suitable Demand Response program (e.g. RTP, CPP, ToU etc.) according to some

appropriately selected metrics/KPIs (i.e. estimation of the potential availability for load shifting etc.).

- **Community-based virtual power plants services:** The actor here is a community (energy management cooperative) or an Aggregator responsible for the execution of DR programs for a group of prosumers. The actor will be able to control and optimize the energy balance in multiple local distributed generation resources, operating on a profit-oriented approach, thereby providing flexibility services to the network (i.e. a DSO) exploiting the prosumers' assets.
- **Active grid System flexibility DR services:** The prosumers, directly or via enabling aggregators, will be able to offer their production assets as flexibility resources. The DSO can take advantage of the grid flexibility, in order to improve grid stability, accessing on the grid resources and managing the flexibility of a single producer/prosumer to provide flexibility-as-a-service. The DSO will be supported in decision making, the actions selected will operate on services to balance the grid and then the platform will match the requested services with prosumers offers.

Table 24 MF2: DR Services and big data technologies for optimizing flexibility

MF3: Secure blockchain-based applications for DR management, control and financial settlement

- **Secure Energy data handling:** The system will store data feed by smart energy metering devices using blockchain distributed ledger framework in secure way.
- **Smart contract for DR flexibility services:** The Aggregators aggregate individual flexibility of prosumers via smart contract in response to the DSO flexibility request and they are made aware of individual prosumer deviations from flexibility request.
- **Smart Contract for Energy trading market:** The aggregators/producers/prosumers will be able to offer their services by reacting to changes in the price of energy compared to the reference value, thanks to the trading marketplace that will be created using the smart contracts. The prosumers may trade energy in a peer to peer fashion directly.
- **Decentralized coordinated control for Grid:** The DSO and aggregators will be enacted with the ability of assessing and tracing the share of the contracted flexibility service that has been activated at the grid level in near real-time.
- **DR Financial Settlement:** The financial settlement of DR transaction is done in an automatic and closer to the real time fashion using a scalable and tamper evident blockchain based platform.

Table 25 MF3: Secure blockchain-based applications for DR management, control and financial settlement

The technologies defined within the macro-functionalities were then put into relation, creating a flow of functioning that goes through them, highlighting the different dependencies between them as follows:

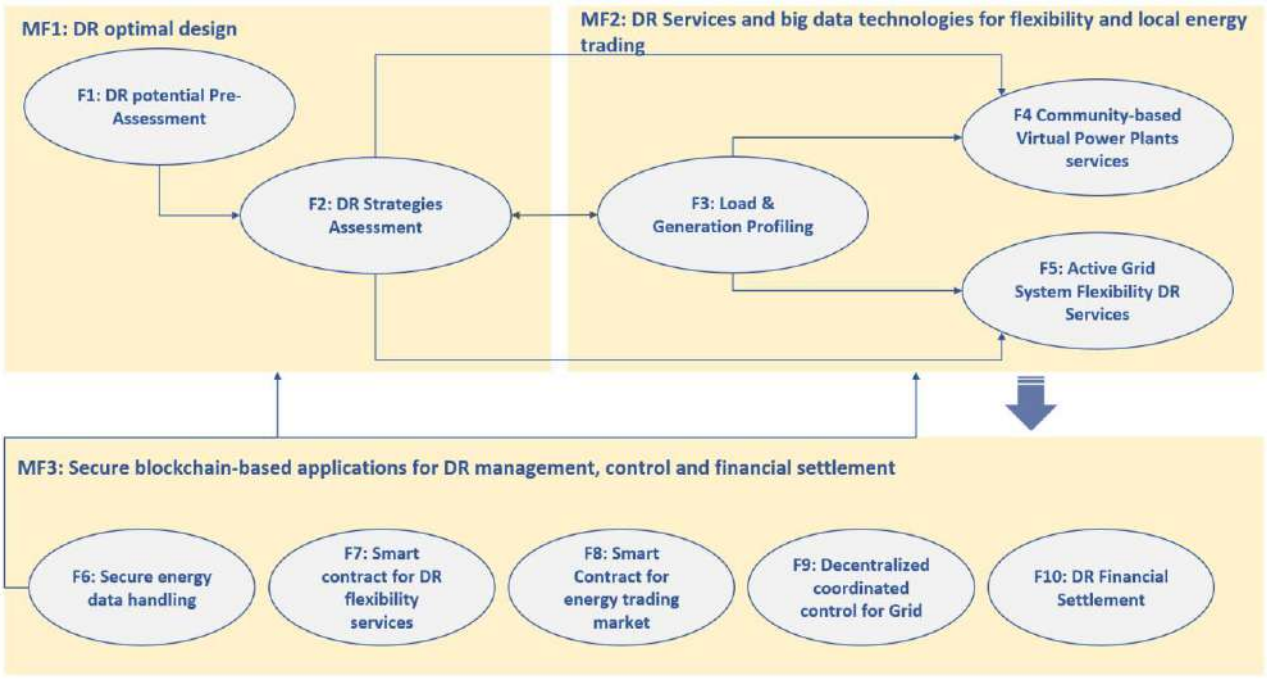


Figure 20 eDREAM System Functionalities

Starting from the identified macro-functionalities, on the basis of the technologies available from the technical partner of the project, of the internal consultation of the partner responsible of the pilots by the internal technology providers and of the feedback obtained from the process of elicitation of the stakeholders' requirements during the first two phases of this task, the BRs related to each single functionality are defined as shown in the Table 26:

