D2.1 AI REDGIO 5.0 Requirements Engineering Methodology

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Abbreviations and Acronyms:	
WP	Work Package
THB	Trial Handbook
(E)DIH	European Digital Innovation Hub
DF	Didactic Factory
V&V	Verification and Validation
MDSEA	Model-Driven Service Engineering Architecture
SE	Software Engineering
PIS	Performance Indicator Systems
CJ	Customer Journeys
BP	Blocking Points
DT	Digital Transformation

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AI REDGIO 5.0

1. Executive summary

D2.1 AI REDGIO 5.0 Requirements Engineering Methodology is the first deliverable of WP2. The scope of this document is to define a methodology for Requirements Engineering in order to support the project in its implementation and further assessment along its lifetime.

This deliverable is associated to Task 2.1 "Requirements Engineering Method for AI REDGIO 5.0", which establishes two main objectives intended to assess through this first deliverable:

1. To capture the needs of projects pilots, (E)DIHs, AI platforms and Data Spaces;

2. To initialise the assessment of the project business impact on the industrial pilots.

Therefore, D2.1 defines a common methodology for the continuous requirements gathering, validation and assessment of the project activities, sets the procedure for the application of the established methodology and builds up a set of indications for the correct implementation. D2.1 will address the 4 AI REDGIO 5.0 pillars: Experiments, Digital Innovation Hubs, AI Platforms and Data Spaces.

The Requirements Engineering Method will be based on the usage of Handbooks, and will enable the collection and harmonization of scenarios, needs and requirements from the four different pillars of the project. Namely, the following handbooks will be designed and implemented:

- Trial Handbook

- (E)DIH Handbook

- Techno Handbook

In AI REDGIO 5.0 each of the pillars will require the usage of a concrete handbook. Therefore, the Requirements Engineering Method will enable the compilation of information through the Trial Handbook, the (E)DIH Handbook and the Techno Handbook.

The responsible of each instrument, phase and activity to be carried out within the Requirements Engineering Method is established in the *D2.1 AI REDGIO 5.0 Requirements Engineering Methodology*; as well as the expected timeline.

The compliance with the methodology outline in this deliverable will ensure that the expected results are achieved within the project and the correct development of all the work packages and deliverables.

2. Introduction

2.1. Scope of the deliverable

This deliverable aims at defining a methodology for capturing the needs and business requirements of projects pilots and assessing the project business impact on the industrial pilots. It will have further impact in other tasks and deliverables.

The deliverable includes the following chapters:

- Chapter 2, Introduction: this chapter introduces the deliverable and explains its links with other deliverables, tasks and work packages of AI REDGIO 5.0 project.

- Chapter 3, Methodology: this chapter explains the methodology to be used for the collection and harmonization of scenarios, needs and requirements. Within this chapter the Trial Handbook, (E)DIH Handbook and Techno Handbook will be presented, together with a specific section on the collection of legal and ethical requirements.

- Chapter 4, Responsibilities: this chapter details the responsibilities associated with each step of the Requirements Engineering Methodology.

- Chapter 5, Action Plan: this chapter presents a detailed timeline of all tasks related to the methodology. Deliverables to be developed are also considered.

2.2. Contributions to other WPs

Deliverable D2.1 AI REDGIO 5.0 Requirements Engineering Methodology delivered at M3 contributes to:

- WP2 Needs, requirements, evaluation for AI-driven Industry 5.0;

- WP3 (E)DIHs Network for AI-at-the-Edge Industry 5.0;

- WP4 Industry 5.0 Data4AI Platform & Data Spaces;

- WP5 Industry 5.0 EDGE AI Toolkit & AI-On-demand Platform;

- WP6 AI REDGIO 5.0 Application Experiments.

D2.1 will impact specific tasks within WP2, by defining a common methodological framework for the requirements gathering within the project. D2.1 will contribute to:

- T2.2 "*Platforms and Experiments Scenarios & Expectations*" which goal is to provide a common framework to capture all the scenarios, needs and requirements of the different WPs throughout the lifetime of AI REDGIO 5.0.

- It will also have direct impact on T2.3 "*Requirements Specification for AI-driven Human-Resilient-Sustainable Manufacturing*", which aims to analyse the AI (E)DIH and Experiments requirements thanks to the methodologies described in the present deliverable.

- Additionally, it will impact T2.4 "*Legal and ethical requirements for AI Collaborative Intelligence Scenarios*", which aims to set out the legal and ethical requirements for AI Collaborative Intelligence Scenarios (EAI) with which the AI REDGIO 5.0 tools must comply.

Furthermore, D2.1 will also directly contribute to WP6 *"AI REDGIO 5.0 Application Experiments"* as it will set the methodology for the information gathering, progress and monitoring of the experiments carried out within this WP.

Finally, D2.1 will also contribute to WP3 "*(E)DIHs Network for AI-at-the-Edge Industry 5.0*", WP4 "*Industry 5.0 Data4AI Platform & Data Spaces"*, WP5 "*Industry 5.0 EDGE AI Toolkit & AI-On-demand Platform"* by establishing the methodology for requirements and scenario collection.

2.3.   Contributions to other deliverables

D2.1 will contribute to six deliverables from WP2:

- D2.2 and D2.6 "*Platforms and experiments AI Scenarios*", in M6 and M24. These reports describe the user scenarios in DF and SME experiments and a first matching with the WP3-4-5 platforms.
- D2.3 and D2.7 "*User Requirements Specification for edge-AI Industry 5.0*", in M6 and M24. These reports describe the user requirements from our experiments as well as technical specifications for WP3-4-5.
- D2.4 and D2.8 "*AI REDGIO 5.0 experiments socio-business 6Ps Assessment and Lessons Learned*", in M21 and M36. These reports describe the 6Ps analysis results for Industry 5.0 Digital Transformation at the end of first and final iteration of experimentations.

3. Methodology

3.1. Introduction

AI REDGIO 5.0 project follows a two iterations approach for its main 5 WPs (WP2-6), so that at the end of the first iteration at M21 (and at the end of the project M36) the common project design and development methodology will allow a cross-WP analysis.

AI REDGIO 5.0 project encompasses three main system types:

- AI-based DF and SMEs experiment solutions (WP6);

- AI (E)DIH services (WP3);

- AI platforms for AI (E)DIHs and SMEs (WP4, WP5).

The 'Users' of the 'systems' developed in AI REDGIO 5.0 belong to various types, from customers of AI-focused (E)DIHs to users of AI platforms and SMEs manufacturers, therefore this section describes AI REDGIO 5.0 methodology to support a 'general' system design and development process in an abstract way. For the sake of clarity in this paragraph, we call simply 'requirements' both the 'business' requirements from AI (E)DIHs and SMEs users and the 'technological' requirements from AI platforms users. Therefore, the AI REDGIO 5.0 Methodology is devised in terms of an abstract 'system' design and development, in which 'requirements' are elicited from the 'users' of the 'system', then the system developers (technology providers or (E)DIH service designers) analyse, categorise and prioritise the 'requirements' collected from the 'users' and, finally, build up the 'system' (being that a new (E)DIH service or an enhanced AI platform/tool) from 'components' (which can be IT artefacts or organizational processes), each with specific functionalities which match 'technical requirements'. These 'components' integrated together are chosen to provide the 'system' functionalities needed to provide the elicited requirements. Moreover, these 'components', linked together and integrated in a 'system architecture', can then be deployed, tested and verified against the 'technical' requirements, and, finally, validated[1] against the original 'requirements' by the 'users'.