Functionalities		Requirements
Macro functionality 1: DR optimal design		
DR potential pre-assessment	• Multi-Building DR characterization through thermal, optical and LIDAR information fusion, along with power grids GIS data	
DR strategies assessment	• Forecast of electricity production/consumption • Baseline load calculations in DR programs • PV/RES Degradation & Trend Analysis • Graph-based analytics	
Macro functionality 2: DR Services and big data technologies for flexibility and local energy trading		
Load & Generation Profiling	• Big Data Clustering at Multiple Scales • VPP and Customer segmentation and profiling	
Community-based virtual power plants services	• Virtual Power Plant Generation Modelling and Optimal Coalition Forecasting • Decision Making and DR Optimization • Interactive Visualization for energy trading	
Active Grid-System flexibility DR services	• Forecast of electricity production/consumption at grid level • Electric Vehicle (EV) fleet monitoring • Charging Stations monitoring • Charging Stations management • Baseline flexibility estimation • Decision Making and DR Optimization • Interactive Multi-purpose Visualization for-system flexibility services provisioning	
Macro functionality 3: Secure blockchain-based applications for DR management, control and financial settlement		
Secure energy data handling	• Secure data handling	
Smart contract for DR flexibility services	• LV grid congestion control through flexibility management • Prosumers flexibility monitoring and DR tracking • Interactive visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets	
Smart Contract for energy trading market	• Peer to peer local energy trading among prosumers • Interactive visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets	
Decentralized coordinated control for Grid	• LV grid congestion control through flexibility management • Interactive visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets	
DR Financial Settlement	• Closed loop DR verification and Financial settlement • Interactive visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets	

Table 26 eDREAM Functionalities and relative Requirements

The definition of the functionalities of the eDREAM platform directly connected to the business and user requirements has allowed us to better specify the components of the platform in the tasks related to the definition of use cases (T2.2) and the definition of the platform architecture and specifications of the system (T2.4).

The subdivision of the platform into components was indispensable for the definition of the architecture deployment view, acting as the basis for the design of the related deployment diagrams. Providing help for

understanding how to better deal with deployments in the development activities expected in WP3, WP4 and WP5 through the definition of some best practices for deployments.
Particularly, the fundamental best practice for the deployments provides to consider at least three environments: (1) development, (2) staging and (3) production. In that case, the workflow might look like this:

- Developers work on bugs and features in separate branches. Really minor updates can be committed directly to the stable development branch.
- Once features are implemented, they are merged into the staging branch and deployed to the Staging environment for quality assurance and testing.
- After testing is complete, feature branches are merged into the development branch.
- On the release date, the development branch is merged into production and then deployed to the Production environment.

4 Business Requirements v2

4.1 Introduction and methodology

The Business requirements are a high-level description of what the system needs to do. They are based on the vision of the process and on the vision of the architecture of the to-be design. Business requirements are listed as key features necessary to meet the objectives and strategies indicated for the project. The Business requirements provide guidance for the project and become the basis for the User Requirements [9].

In this chapter each Business Requirement defined in the previous section will be described on the basis of the feedback of the first two phases of the Business Requirements Elicitation process which, in the first 20 months of the project, has required the implementation of the following activities:

- Definition of the Elicitation methodology to define the Business Requirements through the internal and external consultation;
- Internal Elicitation for the identification and categorization of the first set of Business Requirements Identification;
- Preparation of a short, clear and informative presentation of the project for the external Stakeholders;
- Preparation and release of a Survey/Questionnaire to gather needs from the external stakeholders;
- Discussion and confrontation with external experts from other H2020 similar project consortia also through this questionnaire;
- Release of the first version of the Business Requirements;
- Organization and participation in different events for meeting and discussing the requirements with the external stakeholders by using of different RE techniques, continuing the collaboration with other H2020 similar project consortia;
- Online sharing of the questionnaire for the elicitation of stakeholders needs;
- Release of the second version of the Business Requirements.

Starting from the internal elicitation, a first set of BRs has been made. Afterwards, a questionnaire has been created to refine the first set of requirements according to an initial stakeholders' prospective. The questionnaire shared during other H2020 project consortium meetings, workshops, conferences and through the project website can be found in ANNEX III while the relative analysis can be found in section 3.3.3 of this deliverable. On the base of the feedback coming from this analysis and from the utilization of other RE tools, in this chapter can be found the refined requirements with respect to the requirements presented in the D2.1.

A specific template has been adopted for the definition of Business Requirements. During the internal elicitation phase, the template was circulated among the project partners to identify the main requirements and was subsequently updated based on feedback from the various stages of the requirements elicitation process. The template for Business Requirement definition can be found in the ANNEX I of this deliverable.

4.2 eDREAM business requirements specification

4.2.1 Field Data Aggregation

In addition to the business requirements defined by the process of interaction with stakeholders, also the requirements relative the capacity of the eDREAM platform to be able to communicate with the field in order to obtain data in an open and interoperable way must be considered. In this paragraph these requirements have been considered as reported in Table 27 and in Table 28.

Requirement ID	FD-BR01
Title	**Electric meters, edge and field device electric measures**
Description	The eDREAM platform should have an interface with the Automatic Meter Infrastructure in order to retrieve data about the load curves. Data from electric equipment and field devices should be acquired directly (from apparatus) or indirectly (from SAP, SCADA and other data acquisition systems). Among the others, some protocols sample to be chosen, are provided for protection and substations (IEC 61850, CIM), for electric vehicles charging stations (e.g.: OSPC etc.), for home and building automation (e.g.: zigbee, knx etc.) and for general purpose (e.g.: Modbus, profibus etc.).
Success Criteria	Setting up of a data collection infrastructure able to gather all the data of interest for the application of DR programs.
Dependencies	Availability of data collection infrastructure MF01-BR02, MF01-BR03, MF01-BR05, MF02-BR01, MF02-BR03, MF02-BR06, MF02-BR07, MF02-BR08, MF03-BR01, MF03-BR02, MF03-BR03, MF03-BR04
Priority	High

Table 27 FD-BR01 Electric meters, edge and field device electric measures

Requirement ID	FD-BR02
Title	**Weather data availability**
Description	The presence of mechanisms for real time weather data recovery (API to retrieve weather data from online weather services, local weather stations) is expected.
Success Criteria	Setting up of a mechanism to retrieve the weather data.
Dependencies	Availability of weather service or weather station MF01-BR02, MF01-BR05, MF02-BR03, MF02-BR06, MF02-BR07
Priority	High

Table 28 FD-BR02 Weather data availability

4.2.2 DR optimal design

Requirement ID	MF01-BR01
Title	**Multi-Building DR characterization through thermal, optical and LIDAR information fusion, along with power grids GIS data**
Description	Estimate the demand response potential over a wide area of building assets based on the energy demand profile assessment and the overall energy performance of the buildings through optical, thermal and LIDAR images.
Success Criteria	1) Present data for differences between peak and minimum energy demand (aggregated and individual) requirements 2) Provide information about the presence of energy intensive plant items of the building (e.g. HVAC, CHP, …) and the heat-loss parameters 3) Information about the orientation and shading of the building

	4) Detect data for EE, RES micro-generation potential.
Dependencies	X
Priority	Mid

Table 29 MF01-BR01 Multi-Building DR characterization through thermal, optical and LIDAR information fusion, along with power grids GIS data

Requirement ID	MF01-BR02
Title	**Forecast of electricity production/consumption**
Description	Detection of prosumer's energy consumption/production patterns. Forecast the production / consumption for each prosumer on a specified time period through time series analysis and deep learning techniques.
Success Criteria	Accurate predictions of energy supply and demand at different levels of granularities (scale / time).
Dependencies	FD-BR01, FD-BR02, MF03-BR01
Priority	High

Table 30 MF01-BR02 Forecast of electricity production/consumption

Requirement ID	MF01-BR03
Title	**Baseline load calculations in DR programs**
Description	Estimate the baseline load of a customer based on the provided smart metering data / energy demand profiles.
Success Criteria	Present data for baseline load estimation(s) and associated accuracy.
Dependencies	FD-BR01, FD-BR01, MF03-BR01
Priority	High

Table 31 MF01-BR03 Baseline load calculations in DR programs

Requirement ID	MF01-BR04
Title	**PV/RES Degradation & Trend Analysis**
Description	1) Provide degradation rate of PV system for long term energy production estimation, which will contribute to the calculation of long-term DR scheduling, in order to maximize the benefits for DSOs, Aggregators and prosumers. 2) Improve the short-term forecasting of PV generation by identifying trends in production curve related to PV system parameters (e.g. temperature, irradiance etc.) due to possible malfunctions of the PV panels or other possible reasons.
Success Criteria	3) Calculate the degradation rate (Rd) at which PV systems lose their performance over time. 4) Short-term electricity PV production forecasting based on time series historical data.
Dependencies	MF01-BR02
Priority	Mid

Table 32 MF01-BR04 PV/RES Degradation

Requirement ID	MF01-BR05
Title	**Graph-based analytics**
Description	Visual analysis with graph techniques of historical data related to prosumers and Demand Response programs.

	What-if analysis for Demand Response programs application.
Success Criteria	1) Visual clustering of common features among prosumers; 2) Multi-objective analysis of DR related parameters; 3) Analysis of spatio-temporal domain patterns of historical data; 4) Correlation between different parameters of Demand Response programs; 5) Validation of DR strategies.
Dependencies	FD-BR01, FD-BR02, MF02-BR06, MF02-BR13, MF03-BR01
Priority	Mid

Table 33 MF01-BR05 Graph-based analytics

4.2.3 DR Services and big data technologies for flexibility and local energy trading

Requirement ID	MF02-BR01
Title	**Big Data Clustering at Multiple Scales**
Description	Scalable procedure for extracting a number of clusters from a large amount of users load curves in order to be helpful especially for the possibility to apply this procedure to heterogeneous data sets with a variable number of load curves. That means the possibility to apply the same technique with different constraints and starting conditions.
Success Criteria	Clusterization will produce a number of well identified and separate clusters. The number and the mutual distance of clusters will respect the threshold derived from proper indicators to be defined.
Dependencies	FD-BR01, MF01-BR03, MF02-BR03
Priority	Mid

Table 34 MF02-BR01 Big Data Clustering at Multiple Scale

Requirement ID	MF02-BR02
Title	**VPP & Customer Segmentation and Profiling**
Description	Assignment of the customers to a particular customer group by recognizing the customer's load profile pattern. Segmentation of prosumers and producers will be also useful for categorizing the participation of small and medium generation to ancillary and balance markets.
Success Criteria	A number of categories of producers and consumers will be identified according to indicators to be defined (technology, generation curve, time response, frequency, voltage and reactive capacity modulation, etc.). The profiling clusterization will be consider also dynamic and time variable constraints. It will be returned useful profiles according to the selected demand response strategy to be adopted (price-based programs, incentives, ToU, etc.).
Dependencies	MF01-BR03, MF02-BR01
Priority	Mid

Table 35 MF02-BR02 VPP & Customer Segmentation and Profiling

Requirement ID	MF02-BR03
Title	**Virtual Power Plant Generation Modelling and Optimal Coalition Forecasting**
Description	Construction of optimal coalitions of the producers in Virtual Power Plant for stable and reliable supply.

Success Criteria	Optimal coalitions of energy producers are created to meet different objective functions associated with services provisioning.
Dependencies	FD-BR01, FD-BR02, MF01-BR01, MF01-BR04, MF03-BR01
Priority	High

Table 36 MF02-BR03 Virtual Power Plant Generation Modelling and Optimal Coalition Forecasting

Requirement ID	MF02-BR04
Title	**Decision Making and DR Optimization**
Description	The DSO/Aggregator will need a dedicated application, in order to use the services of the platform to perform optimized control through a decision-making support system and a toolset for DR Optimization. The application will handle the provision of consumption/production (and VPP production) forecasts and notifications for detected events. The DSO/Aggregator will be supported in decision making. The actions selected will operate on services (e.g. production/load modulation) to balance the grid and then the platform will match the requested services with prosumers offers, in order to identify the optimal scheduling among prosumers to relax the congestions. The price will be the controlling signal, so the actions will leverage price level (triggering signal) corresponding to matched requests. In the case of VPP, loads and generators profiles together with flexibility assessment and consumption/generation forecast are used to obtain optimal set-points for generators and load curtailment according to the RES drop Energy Community scenario.
Success Criteria	A variety of optimization algorithms/strategies available to support DR optimization needs of customers. Decision making supporting tools implementing optimized DR strategies by integrating services for forecasting requests, events detection etc. Service requests/offers matching system able to interact with prosumers' smart contracts and aggregate flexibility service offers.
Dependencies	MF01-BR02, MF01-BR03, MF01-BR04, MF02-BR03, MF02-BR06, MF02-BR11, MF03-BR01
Priority	High

Table 37 MF02-BR04 Decision Making and DR Optimization

Requirement ID	MF02-BR05
Title	**Interactive Visualization for energy trading**
Description	Visualization of the necessary data for the interaction between prosumers/VPP coalitions and the energy market.
Success Criteria	1) Visualization of the surplus /deficit of locally produced electrical energy, generation peaks, valleys compensations and aggregated energy production potential; 2) Visualization of electricity prices.
Dependencies	MF01-BR05, MF02-BR13
Priority	High