Accordingly, to provide a general approach covering all project system types, the AI REDGIO 5.0 Requirement Engineering and Verification and Validation (V&V)[1] methodology is based on methodologies which have been adopted for design and development of different types of systems, such as Software Engineering (SE) concerning IT artefacts (see[2], as an example), Model-Driven Service Engineering Architecture (MDSEA)[3] concerning integration between domain components (IT artefacts, Organization/Human and Physical means), and the ECOGRAI methodology[4], a method to design and implement Performance Indicator Systems (PIS) for industrial organizations, enabling identification of action means on which decision makers can act to reach their objectives in an integrated way along the system decisional structure.

The approach of the Requirements Engineering and V&V Methodology for AI REDGIO 5.0 encompasses a complete requirements life-cycle management method, based on the above-mentioned methodologies, for collecting and harmonizing scenarios, needs and requirements from the different pillars of the project, with the support of specific data structures (namely, the Handbooks) for information sharing along the whole requirements life-cycle, as shown in Figure 1. Accordingly, to take into account the specific characteristics of

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[1] Verification and Validation (V&V) include both checking that components and system match their technical requirements (verification) and that the overall system matches the user requirements (validation)

[2] Sommerville, Ian. "Software engineering 9th Edition." *ISBN-10* 137035152 (2011): 18

[3] MSEE project, (FP7 2012), *Manufacturing SErvice Ecosystem Project*

[4] Ducq Y., Vallespir B., "Definition and Aggregation of a performance measurement system in three aeronautical workshops using the ECOGRAI method", Production Planning and Control, Vol 16, Issue 2, 2005

the addressed 'systems', specific methodologies will be adopted as needed, such as Customer Journeys for (E)DIHs or User Journeys and Grand Scenarios for technological artefacts.

AI REDGIO 5.0 REQUIREMENTS ENGINEERING METHODOLOGY

| WP2 Scenarios and requirements |

| TRIAL HANDBOOK | (E)DIH HANDBOOK | TECHNO HANDBOOK |

| WP6 Experiments | WP3 DIH Ecosystem | WP4 Data4AI Platform & Data Spaces | WP5 AI Toolkit & AI-On demand Platform |
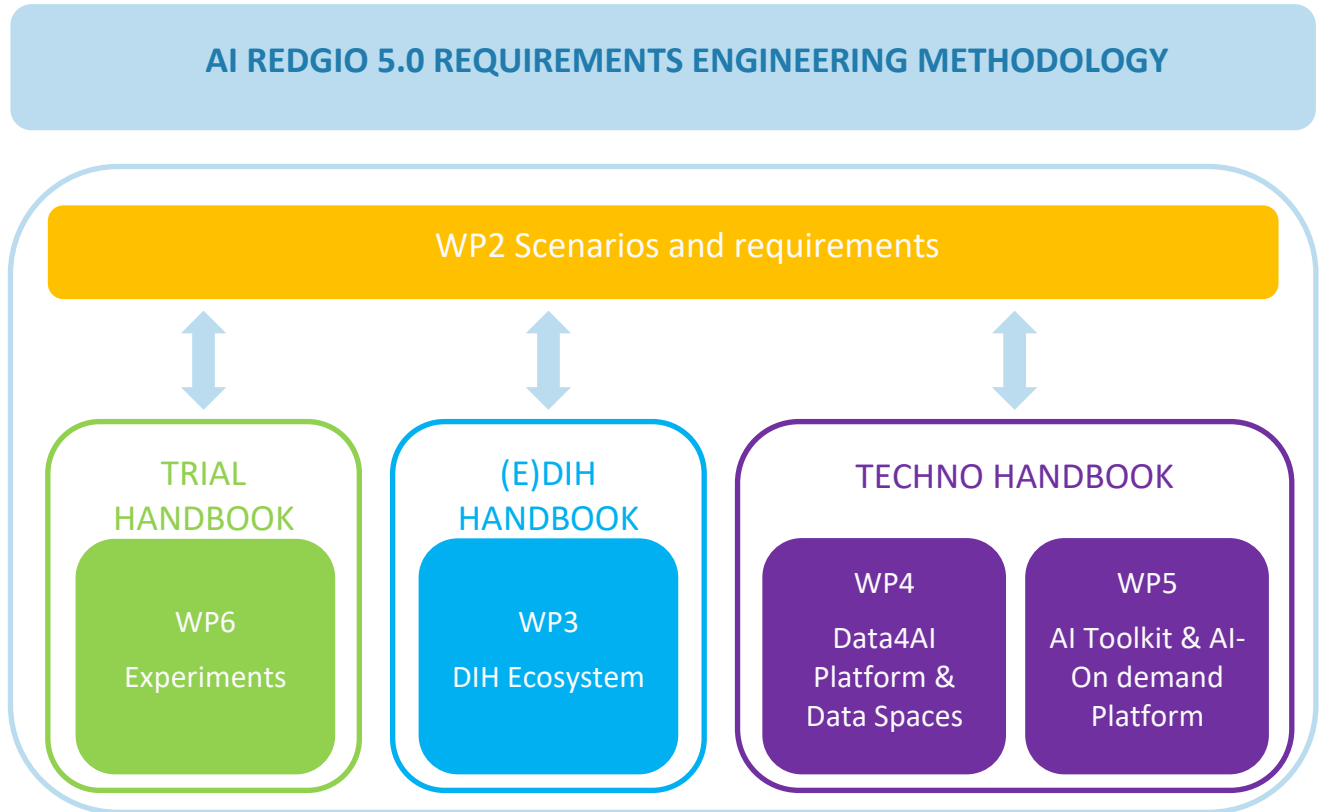
Figure 1: Requirement Engineering & Verification and Validation methodology information support

The AI REDGIO 5.0 Requirements Engineering and V&V Methodology for the requirements and scenario management, which follows the above-mentioned approach, consists of 5 phases (see Figure 2):

- **PHASE 1: Scenario Analysis.** This phase consists on drawing the as-is and to-be scenarios of the addressed 'system' including bottlenecks, objectives and KPIs elicited from the 'system' users.

- **PHASE 2: Business/Technological Requirements, elicitation and analysis**. In this phase business process modelling and formal modelling will be considered, as well as the identification of the above mentioned 'requirements', their classification, prioritization and grouping.

- **PHASE 3: Technical Requirement Specification and AI-focused architecture design**. This phase is oriented to the identification of 'technical' requirements of system components covering the business/technological requirements elicited from 'system' users.' The chosen components are then composed in the system architectural solution.

- **PHASE 4: Deployment and verification**. This phase considers the solution deployment and solution integration and testing (verification of technical requirements).

- **PHASE 5: Requirement validation, assessment and lessons learned**. This phase will include the assessment of coverage and completion of business/technological requirements and identification of lessons learned.

PHASE 1 – Scenario Analysis	AS-IS/To be Scenarios, bottlenecks, objectives, KPIs
PHASE 2: Business/Technological Requirements, elicitation and analysis	Business processing modelling, business/technological requirements identification (nr-prio), classification, grouping
PHASE 3: Technical Requirement Specification and AI-focused architecture design	Identification of technical requirements covering business/technological requirements AI-focused system architecture design
PHASE 4: Deployment and verification	Integrated platform/stem deployment and testing (verification)
PHASE 5: Requirement validation, assessment and lessons learned	Assessment of coverage/completion of business/technological requirements (validation) and lessons learned identification

Figure 2: AI REDGIO 5.0 Requirements Engineering and V&V Methodology: first iteration of the project

3.2. Adoption of the methodology for experiments

AI REDGIO 5.0 WP6 "*AI REDGIO 5.0 Application Experiments*" aims:

i. to supervise and coordinate 7 AI REDGIO 5.0 SME-driven Experiments, defining common methods, tools, KPIs to foster their deployment and to evaluate their achievements;

ii. to prepare, conduct, monitor and evaluate the 3 SME-driven Experiments in AI REGIO Regions complemented by the other 3 AI REGIO regions covering in total 6 Vanguard regions;

iii. to prepare, conduct, monitor and evaluate the 4 SME-driven Experiments in AI PILOT Regions complemented by the other 4 AI PILOT regions covering in total 8 Vanguard regions;

iv. to develop and run TERESA experimentations in selected regions out of the AI REDGIO 5.0 14 Regions;

v. to follow experiments conducted by SMEs in the Regions winning the Open Calls' two waves and collect and benchmark experiences, business benefits, social feedback, lessons learned in a Recommendation paper for Regional/EU authorities.