Table 38 MF02-BR05 Interactive Visualization for energy trading

Requirement ID	MF02-BR06
Title	**Forecast of electricity production/consumption at grid level**
Description	Detection of energy consumption/production patterns at micro-grid level. Forecasts the production / consumption at micro-grid level through the time series analysis and deep learning techniques to provide useful forecast data, so as to improve choosing the best offers in terms of flexibility.
Success Criteria	Accurate predictions of energy supply and demand at micro-grid level
Dependencies	FD-BR01, FD-BR02, MF03-BR01
Priority	High

Table 39 MF02-BR06 Forecast of electricity production/consumption at the grid level

Requirement ID	MF02-BR07
Title	**EV fleet monitoring**
Description	Quantify in real time the flexibility that could be provided from the Fleet Manager to the DSO.
Success Criteria	DR campaign performed using EVs as big consumers.
Dependencies	FD-BR01, FD-BR02, MF02-BR04, MF02-BR09, MF03-BR01
Priority	High

Table 40 MF02-BR07 EV fleet monitoring

Requirement ID	MF02-BR08
Title	**Charging Stations monitoring**
Description	Quantify in real time the flexibility that is being provided from the Fleet Manager to the DSO.
Success Criteria	DR campaign performed using EVs as big consumers.
Dependencies	FD-BR01, FD-BR02, MF02-BR04, MF02-BR09, MF03-BR01
Priority	High

Table 41 MF02-BR08 Charging Stations monitoring

Requirement ID	MF02-BR09
Title	**Charging Stations management**
Description	Allow the Charging Stations Manager to remotely start/stop a charging session and modify the charging station power output according to the DSO needs in real time.
Success Criteria	DR campaign performed using EVs as big consumers.
Dependencies	FD-BR01, MF03-BR01
Priority	High

Table 42 MF02-BR09 Charging Stations management

Requirement ID	MF02-BR10
Title	**Baseline flexibility estimation**
Description	Estimate the energy flexibility availability of the consumer.

Success Criteria	Present data for baseline flexibility estimation(s) and associated accuracy.
Dependencies	FD-BR01, MF01-BR02, MF01-BR03, MF03-BR01
Priority	High

Table 43 MF02-BR10 Baseline flexibility estimation

Requirement ID	MF02-BR11
Title	**Interactive Multi-purpose Visualization for system flexibility services provisioning**
Description	Visualization of the parameters and benefits related to flexibility services for the interaction between prosumers, aggregators, VPPs and DSO. Visualization of the results of the applied DR strategies and the indication of the flexibility availability of end-users (prosumers). This application allows DSO/Aggregator to know in near real-time the share of activated and validated flexibility services and support smart integration of fluctuating RES along with ensuring power network reliability.
Success Criteria	1) Visualization for the prosumers of flexibility service capability; 2) Information for the prosumers' energy consumption shifting profile (after the applied DR strategy) and scheduling of energy consumption; 3) Enable the DSO/Aggregator through multi-objective analysis of the visual patterns to formulate his energy management strategy and integrate the available share of RES without creating instability.
Dependencies	MF01-BR05, MF02-BR06
Priority	High

Table 44 MF02-BR11 Interactive Multi-purpose Visualization for system flexibility services provisioning

4.2.4 Secure blockchain-based applications for DR management, control and financial settlement

Requirement ID	MF03-BR01
Title	**Secure Data Handling**
Description	Blockchain based distributed ledger will be used to store the smart meters' energy data and associated energy transactions In a tamper-evident manner, using digital fingerprinting.
Success Criteria	A scalable second tier solution based on blockchain will be put in place as secure storage.
Dependencies	FD-BR01
Priority	High

Table 45 MF03-BR01 Secure Data Handling

Requirement ID	MF03-BR02
Title	**LV grid congestion control through flexibility management**
Description	Prevention of potential congestion points in the Grid by evaluating the flexibility offers received from the aggregators, choosing the best offers and tracking the monitored activity.
Success Criteria	The potential congestion points are successfully prevented and minimized.
Dependencies	FD-BR01, MF01-BR02, MF02-BR06, MF02-BR11, MF03-BR01, MF03-BR03, MF03-BR06
Priority	High

Table 46 MF03-BR02 LV grid congestion control through flexibility management

Requirement ID	MF03-BR03

Title	**Prosumers flexibility monitoring and DR tracking**
Description	Monitoring and control of the prosumer activity to follow the corresponding promised flexibility and DR agreement.
Success Criteria	The agreed energy curves between the prosumers and aggregators are correctly followed.
Dependencies	FD-BR01, MF01-BR02, MF02-BR06, MF02-BR11, MF03-BR01, MF03-BR05, MF03-BR06
Priority	High

Table 47 MF03-BR03 Prosumers flexibility monitoring and DR tracking

Requirement ID	MF03-BR04
Title	**Peer to peer local energy trading among prosumers**
Description	Provide a market session enforced by smart contracts allowing the registration of demand and offer actions and the computation of the clearing price and the matching actions.
Success Criteria	Accurate clearing price calculation and correct matching between the demand and offers actions.
Dependencies	FD-BR01, MF01-BR02, MF03-BR01, MF03-BR05, MF03-BR06
Priority	High

Table 48 MF03-BR04 Peer to peer local energy trading among prosumers

Requirement ID	MF03-BR05
Title	**Interactive Visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets**
Description	A dedicated application will be developed in order to provide a user interface for prosumers, in which they will be able to interact with the smart contract defining the service, edit and delete the parameters, e.g. trigger price level, penalty, flexibility offer (production/load modulation).
Success Criteria	Prosumers will be able to manage subscription to smart contracts defining different services to be offered and manage load/price parameters of subscribed contracts.
Dependencies	MF03-BR01, MF03-BR03, MF03-BR04
Priority	Mid

Table 49 MF03-BR05 Interactive Visualization to customize self-enforcing smart contracts for prosumer bidding and scheduling in electricity markets

Requirement ID	MF03-BR06
Title	**Closed loop DR verification and Financial settlement**
Description	Services matched through the platform between DSO and Prosumer, and DSO and aggregator (e.g. production/load modulation) will be monitored and verified. Prosumers and aggregators will be billed or remunerated accordingly. The verification process will be used also to sanction actors who don't comply with the agreements. The remuneration and penalties should be proportional to the difference between the baseline and the actual flexibility request.
Success Criteria	Monitoring of the Outputs from the smart contracts (MATCHED) defining prices, penalties and services. The verification process will be used for (1) Billing, (2) User Remuneration, (3) Penalties.
Dependencies	MF03-BR02, MF03-BR03, MF03-BR04

Priority	High

Table 50 MF03-BR06 Closed loop DR verification and Financial settlement

5 User requirements v2

5.1 Introduction and Methodology

The User Requirements provide further details respect the Business Requirements deepening the functionality required in terms of functionality, usability, performance, security, legal compliance, and compatibility. They cover the requirements that the user(s) need to perform the to-be design. They include functional requirements, UI requirements and non-functional requirements [9].