Each of the 14 Didactic Factories and 7 SMEs experiments will develop a Trial Handbook, foreseen as a useful document to support the implementation of the experiments, that will report the activities and outcomes that will be then summarized in the WP2 deliverables D2.2 (scenarios M6) and D2.3 (requirements and KPIs M6) and in the WP6 deliverables D6.1 (AI REDGIO 5.0 Experiment Plan M12).

3.2.1. Trial Handbook

The AI REDGIO 5.0 Trial Handbook (THB) is the tool used to monitor the launch and evolution of AI REDGIO 5.0 pilot experiments. The Trial Handbook is a confidential document and the central information source for all tasks regarding the pilots, defining in detail the entire process carried out throughout the experiment and the outcomes and results of the activities performed. As such, the objective of this guide is

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to define, structure, coordinate and collect information regarding the pilot experiments of the AI REDGIO 5.0 project in a standardised manner and assess their impact.

A Trial Handbook will be created for each of the 14 Didactic Factories and 7 SME experiments as a "confidential" one-stop-shop. From this repository of scenarios and business processes, proper materials will be extracted for many AI REDGIO 5.0 deliverables, mainly in WP2 and WP6.

Each experiment will write and be responsible of its own Trial Handbook and of the gathered information, but in order to better coordinate and align the development of activities inside the experiment participants, **the AI REDGIO 5.0 Trial Handbook will provide a common structure to gather and present data**. Therefore, the THB will include the following chapters:

- CHAPTER 1: Experiment overview;

- CHAPTER 2: Business Requirements;

- CHAPTER 3: Implementation and results.

By respecting this structure, the AI REDGIO 5.0 Trial Handbook will contribute to the different tasks mainly within WP2 and WP6 (see Figure 3).

Figure 3: AI REDGIO 5.0 Trial Handbook structure

Chapter 1: Experiment Overview

The 1st Chapter "Experiment Overview" of the Trial Handbook will **gather all the key overall information of the pilot experiment** to allow a comprehensive understanding of the trial, including general information like the trial site and the involved stakeholders, and fully depicting the initial business scenario, with current weaknesses, bottlenecks and objectives, as well as the expected business scenario linked to specific KPIs. In particular, a comprehensive description of the AS-IS and TO-BE business and innovation scenario will be reported in this Chapter and then summarized in D2.3 *User Requirements Specification for edge- AI Industry 5.0* (M6)

The foreseen structure of Chapter 1 is the following:

- General description and motivation;

- Objectives & benefits;

- Experiment team;

- Social, economic and legal/ethical framework;

- AS-IS Scenario;

- Weaknesses and bottlenecks;

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- Technical Information (state of art).

- TO-BE Scenario;

- Expected results and KPIs;

Chapter 2: Business Requirements

In AI REDGIO 5.0, it is crucial to identify and assess the business requirements of each of the experiments. Therefore, the AI REDGIO 5.0 Trial Handbook will include a **chapter related to Business Requirements**. This chapter will capture the business requirements of each experiment in a table (see Table 1), including:

- Business process;

- Business requirements;

- Ethical procedures and experiment-specific features;

- User requirement specifications.

Table 1: Example of a Business Requirement table

Req #	Business Requirement	Description	Priority	Application Area	Functional Requirement?
00	Name of business requirement	Short description of the business requirement	- Critical - Preferred - Optional	Area of application of Business Requirement	- Functional - Non-Functional

A detailed report of the experiments business requirements will be included in D2.3

Chapter 3: Implementation and results

The 3rd Chapter will be mainly focused on the implementation of the pilot experiment, including an action plan describing the different trial phases, achievements and outcomes, including barriers. In addition, final results and lessons learnt will be described, together with a preliminary exploitation plan for the trial.

- Experiment Implementation:

  o Implementation plan;

  o Description of the results;

  o Barriers faced;

  o Lessons learned;

  o Measures KPIs.

  o Dissemination, Impact and Exploitation

    ▪ Video of the pilot

These contents will be also summarized in WP6 and will be updated according to the two iterations of the project.

3.3. Adoption of the methodology for (E)DIHs

AI REDGIO 5.0 WP3 "*(E)DIHs Network for AI-at-the-Edge Industry 5.0*" aims

i)   to create an ecosystem of (E)DIHs active in AI-at-the-edge for Manufacturing Industry 5.0;

ii)   to define I5.0 inspired methods and tools for Service Portfolio analysis and Customer Journeys CJs as well as collaboration corridors among (E)DIHs to fill the service offering gaps evidenced by CJs define customer journeys and Digital Transformation pathways;

iii)   to materialise a network of AI-at-the-edge Experimental Facilities where to perform experiments WP6;

iv)   to extend and integrate the existing DIHIWARE platform for Industry 5.0 (E)DIH networks;

The implementation of such activities is driven by this (E)DIH Handbook document, which, for each (E)DIH, will report the extensive achievements and outcomes to be then summarized in the WP2 deliverables D2.2 *Platforms and experiments AI Scenarios* (M6) and D2.*3 User Requirements Specification for edge- AI Industry 5.0* (M6) and in the WP3 deliverables D3.1 *(E)DIH Service Portfolio, Customer Journey and Pipelines* (M9), D3.2 *Collaboration Corridors for AI-at-the-Edge (E)DIH* (M12) and D3.3 *Testing and Experimental facilities Network* (M12). Finally, WP3 will develop a one-stop-shop portal for service and assets offering by the AI REDGIO 5.0 (E)DIH ecosystem and integrate it into the AI REDGIO 5.0 AI-at-the-Edge Marketplace (D3.4 M12).

The AI REDGIO 5.0 (E)DIH methodology is an evolution of the METHODIH methods and tools (see section 3.3.1 METHODIH Methodology).

3.3.1. METHODIH Methodology

METHODIH has elaborated a methodology to support (E)DIHs in extending and improving their service proposition both to their constituency and to other (E)DIHs in the network (e.g., the DIH4INDUSTRY network). The following main achievements are inherited by AI REDGIO 5.0:

a.   **Service Portfolio Analysis**. A structured approach is proposed to (E)DIHs in order to define their as-is and to-be service portfolio. Services are classified in 5 main top-level categories: **D-BEST – Data, Business, Ecosystem, Skills and Technology** (see Figure 4), while a 3-levels taxonomy with examples is provided in order to support (E)DIHs in the definition and description of their as-is and to-be services. In particular, for the to-be services, three main categories have been depicted: Project-funded, Project-inspired, Project-collaborative services with an increased degree of co-operation with the projects and its beneficiaries.
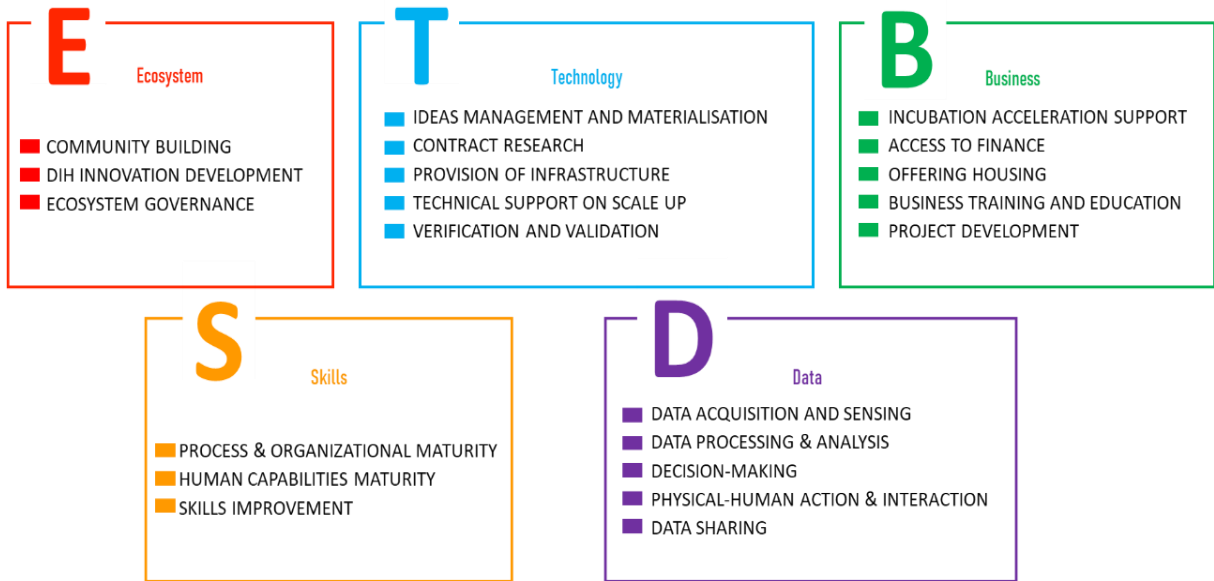
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E Ecosystem
- COMMUNITY BUILDING
- DIH INNOVATION DEVELOPMENT
- ECOSYSTEM GOVERNANCE

T Technology
- IDEAS MANAGEMENT AND MATERIALISATION
- CONTRACT RESEARCH
- PROVISION OF INFRASTRUCTURE
- TECHNICAL SUPPORT ON SCALE UP
- VERIFICATION AND VALIDATION

B Business
- INCUBATION ACCELERATION SUPPORT
- ACCESS TO FINANCE
- OFFERING HOUSING
- BUSINESS TRAINING AND EDUCATION
- PROJECT DEVELOPMENT

S Skills
- PROCESS & ORGANIZATIONAL MATURITY
- HUMAN CAPABILITIES MATURITY
- SKILLS IMPROVEMENT

D Data
- DATA ACQUISITION AND SENSING
- DATA PROCESSING & ANALYSIS
- DECISION-MAKING
- PHYSICAL-HUMAN ACTION & INTERACTION
- DATA SHARING

Figure 4: 5 main top-level categories for service classification

b. **Customer Journeys (CJ) and Blocking Points (BP)**. A Customer analysis is proposed in order to understand typical needs, expectations and interaction workflows by the various ecosystem stakeholders. Customizable templates for Technology Providers, Technology Users, Students, Start-ups, Public Bodies and other (E)DIH customers are provided, in order to ease the identification of customers and the definition of typical interaction workflows. Customer Journeys (CJ) (see Figure 5) are then defined as level-by-level Digital Transformation (DT) evolutionary pathways (see Figure 6) that typically model the customer interaction with an (E)DIH. A third step in this analysis is the identification of Blocking Points, i.e., of factors preventing customers to evolve their Digital Transformation from one level to the subsequent one.

OBSERVATION
Search information

AWARENESS
Understand benefits and challenges

EXPERIMENT
Proof of concept

EXPERIENCE
Test the prototype inside the company's facility

ADOPTION
Decision to invest in the new technology

IDEATION
Consolidate and validate the business idea

DESIGN & ENGINEERING
Develop the solution

MVP
Test the solution and verify its business potential

VERIFICATION & VALIDATION
Find early adopters and financial resources

GO TO MARKET
Get prepared to launch the technology on the market

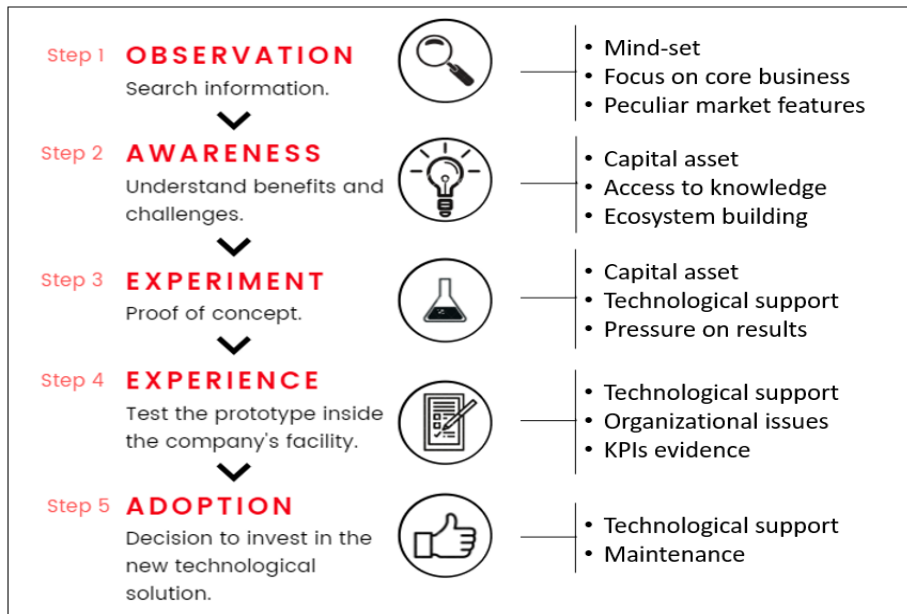**Figure 5: Customer Journeys**

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Figure 6: Digital Transformation Journey – Blocking Points

c. **Service-oriented Digital Transformation Matrix**. The third step of the methodology consists of populating the Customer Journeys with as-is and to-be Services in order to overcome the Blocking Points identified. The result is a bi-dimensional matrix (see Figure 7) where the different steps of the CJ are implemented by services, supporting the evolutionary pathways from one level to the subsequent one. Generic DT Matrices can be generated by the (E)DIHs for each of their customers' typologies as reference sequences of services for DT (pathways): new to-be services are aimed to fill gaps in the pathway and to overcome blocking point's limitations. Such generic pathways are then to be instantiated for the specific Customer and, in the case of Manufacturing SMEs, accompanied by a DT plan along the six dimensions of the pathway (6Ps migration model). For each milestone achieved by the customer in its DT journey, a success story can be generated and substantiated by evidence of the progress made.
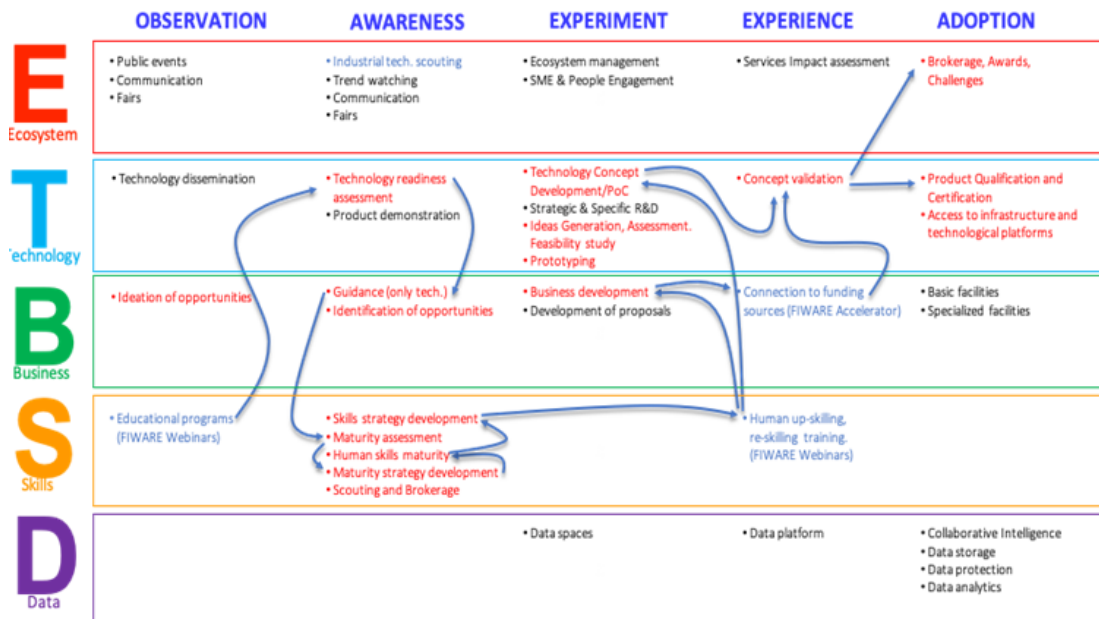

Figure 7: Service-oriented Digital Transformation Matrix

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3.3.2. (E)DIH Handbook

The AI REDGIO 5.0 (E)DIHs Handbook ((E)DIHs HB) is the tool used to monitor the (E)DIHs' evolution throughout the project. The (E)DIH Handbook is the central source of information regarding the (E)DIHs, recollecting information related to:

- (E)DIH service offer;

- The "customer" side of the (E)DIHs, identifying different behaviours in order to define customer journeys and measure milestones in the Digital Transformation pathways;

- Business model and value chain scenarios, including models for governance and socio-environmental sustainability;

A DIH Handbook will be created for each of the AI REDGIO 5.0 (E)DIHs as a "confidential" one-stop-shop for WP3 of the project. From this repository, proper materials will be extracted for many AI REDGIO 5.0 deliverables.

Each DIH partner will write and be the responsible of its own deliverables and of the gathered information, but in order to better coordinate and align the development of activities within the experiment participants, **the AI REDGIO 5.0 (E)DIH Handbook will provide a common structure to gather and present data**. Therefore, this Handbook is intended to be compiled by each AI REDGIO 5.0 DIH in its Chapters, according to the following guidelines:

- CHAPTER 1: Service Portfolio Analysis;

- CHAPTER 2: Customer Journeys;

- CHAPTER 3: (E)DIH Services Development, implementation and exploitation;

- CHAPTER 4: Business and Governance Models.

By respecting this structure, the AI REDGIO 5.0 (E)DIH Handbook will contribute to the different tasks within WP2 and WP3 (see Figure 8).
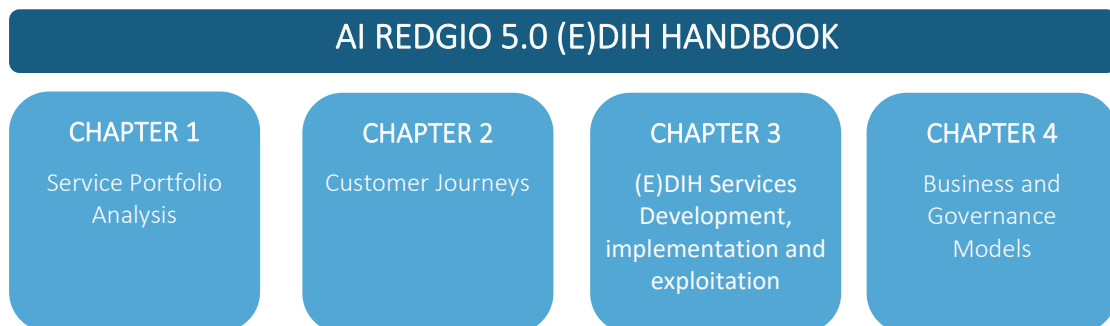

AI REDGIO 5.0 (E)DIH HANDBOOK

CHAPTER 1	CHAPTER 2	CHAPTER 3	CHAPTER 4
Service Portfolio Analysis	Customer Journeys	(E)DIH Services Development, implementation and exploitation	Business and Governance Models

Figure 8: AI REDGIO 5.0 (E)DIH Handbook methodology

Chapter 1: Service Portfolio Analysis

Thanks to a shared online sheet, (E)DIHs are made aware of their current (as-is) service offering and are invited to plan their desired (to-be) services according to the D-BEST methodology. A series of interactive and participative workshops supports confrontation and mutual inspiration for the development of new services, some of them in a cross-(E)DIH collaboration form. Once the excel sheet has been synthetically compiled, the extensive description of the services is foreseen in Chapter 1 of the (E)DIH Handbook. The (E)DIH Handbook will mostly focus on to-be services and on those who require collaboration by other (E)DIHs. The needs and requirements for the development of the to-be services will be collected and included in D2.5. The

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implementation and validation of the to-be services will be described in Chapter IV and reported in WP3 progress reports.

Chapter 2: Customer Journeys

Thanks to a number of Customer Journeys templates (for AI technology providers, for Manufacturing SMEs, for Public Agencies), the DIHs are able to select and customize the most suitable Customer Journeys and Blocking Points for each of their Customer typology. This will allow the compilation of user scenarios reporting the interaction of the different customer typologies with the (E)DIHs. This is going to be included in D2.3. The instantiation of the generic CJs and BPs with the specific D-BEST services will be subject of the following Chapter 3.

Chapter 3: (E)DIH Services Development, implementation and exploitation

This chapter collects information on how experiments (individual and in collaboration) are implemented within AI REDGIO5.0 and how (E)DIHs exploit the generated results. The idea is to identify and then facilitate the dissemination of good practices and lessons learned regarding the methodologies and approaches adopted by (E)DIHs to develop services. Specifically, for each experiment the following information will be collected:

- Description of the developed service;

- Tasks performed for the implementation of the service, as well as the timing followed;

- Barriers and difficulties encountered during implementation and the measures taken to overcome them;

- Results achieved by the implementation of the service;

- Roadmap for the correct exploitation of the results;

- Lessons learned from the experience.

Chapter 4: Business and Governance model

This chapter is studying and discussing different Business and Governance models at three different levels: The Single DIH level, the (E)DIH-(E)DIH level and the Coordinator level (AI REDGIO 5.0 project or DT Accelerator in the future). For each of them, different options of Business and Governance models will be presented, discussed and assessed. Each (E)DIH will select the most suitable models and evaluate them along the lifetime of the project. Results will be reported in D3.5.

3.4. Adoption of the methodology for AI Platforms and Data Spaces

WP4 "*Industry 5.0 Data4AI Platform & Data Spaces*" and WP5 "*Industry 5.0 EDGE AI Toolkit & AU-On-demand Platform*" focus on the development of a comprehensive technological offer for (E)DIHs and SMEs in order to foster the adoption of AI innovative solutions and to support the new Industry 5.0 paradigm, where AI-driven autonomous systems are efficiently and effectively interacting with Humans according to the Collaborative Intelligence paradigm.

The Techno Handbook (TechHB) is meant to be a supporting document that depicts the evolution of the technological offer in a comprehensive and clear way.

3.4.1. Techno handbook

In particular, the Techno Handbook is the tool used as a one-stop-shop to collect all the information regarding the development of the technological activities of the project. As such, the objective of this guide

is to define, structure, coordinate and collect information regarding the technological aspects of the AI REDGIO 5.0 project in a standardised manner and assess their impact.