User requirements (within the context of the StRS) include required inputs/selections/information observations which users/operators/maintainers need to perform through the use of the system, any outputs they require from the system to perform these tasks, and any applicable conditions or constraints governing their interaction with (i.e., usability of) the system.

A specific template has been adopted for the definition of the User Requirements. During the internal elicitation phase, the template was circulated among the project partners to identify the main requirements.

The template for the User Requirements definition can be found in the ANNEX II of this deliverable.

5.2 eDREAM user requirements specification

No.	Type	Description	Priority
UserReq 01	Legal compliance	Sensitive data must be encrypted when transmitted.	High
UserReq 02	Legal compliance	Sensitive data must be encrypted when stored.	High
UserReq 03	Legal compliance	All the data must not be sold or used for any different purposes than the SMILE project.	High
UserReq 04	Security	The storage solution must enable the other components of the platform to access the stored data in a secure mode.	High
UserReq 05	Security	The storage solution must grant the access to data only to authorized users.	High
UserReq 06	Security	The system must allow for prosumer registration with the market and their validation.	High
UserReq 07	Security	The application must grant the access only to authorized users and grant the non-repudiability.	High
UserReq 08	Security	The energy transactions must be stored in a secure and tamper proof manner.	High

UserReq 09	Compatibility	The system must be able to acquire real-time measures from the field with adequate latency identified according to the eDREAM platform services, or from existing automatic reading systems.	High
UserReq 10	Compatibility	The system must be able to acquire weather data with a certain granularity useful for the forecast functionalities.	High
UserReq 11	Compatibility	The system must be able to collect EV data and EVSE data in real time, data coming from EVSEs and the EVs should be consistent, reliable, transparent and accessible to the partners.	
UserReq 12	Compatibility	The system must be able to receive data from Aerial Thermal, Optical and LIDAR scans, combined with GIS map of the existing power grids.	High
UserReq 13	Compatibility	The system and the final user must be able to retrieve historical data about field measurements from the decentralized repository.	High
UserReq 14	Compatibility	The system must be able to receive real-time measurements concerning the energy data related to PV systems (e.g. Voltage, Current, Output Power) and data for device physical parameters and constraints.	Mid
UserReq 15	Compatibility	The system must be able to retrieve data from a great number of devices and services.	High
UserReq 16	Compatibility	The information types produced, consumed and transformed must be documented in an information model which must also include the relationships between information types considering context data or metadata, e.g., location, accuracy, submit and generation times, ownership.	High

UserReq 17	Connectivity	the eDREAM platform modules must be able to communicate with each other to provide the expected functionalities	High
UserReq 18	Connectivity	The eDREAM system must assure all interfaces needed for interconnection to infrastructures already existing in the pilot sites	High
UserReq 19	Connectivity	The end users must always be able to access the eDREAM platform online	High
UserReq 20	Connectivity	The access to the decentralized repository must always be guaranteed	High
UserReq 21	Functionality	The system must be able to provide to the end user the prosumer or group of prosumers production/consumption forecast on specified time frame considering weather forecast, device parameters and historical data.	High
UserReq 22	Functionality	The system must be able to store the results of the learning algorithms in a database for all the interested parties to access at any time.	High
UserReq 23	Functionality	The system must be able to provide historical data for outages of large power plants, bidding strategies, fuel prices and transmission congestion.	High
UserReq 24	Functionality	The system must be able to provide KPIs from Decentralized Repository.	High
UserReq 25	Functionality	The system must be able to process data gathered from different sources in order to achieve flexibility profiling. It is crucial for such calculation to ensure the capacity to provide data coming from differed database and data lake (batch, pre-processed, other modules outputs, devices etc.).	High

UserReq 26	Functionality	The system must aggregate and optimize the production profiles by surplus/deficit and peaks/valleys compensations.	High
UserReq 27	Functionality	The system must be able to provide the optimized DR strategy in VPP level.	High
UserReq 28	Functionality	The system must be able to provide “Trend analysis”.	High
UserReq 29	Functionality	The system must be able to have access to energy prices from Energy markets to provide service to the users	High
UserReq 30	Functionality	The system must be able to compute grid production/consumption forecast on specified time frame considering weather forecast, device parameters and historical data.	High
UserReq 31	Functionality	The system must be able to constantly calculate EV load forecasting to estimate the amount of energy that electric vehicles can consume to meet the DSO's flexibility demand and perform optimized DR campaign	Mid
UserReq 32	Functionality	The system must be able to show EVSE data and EV data through the user interface	Mid
UserReq 33	Functionality	The user must be able to send the user’s preferences about load modulation and shifting	High
UserReq 34	Functionality	The prosumer must be able to send their flexibility availability to aggregators.	High
UserReq 35	Functionality	The aggregator must be able to have the energy consumption baseline flexibility estimation of the prosumers	High
UserReq 36	Functionality	The aggregator must be able to send flexibility requests to prosumers.	High
UserReq 37	Functionality	The aggregator must be able to elect a subset of prosumers to meet a specific aggregated level of flexibility	High

UserReq 38	Functionality	The system must allow the DSO to detect future congestion or voltage fluctuation points at LV grid level.	Mid
UserReq 39	Functionality	The system must allow the track the flexibility delivery of each aggregator and to aggregate and compensate potential local imbalances.	High
UserReq 40	Functionality	DSO must be able to request to the aggregators, through the marketplace, the necessary flexibility to avoid forecast congestion point	High
UserReq 41	Functionality	The DSO must be able to select from several flexibility offers	Mid
UserReq 42	Functionality	The system must allow any validated prosumer to publish new energy bid/offer actions in the system.	Mid
UserReq 43	Usability	The eDREAM platform must ensure all interfaces needed to provide the functionalities	High
UserReq 44	Usability	The user must be able to access to historical electricity prices and the respective time spots from Decentralized Repository.	High
UserReq 45	Usability	The system must be able to scalable horizontally or vertically depending on the demands related to data ingestion, processing and storage.	Mid
UserReq 46	Usability	The application interface must allow the prosumers to initialize or edit the parameters used by the smart contracts for both the energy and flexibility trading.	High
UserReq 47	Performance	The system must be able to pre-process the monitored data to provide input for the learning algorithms according to a data model schema in order to detect prosumer energy consumption/production frequent patterns on historical data.	High

UserReq 48	Performance	The system must be composed of several micro-services, so as to better perform different processes on multiple machines.	High
UserReq 49	Performance	The systems must include modules that implement near real-time data processing techniques, ensuring response within specified time constraints. This requirement indicates that there are no substantial delays and quantification of the system responsiveness will depend on the specific use-case and context	High
UserReq 50	Performance	The system must be able to process EV data (Battery State-of-Charge, residual Autonomy, minutes to Full Charge, Geolocation, Doors Car State, Engine Car State) and EVSE data (power, voltage, current, plug status, energy consumption) in order to manage in real time the flexibility providing relative information to the Fleet Manager and to the DSO.	Mid

Table 51 eDREAM User requirements v2

6 Mapping Business Requirements/Use Cases

As previously highlighted, the activities of Task 2.1, related to this deliverable, were proceeded in parallel with those of Task 2.2 in which use cases of the eDream solution have been updated during the second phase in the D2.7.

Thanks to the Participatory Design (PD) activated during these first twenty months involving both internal and external experts, the second formalization of Stakeholder requirements in the D2.6 has led to a definition of a set of relevant use cases and scenarios described in the D2.7 as second version of the deliverable related the task T2.2.

The approach based on the definition of platform functionalities in the consideration of both the feedback from the internal and external elicitation process and the characteristics of the three pilot sites of the project has facilitated the definition of use cases in the first phase (M1-M8) and their update in the second phase (M9-M20) also based on the work done in the task T2.4 for the definition of the project platform architecture, allowing an easy identification of the use flows of the platform by associating the relative functionalities to the steps of using the platform.

It follows that the individuation of the functionalities has been essential for the definition of the project objectives with the reference on the three expected High-Level Use Cases (HL-UCs) in D2.7: Prosumer DR flexibility aggregation via smart contract, Peer-to-peer energy trading market and VPP in Energy Community.

For each of these HL-UCs, specific low-level use cases have been defined in detail in the D2.7. In the table below are shown the entire hierarchy of use cases defined for the eDREAM platform.

eDREAM USE CASES INVENTORY
HL-UC01: Prosumers DR flexibility aggregation via smart contract
HL-UC01_LL-UC01: Prosumers enrolment with the aggregator
HL-UC01_LL-UC02: Contract settings
HL-UC01_LL-UC03: Potential energy flexibility evaluation
HL-UC01_LL-UC04: Energy demand/production forecasting for day-ahead trading of flexibility
HL-UC01_LL-UC05: Flexibility request
HL-UC01_LL-UC06: Flexibility offering
HL-UC01_LL-UC07: Flexibility acceptance
HL-UC01_LL-UC08: Flexibility provisioning
HL-UC02: Peer-to-peer energy trading market
HL-UC02_LL-UC01: Prosumers registration with the energy trading platform

HL-UC02_LL-UC02: Prosumers bids/offers submission
HL-UC02_LL-UC03: Energy clearing price determination
HL-UC02_LL-UC04: Transactions validation and financial settlement
HL-UC03: VPP in Energy Community
HL-UC03_LL-UC01: Prosumers Profiling and Clusterization
HL-UC03_LL-UC02: VPP capability evaluation for Reserve services and for Frequency services
HL-UC03_LL-UC03: VPP Export Evaluation for Wholesale market (Intraday trading) and for Imbalance market

Table 52 eDREAM use cases inventory

In this chapter, there will be reported the relationships between the BRs and the HL-UCs, comprised the relative Low-Level Use Cases.

In the table below are shown the mapping between the BRs and the Use Cases, in which is indicated for each use case the relative requirements that the platform must guarantee to ensure the correct progress of the use case operations flow.

The eDREAM project is co-founded by the EU's Horizon 2020 innovation programme
under grant agreement No 774478

		Field Data Aggregation		MF01: DR optimal design					MF02: DR Services and big data technologies for optimizing flexibility										MF 03: Secure blockchain-based applications for DR management, control and financial settlement					
		FD-BR01	FD-BR02	MF01-BR01	MF01-BR02	MF01-BR03	MF01-BR04	MF01-BR05	MF02-BR01	MF02-BR02	MF02-BR03	MF02-BR04	MF02-BR05	MF02-BR06	MF02-BR07	MF02-BR08	MF02-BR09	MF02-BR10	MF02-BR11	MF03-BR01	MF03-BR02	MF03-BR03	MF03-BR04	MF03-BR05	MF03-BR06
Prosumer DR flexibility aggregation via smart contract	HL-UC01	■	■	■	■	■	■	■	■			■		■	■	■	■	■	■	■	■	■		■	■
	HL-UC01_LL-UC01	■	■	■	■	■		■				■		■	■	■		■	■			■			■
	HL-UC01_LL-UC02	■	■	■	■	■	■							■				■		■		■			■
	HL-UC01_LL-UC03			■	■	■												■							
	HL-UC01_LL-UC04						■							■	■	■		■	■	■					
	HL-UC01_LL-UC05											■		■				■	■	■	■			■	
	HL-UC01_LL-UC06								■			■								■	■	■		■	■
	HL-UC01_LL-UC07											■								■	■	■		■	■

	HL-UC01_LL-UC08																								
Peer-to-peer local energy trading market	HL-UC02																								
	HL-UC02_LL-UC01																								
	HL-UC02_LL-UC02																								
	HL-UC02_LL-UC03																								
	HL-UC02_LL-UC04																								
VPP in Energy Community	HL-UC03																								
	HL-UC03_LL-UC01																								
	HL-UC03_LL-UC02																								
	HL-UC03_LL-UC03																								

Table 53 Mapping between BRs and Use Cases of the eDREAM platform

6.1 Prosumer DR flexibility aggregation via smart contract

The BRs that the platform must guarantee to ensure the correct progress of the operational flow related to this HL-UC (HL-UC01) are many and go through all the four macro-functionalities defined in this deliverable.