The AI REDGIO 5.0 Techno Handbook will provide a common structure to gather and present data. Therefore, the handbook will at least include these chapters:

- CHAPTER 1: Technology overview
    - o Technology description;
    - o Backgrounds and state of the art.
- CHAPTER 2: Requirements
    - o User Journeys and Grand Scenarios;
    - o User requirements;
    - o Mapping of technologies on requirements;
    - o Technological gaps Identification.
- CHAPTER 3: Action Plan and Lessons Learnt
    - o Development plan
- CHAPTER 4: Business Model and Exploitation
    - o Value proposition;
    - o Technological trends;
    - o Competitors (Direct /Indirect) Analysis
    - o Licensing Models (type of license to which the utilization of this technology is subject to)

By respecting this structure, the AI REDGIO 5.0 Techno Handbook will contribute to the different tasks within WP4 and WP5 (see Figure 9).
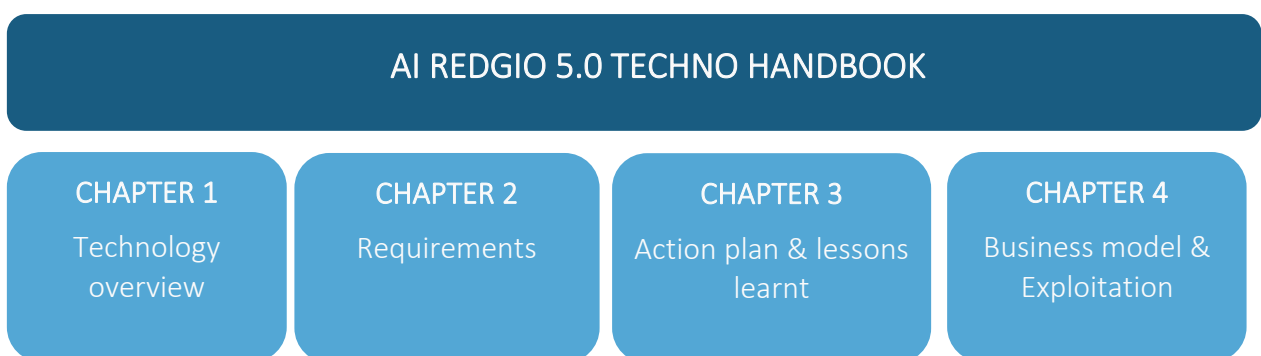
AI REDGIO 5.0 TECHNO HANDBOOK

CHAPTER 1	CHAPTER 2	CHAPTER 3	CHAPTER 4
Technology overview	Requirements	Action plan & lessons learnt	Business model & Exploitation

Figure 9: AI REDGIO 5.0 Techno Handbook methodology

Chapter 1: Technology overview

The 1st Chapter "Technology Overview" will **collect all the key information of the technologies** made available within the AI REDGIO 5.0 Consortium to draw a complete and exhaustive picture of the technological background of each Key Exploitable Asset in AI REDGIO 5.0 technological pillar (namely within WP4 and WP5). This chapter will contain a precise but concise description of the asset under development, as well as provide the way to collect, thanks to a series of "ad hoc" templates, further technical details such

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as system architecture, adopted standards and used data models and ontologies, available API and other interoperability mechanisms, current license schema, packaging and deployment options, and so on.

Chapter 2: Requirements

The 2nd Chapter "Requirements" will identify and assess Technological Requirements for the developments of each Key Exploitable Asset within the scope of AI REDGIO 5.0. Here, the potential users/adopters of the asset will be elicited, and thanks to a User Journeys template, the interaction of the different user groups with the available and future asset functionalities will be described. This will affect each AI REDGIO 5.0 asset creating a complete description of assets envisaged functionalities. In this chapter, a table will map background technologies and requirements, highlighting which specific technology/tool meets each specific requirement and why, favouring in this way an immediate verification of technological gaps to be filled in during the AI REDGIO 5.0 project.

Chapter 3: Action Plan and lessons learnt

The 3rd Chapter "Action Plan" is concerned with the specification of the action needed to improve the asset, considering the envisaged integration and/or development scenario ongoing within the AI REDGIO 5.0. Through a shared sheet, a detailed technological development plan will be produced indicating which assets will be installed and when and which improvements will be released according to the project Milestones.

A specific section for Lessons Learnt will be included to collect a list of best practices, emerged during the development activities in all the phases (e.g., design, development and integration of the described asset).

Chapter 4: Business model and Exploitation

The last Chapter "Business Model and Exploitation" will analyse the resulting technological asset from a business perspective, but still keeping a "technology provider perspective", anticipating IPR issues and exploitation agreements, as well as concrete tools and vehicles to move the asset toward the "internal market" (e.g., pilots, OC winners, (E)DIHs) and "external market" (in strict collaboration with WP7).

A specific table will list, for each asset, the licensing model in order to define the boundaries of use of each component.

3.5. Legal and ethical requirements

The legal and ethical dimension plays a central role in AI REDGIO 5.0 workplan and has a transversal nature. It is paramount to promote the human-centric and trustworthy AI paradigm in the project: the legal and ethical constraints to be defined in T2.4 "Legal and ethical requirements for AI Collaborative Intelligence Scenarios" are strictly interrelated with the ethics assessment and governance to be performed under T1.4, as well as with the TEchnology and REgulatory SAndboxes which will be part of the experimentations in WP6 (in particular, T6.4 "*TERESA Experiments in TEF Network*") and, above all, with T7.1 "Legal, Regulatory and Ethical Issues".
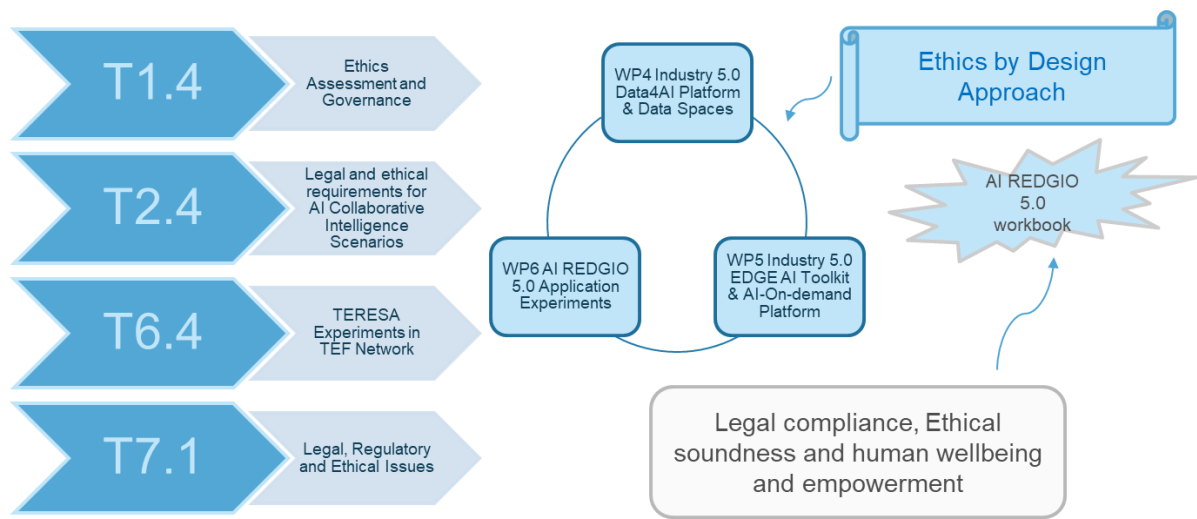
Figure 10: Transversal nature of the legal and ethical activities in AI REDGIO 5.0 Workplan

In order to elicit the set of legal and ethical requirements with which the AI REDGIO 5.0 tools and experiments must comply, the following activities will be performed:

- **Legal and ethical survey**, consisting in the legal and ethical review and analysis of the applicable regulatory framework. This activity, which will be performed in conjunction with T7.1 "*Legal, Regulatory and Ethical Issues*", is directed to identify all the legal and ethical issues surrounding AI REDGIO 5.0 environment and to examine their relevance for the project's technologies and experiments. Different regulatory sources will be deepened, both at national level (in particular the national legislations of the countries where the experiments will be conducted) and at European level. In this regard, special attention will be given to the evolving legislation, such as the AI Act, the Data Governance Act, the Data Act and the AI Liability Directive, as well as to the relevant ethics instruments, such as the "Ethics Guidelines for Trustworthy AI" [1] and the "Assessment List on Trustworthy AI" (ALTAI).