The requirements related to the **"Field Data Aggregation"** are essential for the aggregators to determine the prosumer flexibility availability and to estimate the prosumer electricity production/consumption based on data retrieved from the field and weather services. While, in case there are EVSEs in the grid, it is important for the platform to be able to monitor availability EVs and batteries to satisfy DSO flexibility request.

The requirements related to the **"DR optimal design"** are essential for the aggregators to determine the prosumer flexibility availability and to estimate the prosumer electricity production/consumption with the aim to dynamically assess, formulate and validate their DR strategies exploiting the data gathered by the Field Data Aggregator Level.

The requirements related to the **"DR Services and big data technologies for optimizing flexibility"** are essential for the aggregators to raise prosumers awareness of the DR programs in order to encourage their enrolment and for the DSO to detect day ahead congestion points in the grid and have a decision support system in the case where, due to insufficient flexibility made available by the aggregate, the DSO the DSO must directly intervene by technically limiting connection capacity or using direct control of prosumers assets to avoid an overload. While, in case there are EVSEs in the grid results important to monitor the fleet of EVs and to monitor and control the EVSEs.

The requirements related to the **"Secure blockchain-based applications for DR management, control and financial settlement"** result essential to guarantee secure data handling and to establish the self-enforcing smart contract for flexibility between aggregators and prosumers and between aggregators and DSO monitoring and validating these services. In particular, the MF03-BR06 is essential in several low-level use cases to guarantee the remuneration and penalization of the prosumers and aggregators based on the specification of the smart contract.

6.2 Peer-to-peer local energy trading

The BRs that the platform must guarantee to ensure the correct progress of the operational flow related to this HL-UC (HL-UC02) are essentially related to the third macro-functionality, "**Secure blockchain-based applications for DR management, control and financial settlement"**, because it considers the case in which the prosumers are registered with the energy trading platform or with the energy aggregator.

These requirements result essential to guarantee secure data handling and to establish the peer to peer local energy trading market among prosumers.

The MF03-BR06 is essential in several low-level use cases to validate energy transactions and settle prosumers accounts.

The data about the prosumer identification and energy production/demand will be available thanks to the compliance with the relevant requirements about the field data gathering and aggregation (FD-BR01) and the interactive visualization tool (MF03-BR05).

6.3 VPP in Energy Community

The BRs that the platform must guarantee to ensure the correct progress of the operational flow related to this HL-UC (HL-UC03) are many and go through the first three macro-functionalities defined in this deliverable.

The requirements related to the **"Field Data Aggregation"** together with the requirements related the **"DR optimal design"** are essential for the aggregators or VPP energy managers to receives data of short term generation forecasting, customers' behaviour, and power demand and supply in community's nodes to categorize and assign each prosumer to a specific profile pattern.

The requirements related to the **"DR Services and big data technologies for optimizing flexibility"** are essential for the aggregators or VPP energy managers to perform big data analysis to profile loads to be shed and to identify setpoints of dispatchable generators in order to balance energy demand.

These requirements are essential to provide some balancing and ancillary services such as reserve services, frequency services, intraday trading and imbalance market.

7 Overall Conclusions and Future Work

In this document the consolidated second version of the Business and User requirements for the eDREAM solution was presented, which will be used to refine the application scenarios and use cases in the D2.7 and to provide feedback for the task related the definition of the platform architecture (T2.4) and the development activities ongoing in the technical Work Packages (WP3, WP4, WP5) and their integration (WP6). These requirements will serve as a basis to define the project objectives and the coherence of the platform with the user expectations, representing the state of the process of involving stakeholders in the design and development of the platform that will be continued also in the coming months.

References

[1]. Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition

[2]. Systematic Review of Requirement Elicitation Techniques - Shadab Khan, Aruna B Dulloo and Meghna Verma - International Journal of Information and Computation Technology. ISSN 0974-2239 Volume 4, Number 2 (2014), pp. 133-138

[3]. ISO/IEC/IEEE 29148:2011 Systems and software engineering - Life cycle processes - Requirements engineering

[4]. ISO/IEC/IEEE 15288:2015 Systems and software engineering - System life cycle processes

[5]. Managing Software Requirements: A Use Case Approach - Dean Leffingwell and Don Widrig, Addison-Wesley 2003

[6]. Intro to Requirements Gathering - Kelly Brooke, 2015, http://www.delphicdigital.com/blog/intro-to-requirements-gathering

[7]. Interaction Design: Beyond Human-Computer Interaction - Jenny Preece, Helen Sharp, Yvonne Rogers – Wiley 2002

[8]. The Guide to the Business Analysis Body of Knowledge (BABOK), Version 2.0, International Institute of Business Analysis, March 2009

[9]. Business and User Requirements Template – DOIT, New Mexico Department of Information Technology, http://www.doit.state.nm.us/project_templates.html

ANNEX I: Business requirements template

On the basis of the attributes of the requirements defined in [3] and [9] the following template has been created for the definition of the Business Requirements:

Requirement ID	<Unique ID > (i.e. MF01-BR01)
Title	<Title of the Requirement>
Description	< Description of Requirement>
Success Criteria	<Provide a target that makes it possible to test if requirement was satisfied>
Dependencies	<List other requirement IDs that this requirement is dependent on>
Priority	Low/Mid/High

Table 54 Business Requirements template

Requirement ID: Unique identifier of the requirement that could reflect links and relationships, helping in traceability of requirements. Once assigned, the identification must be unique - it is never modified (even if the identified requirement changes) nor is it reused (even if the identified requirement is eliminated).

Title: Short sentence describing the requirement.

Description: Few lines of text describing the requirement.

Success Criteria: Defines the condition for the verification that the requirement has been satisfied providing the information necessary to measure if the requirement has been satisfied.

Dependencies: Indication of the dependencies with other requirements if they exist.

Priority: Identification of the priority of the requirement established through a consensus process among internal and external stakeholders and based on simple evaluation scheme which provides for the indication of High, Medium, or Low priority.

ANNEX II: User requirements template

The following template has been created for the definition of the User Requirements:

No.	Type	Description	Priority
UserReq XX	Legal compliance / Security / Compatibility / Connectivity / Functionality / Usability / Performance	< Description of Requirement>	Low/Mid/High

Table 55 User Requirements template

Requirement ID: Unique identifier of the requirement helping in traceability of requirements.

Requirement type [3][9]:

- **Legal Compliance (Privacy) requirement:** specifies any requirements preserve the disclosure restrictions on information, guaranteeing that no one will be break the rules of personal privacy and proprietary information;
- **Security requirement:** specifies any requirements for the control of access to guarantee the integrity and the availability of the data;
- **Compatibility requirement:** specify the requirements relating to the compatibility with other systems both software and hardware;
- **Connectivity requirement:** definition of how the system is required to interact with external systems (external interface), or how the system elements within the system, including human elements, interact with each other (internal interface);
- **Functionality requirement:** specifies the functionality of the software that developers need to integrate into the system to allow users to perform their tasks, thereby meeting business requirements;
- **Usability requirement:** provides the basis for the design and evaluation of systems to meet the user needs. Usability requirements are developed in conjunction with, and form part of, the overall requirements specification of a system;
- **Performance requirement:** defines the extent or the manner in which, and under what conditions, a function or task must be performed. These are quantitative requirements of system performance and can be verified individually.

Description: Few lines of text describing the requirement.

Priority: Identification of the priority of the requirement in terms of High, Medium, or Low priority.

ANNEX III: Questionnaire for External Elicitation of Stakeholders Requirements

1. What is your background?

Energy Sector	
DSOs	☐
Aggregators	☐
ESCOs	☐
Technology Providers	☐
Distributed Generation Providers	☐
Energy retailers	☐
Scientific community	☐
End users	
Prosumers	☐
Commercial and Residential Customers	☐
Facility managers	☐
System operators	☐
Stakeholders at the Pilot Sites	☐
General Public	☐
Other	☐

2. Do you use Demand Response programs?

Yes	☐
No	☐
No, but I would like to	☐

If you answered "No" or "No, but I would like to" to the question n. 2, please answer to the question n. 3, 6, 9, 10 and n. 12.
If you answered "Yes" to the question n. 2, please answer to the following questions:

3. Which type of Demand Response programs do you use or know?

Time-of Use (TOU)	☐
Real Time Pricing (RTP)	☐
Critical Peak Pricing (CPP)	☐
Direct Load Control	☐
Interruptible/Curtailable (I/C) Service	☐
Demand Bidding/Buy Back (DB)	☐
Emergency Demand Response Program (EDRP)	☐
Capacity Market Program (CAP)	☐

Ancillary Service (A/S) Markets	☐

4. Do you apply DR programs in both residential and commercial buildings?

Residential	☐
Commercial	☐

5. In which case do you apply the DR programs?

_____
_____
_____
_____
_____

6. What are, in your opinion, the users' limitations on applying DR programs?

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
Require specific information and data that might not be available	☐	☐	☐	☐	☐
Complicated and time consuming	☐	☐	☐	☐	☐
Are designed for well-trained users only	☐	☐	☐	☐	☐
Cannot guarantee secure data handling	☐	☐	☐	☐	☐
Do not take into account the comfort levels of the user	☐	☐	☐	☐	☐
Provide flexibility for the application of DR programs	☐	☐	☐	☐	☐

7. What tools do you use for the implementation of the DR programs?

Demand Response Quick Assessment Tool (DRQAT)	☐
Open Source Open ADR toolkit	☐
AutoDR Database Tool (ADRD)	☐
Demand Limiting Assessment Tool (DLAT)	☐
Other – Please Specify: _____	☐

8. Could you please indicate the specific standards or methods used during the application of DR programs (i.e. for data standards)?

Open ADR	☐
REST API	☐
Particular Metering data format: – Please Specify: _____	☐
Sensors Mesh Network: – Please Specify standard: _____	☐
Other – Please Specify: _____	☐

9. **In your opinion, what are the aspects that are not currently taken into account during the application of DR programs (e.g. comfort level)?**

_____
_____
_____
_____
_____

10. **In your opinion, what type of tool can improve the performance of your DR programs?**

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
Load forecasting	☐	☐	☐	☐	☐
User profiling	☐	☐	☐	☐	☐
Customer clustering	☐	☐	☐	☐	☐
Price signaling	☐	☐	☐	☐	☐

11. **Which aspect of the demand response forecast and energy flexibility assessment phase would you like to improve?**

_____
_____
_____
_____
_____

12. **Using drones for aerial surveying in combination with thermal imaging and laser scanning can assist in assessing demand response potential. Would you be interested in using drones for estimating the demand response of potential prosumers?**

Yes	☐
No	☐

13. What methods currently do you use for load forecasting?

Parametric Methods	
Regression Method	☐
Time series	☐
Similar Day Approach	☐
Autoregressive Moving Average (ARMA)	☐
Spectral Expansion technique (Fourier Series)	☐
State equations	☐
Artificial intelligence methods	
Artificial Neural Networks	☐
Fuzzy Logic	☐

14. Which aspect of load forecasting would you like to improve? (e.g. improve accuracy; use of separate forecast model for each of the metering systems; consideration of PV/RES degradation)

_____
_____
_____
_____
_____

15. Which aspect of customer clustering and segmentation would you be interested? (e.g. facilitate billing strategies definition based on the specific operational profiles)

_____
_____
_____
_____
_____

16. Does your current trading system guarantee secure transactions, if any?

Yes	☐
No	☐

17. Are you interested in secure personal data handling during the DR programs' procedures?

Yes	☐
No	☐

18. What issues do you want to address and ameliorate through secure DR programs in the grid side as a DSO? (question for DSO)

_____
_____
_____
_____
_____

19. Are you interested in automatic financial settlement through the use of smart contract?

Yes	☐
No	☐

20. Do the current tools provide interactive user visualization?

Yes	☐
No	☐

21. What do you expect from interactive multi-purpose visualization tool for the application of DR programs?

_____
_____
_____
_____
_____