- **Two cycle consultation**, which will involve different stakeholders of the manufacturing value chain, such as EDIHs, regional agencies, Vanguard Initiatives representatives, civil society organisations and representatives from the workers. This activity will be functional to capture these stakeholders' needs and expectations, relying on multi-actor dialogues and exchanges. The partners are planning to conduct these consultations mainly through:

  o **Questionnaire and/or individual interviews.** A questionnaire will be distributed to the agencies, representatives and authorities in order to gather the first insights. Such a questionnaire might be replaced and/or complemented by individual interviews, depending on the specific context;

  o **Participatory workshop,** in which all the agencies, representatives and authorities will actively contribute to the discussion, bringing their viewpoint and insights on key aspects and topics;

  o **Analysis of the gathered information.** The feedback obtained in the first two steps will be treated and analysed to extract initial needs and expectations of the above-mentioned participants.

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[1] Ethics Guidelines for Trustworthy AI, European Commission; https://ec.europa.eu/futurium/en/ai-alliance-consultation

- **Fundamental rights impact assessment.** This will be directed to identify and analyse the expected impact of AI REDGIO 5.0 tools on the fundamental rights at stake, in order to identify potential factors and measures to monitor and the appropriate mitigating measures and safeguards to be taken. In this way, it will be ensured that the project's progress and achievements are citizen-respectful and compliant with the rights and freedoms enshrined in the Charter of Fundamental Rights of the European Union[1] (CFR). This is a key step to move forward towards a fair, legally compliant and trustworthy AI REDGIO 5.0 solutions' deployment.

The main ethical and legal (EL) requirements linked to the AI REDGIO 5.0 experiments will be defined in a specific section of the Trial Handbook, which will include the name of the EL requirement, a short description, the priority (critical, preferred or optional), the area of application and the nature (Ethical/Legal). The experiment's leaders concerned will also indicate to which AI REDGIO 5.0 technology asset and/or tool the requirement is linked.

The legal and ethical requirements will be elicited in D2.3 "*User Requirements Specification for edge- AI Industry 5.0 - M6*" and updated in D2.7 "*User Requirements Specification for edge- AI Industry 5.0 – M24*".

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[1]Charter of Fundamental Rights of the European, Official Journal of the European Communities Union; https://www.europarl.europa.eu/charter/pdf/text_en.pdf

4. Responsibilities

This section defines the responsible of each action/task within the methodology.

4.1. Trial Handbook

The AI REDGIO 5.0 Trial Handbook (THB) will be **designed by WP2 and WP6 leaders, and possible other involved partners,** and they will be **responsible of distributing the final version to all the experiments**. They will also be in charge of the quality assurance of the THB, with the support of Mentors, controlling the quality of the information provided and asking for all the needed clarifications, corrections, etc. to the contributors of the documents. For this purpose, **a quality assurance procedure will be carried out after each submission**. This will enable the creation of a high-quality standard document for each of the experiments, which will lead to high quality identification, description of scenarios and final assessment for Industrial and Technological pilots.

In particular, each Trial leader, in collaboration with the end user representatives and the IT provider representatives, will be responsible to complete the information requested in the different THB Chapters. The Mentors, in collaboration with WP2 and WP6 task leaders, will be responsible for the Quality Assurance of the THB in their group. Then, WP2 and WP6 Leaders will be responsible for the final THB evaluation.

The AI REDGIO 5.0 Trial Handbook Chapters will be **distributed to all the experiment participants** and **will include the corresponding instructions** addressing the way in which it needs to be correctly completed. Figure 11 shows the different actions and the responsible task or work package for each of them.
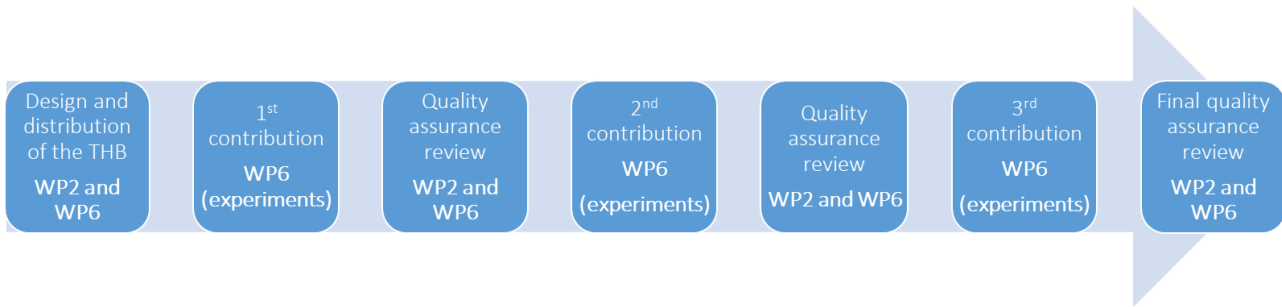

| Design and distribution of the THB WP2 and WP6 | 1st contribution WP6 (experiments) | Quality assurance review WP2 and WP6 | 2nd contribution WP6 (experiments) | Quality assurance review WP2 and WP6 | 3rd contribution WP6 (experiments) | Final quality assurance review WP2 and WP6 |

Figure 11: AI REDGIO 5.0 Trial Handbook responsibilities

Thus, WP2 and WP6 leaders will be responsible for the final submission of the THB, while mentors will be the interface to collect feedbacks from the specific task leaders' experts and to share and include the required information with the experiments under their group.

In particular, T2.2 will be responsible of the creation of the AI REDGIO 5.0 AI DIH Experiments AI Scenarios related sections (D2.2), T2.3 will be responsible for the definition of the Requirements Specification linked sections (D2.3), T2.4 will be responsible for the revision of legal and ethical contents, while WP6 will be responsible for the revision of the implementation and results contents.

4.2. (E)DIH Handbook

The AI REDGIO 5.0 (E)DIH Handbook will be **designed by WP3, together with WP2 task leaders and possible other involved partners,** and they will be **responsible of distributing the final version to all the (E)DIHs**. They will also be in charge of the quality assurance of the (E)DIH Handbook. They will control the quality of the information provided in the (E)DIH Handbook and will request all the needed clarifications, corrections, etc. to the contributors of the documents. For this purpose, **a quality assurance procedure will be carried out after each submission**. This will enable the creation of a high-quality standard document for each of the experiments, which will lead to high quality identification, description of scenarios and final assessment for Industrial and Technological pilots.

The AI REDGIO 5.0 (E)DIH Handbook Chapters will be **distributed to all the technical participants** and **will include the corresponding instructions** addressing the way in which it needs to be correctly completed.

The technical participants will be in charge of completing the AI REDGIO 5.0 (E)DIH Handbook, addressing the topics presented in each of the chapters. The (E)DIH Handbook is composed of four chapters and each of them must be submitted within the deadline (set by WP3) to the responsible, also established by WP3. Figure 12 shows the different actions and the responsible task or work package for each of them.
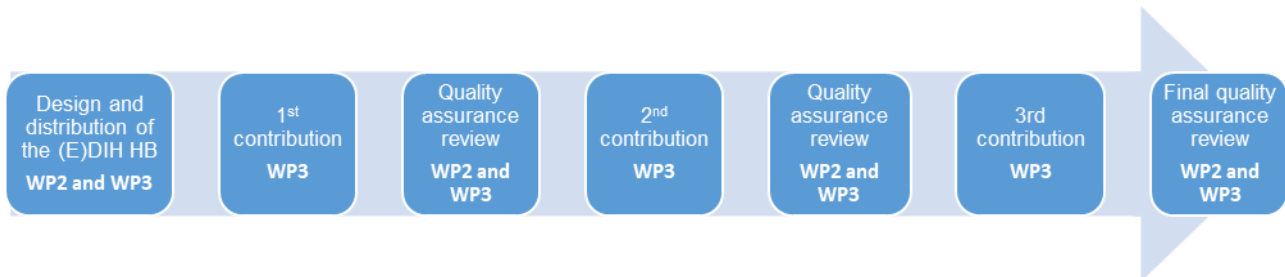

Figure 12: AI REDGIO 5.0 (E)DIH Handbook responsibilities

4.3. Techno Handbook

The AI REDGIO 5.0 Techno Handbook will be **designed by WP4 and WP5 together with WP2 task leaders and possible other involved partners**, and they will be **responsible of distributing the final version.** They will also be in charge of the quality assurance of the Techno Handbook. They will control the quality of the information provided and will request all the needed clarifications, corrections, etc. to the contributors of the documents. For this purpose, **a quality assurance procedure will be carried out after each submission.** This will enable the creation of a high-quality standard document for each of the experiments, which will lead to high quality identification, description of scenarios and final assessment for Industrial and Technological pilots.

The Techno Handbook is composed of four chapters and each of them must be submitted within the deadline (set by WP2, WP4 and WP5) to the responsible, also established by WP2, WP4 and WP5. Figure 13 shows the different actions and the responsible task or work package for each of them.
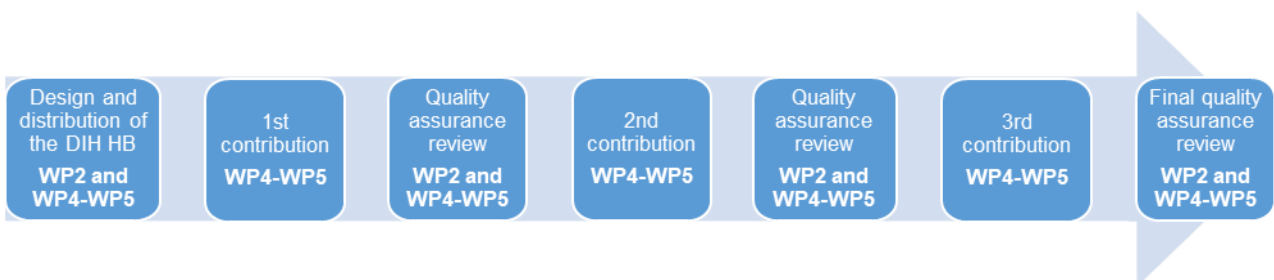

Figure 13: AI REDGIO 5.0 Techno Handbook responsibilities

5. Action plan

This section includes the general overview of the timeline of the proposed methodology.

	YEAR 1											
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
AI DIH and SMEs Scenarios and Expectations: Trial Handbook (WP2 and WP6)						D2.2, D2.3						
Design and distribution (WP2 and WP6)	█	█	█	█								
1st Contribution: Chapter 1, 2 and 3 (WP6)						█						
Quality assurance review (WP2 and WP6)						█						
2nd Contribution: Chapter 1, 2 and 3 (WP6)						█	█	█	█			
Quality assurance review (WP2 and WP6)												█
3rd Contribution: Chapter 1, 2 and 3 (WP6)												
Final quality assurance review (WP2 and WP6)												
Requirements and scenario recollection for (E)DIH: (E)DIH Handbook (WP2 and WP3)						D2.2 D2.3			D3.1			D3.2
Design and distribution (WP2 and WP3)	█	█	█	█								
1st Contribution : Chapter 1, 2 & 3 (WP3)					█	█						
Quality assurance review (WP2 and WP3)						█						
2nd Contribution : Chapter 1, 2 & 3 (WP3)							█	█	█			
Quality assurance review (WP2 and WP3)										█	█	
3rd Contribution: Chapter 4 (WP3)												
Final quality assurance review (WP2 and WP3)												
Requirements and scenario recollection for Platforms: Techno Handbook (WP2 and WP4)						D2.3			D4.1			D4.2, D4.3
Design and distribution (WP2, WP4 and WP5)	█	█	█	█								
Contribution : Chapter 1 (WP4)				█								
Quality assurance review (WP2 and WP4)					█							
Contribution: Chapter 2 (WP4)						█						
Quality assurance review (WP2 and WP3)							█	█				
Contribution: Chapter 3 and 4 (WP4)								█	█			
Final quality assurance review (WP2 and WP4)										█	█	█
Requirements and scenario recollection for Data Spaces: Techno Handbook (WP2 and WP5)						D2.3			D5.1			
Design and distribution (WP2, WP4 and WP5)	█	█	█	█								
Contribution : Chapter 1 (WP4)				█								
Quality assurance review (WP2 and WP4)					█							
Contribution: Chapter 2 (WP4)						█						
Quality assurance review (WP2 and WP3)							█	█				
Contribution: Chapter 3 and 4 (WP4)								█	█	█		
Final quality assurance review (WP2 and WP4)										█	█	█

Figure 14: Overview of the action plan

Actions to be carried out have been defined for the first 12 months of the project. A plan for further definition of the actions to be taken under the Requirements Engineering Methodology after the first 12 months has been established:

Table 2: Plan for the definition of next steps

Deliverable	Action	Responsible	Month
D2.2 AI REDGIO 5.0 Requirements Engineering Methodology	Define next steps of the Requirements Engineering Methodology	T2.1	M21

6. Conclusions

The D2.1 *AI REDGIO 5.0 Requirements Engineering Methodology defines the methodology for Requirements Engineering* in order to support the constant verification and validation of Performance Indicators.

The Requirements Engineering Methodology is based on the Industrial Verification and Validation Method and in the usage of diverse Handbooks, which enables the collection and harmonization of scenarios, needs and requirements from the four different pillars of the project.

The handbooks used for each of the 4 pillars of AI REDGIO 5.0 are:

- The **Trial Handbook** will be used to monitor the launch and evolution of **AI REDGIO 5.0 pilot experiments**. It is the central information source for all tasks regarding the pilots, defining in detail the entire process carried out throughout the experiment and the outcomes and results of the activities performed.

- The **(E)DIH Handbook** is the tool used to monitor the (E)DIHs evolution throughout the project. This Handbook is the central source of information regarding the (E)DIHs, recollecting information related to (E)DIH service offer, the "customer" side of the (E)DIHs defining customer journeys and measuring milestones in the Digital Transformation pathways and the business models and value chain scenarios.

- The **Techno Handbook** used as a one-stop-shop to recollect all the information regarding the development of the technological activities of the project. The Techno Handbook will be applied for **Platforms and Data Spaces**.

The methodology has been established within a concrete timeline and action plan. This timeline enables the correct development and execution of the different activities within AI REDGIO 5.0 and allows the design, development and submit of the deliverables according to the schedule.

The action plan has been defined for the first 12 months of the project. More details on steps and actions will be defined in D2.2 at month 21.