AI for real-world network operation

WP5 – Dissemination, communication, and exploitation of results

D5.2 – Exploitation plan and strategy phase 1

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DISCLAIMER

SUMMARY

The present document represents the deliverable D5.2 – Exploitation plan and strategy phase 1 of the AI4REALNET project. The report portrays the first version of the AI4REALNET Exploitation Plan developed within the framework of Task 5.4 – Exploitation strategy and plan, led by INESC TEC, as part of Work Package 5 – Dissemination, Communication, and Exploitation.

This document presents a preliminary exploitation plan encompassing several important components. First, it provides a detailed characterization of the Key Exploitable Results (KERs), elucidates their significance, and explores potential avenues for exploitation. Additionally, it outlines Intellectual Property Rights (IPR) concepts and strategies, shedding light on the approach to open-source strategies. This ensures the effective safeguarding and utilization of intellectual assets. Furthermore, the document focuses on partner motivations for exploitation, examining the context and drivers that fuel collaborative efforts to achieve the exploitation objectives.

The document also presents the methodology for the identification of the key stakeholders whose engagement and support are pivotal in shaping the trajectory of our project.

Finally, the document commits to unveiling a preliminary business model, offering insights into anticipated revenue streams, cost structures, and value propositions integral to the project's commercialization strategy.

This deliverable will be updated in 12 months (M18): Deliverable D5.4 – Exploitation plan and strategy phase 2. This report will include an updated exploitation plan (compared to version V1) aimed at providing an up to date and detailed description of the exploitation strategy of the consortium. A final version will be produced under Deliverable D5.6 – Exploitation plan and strategy phase 3 (M42). This report will include an updated exploitation plan aimed at describing the post-project strategy planned by the consortium. As the project moves forward, equipped with a clear understanding of the results and the partner motivations, we are well-positioned to navigate the pathway toward realizing our project's objectives and making a meaningful impact.

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ABBREVIATIONS AND ACRONYMS

Acronym	Expansion
AGPL	Affero General Public License
AHMS	Adelaide Health and Medical Science
AI	Artificial Intelligence
AIaaS	AI-as-a-service
ANSP	Air Navigation Service Providers
APS	School of Applied Psychology
ATCO	Air Traffic Controller
ATM	Air Traffic Management
BA	Bachelor of Arts
BMC	Business Model Canvas
BSD	Berkeley Software Distribution
CAGR	Compound Annual Growth Rate
CAI	Centre for Artificial Intelligence
CRE	Commission de Régulation de l'Energie
DER	Distributed energy resources
DSNA	Direction des Services de la Navigation Aérienne
DSO	Distribution System Operator
EASA	European Union Aviation Safety Agency
EDIH	European Digital Innovation Hubs
EEN	Enterprise Europe Network
EID	Ecological Interface Design
ELISE	European Learning and Intelligent Systems Excellence
ELLIS	European Lab for Learning and Intelligent Systems
EPL	Eclipse Public License
ERC	European Research Council
EUPL	European Union Public License

FATE	Fairness Accountability Transparency and Ethics in AI
FHG	Fraunhofer
FHNW	Fachhochschule Nordwestschweiz
FHNW APS	FHNW School of Applied Psychology
FIR	Flight Information Regions
GPL	Gnu Public Licence
HAEF	Humane AI Ethical Framework
HMI	Human Machine Interface
ICAO	Civil Aviation Organization
ICT	Integrated Control Systems
IEEE	Institute of Electrical and Electronics Engineers
INESC TEC	Instituto de Engenharia de Sistemas e Computadores Tecnologia e Ciência
IPR	Intellectual property rights
IRTSX	Institut de Recherche Technologique SystemX
IoT	Internet of things
JCF	Joint Control Framework
KER	Key Exploitable Results
KLM	Koninklijke Luchtvaart Maatschappij
LACC	Levels of Autonomy Cognitive Control
LFE	Linux Foundation Energy
LGPL	Lesser General Public License
LIU	Linköping University
LOA	Levels of Automation
LVNL	Luchtverkeersleiding Nederland
MA	Master of Arts
ML	Machine Learning
MPL	Mozilla Public Licence
NAV	Air Navigation of Portugal

NLP	Natural Language Processing
NLR	Netherlands Aerospace Centre
NRA	French National Regulation Authority
OSS	Open-Source Software
POLIMI	Politecnico di Milano
PPP	Public-Private Partnerships
R&D	Research and Development
RL	Reinforcement Learning
RTO	Research and Technology Organizations
SATW	Swiss Academy of Engineering Science
SBB	Schweizerische Bundesbahnen
SME	Small Median Enterprise
SSH	Social Sciences and Humanities
TE	Technological Contributions
TRL	Technology Readiness Level
TSO	Transmission System Operator
TUD/TU Delft	Delft University of Technology
UKASSEL	University of Kassel
USP	Unique Selling Point
UvA	University of Amsterdam
UVP	Unique Value Proposition
WG	Working Group
WP	Work Package
XAI	Explainable Artificial Intelligence
ZHAW	Zurich University of Applied Sciences

1. INTRODUCTION

The present document defines the Exploitation Plan of the AI4REALNET project. The AI4REALNET project stands at the forefront of integrating Artificial Intelligence (AI) into the operation of critical infrastructures, such as power network, railway network, and air traffic space. The project lies on a novel and multidisciplinary framework designed to augment decision-making in critical infrastructures through human-AI interaction and autonomous AI systems.

The primary purpose of this document is to outline the exploitation plan and strategy for the AI4REALNET project. This plan serves as a roadmap, guiding the project towards achieving its objectives and maximizing the impact of its results. It is designed to ensure that the project's outcomes are not just theoretical advancements, but also practical solutions that can be implemented in real-world scenarios. The exploitation plan is also a tool for managing the project's intellectual property rights (IPRs). It outlines the project's IPR strategy, ensuring that the rights to the project's results are clearly defined and protected. This is crucial for enabling the project results to be effectively used and commercialized.

Thus, the Exploitation Plan and Strategy (phase 1) aims to establish a foundation for the development of individual and common exploitation plans in the project including IPR considerations and open-source strategies. The planned activities encompass the following five pillars:

1. Characterization of the Key Exploitable Results (KERs).
2. Introduction to the Open-Source principles, with an overview of the various open-source licenses and the project's approach to intellectual property rights and exploitation routes.
3. Assess of Partners Individual Exploitation Goals.
4. Identification of the key stakeholders and initiatives that are crucial for the success of the project.
5. Provide a market overview through a preliminary business model, including anticipated revenue streams and value propositions.

Moreover, as the exploitation plan is a living document, and it evolves throughout the project execution, reflecting changes in the project's objectives, results, and context, the last chapter is dedicated to the conclusion and identification of the next steps.

2. EXPLOITATION STRATEGY

2.1 KER CHARACTERIZATION

As defined by Horizon Europe, a KER is an identified main interesting result that has been selected and prioritised due to its high potential for exploitation[1]. In other words, this means a result that is made use of and derived benefits from, downstream of the value chain of a product, process or solution, and/or acts as an important input to policy, further research, or education. Table 1 summarises the KERs of the AI4REALNET project identified by the project's partners. New KERs may emerge during project development.

Nº	KER	Partners Involved
KER 1	Conceptual AI framework for decision-making in critical infrastructures	All
KER 2	AI building blocks: knowledge-assisted, hierarchical, and distributed	UvA, POLIMI, ZHAW, ENLITEAI
KER 3	Software XAI/HMI functions for transparent, safe, and trustworthy AI	TUD, POLIMI, ZHAW, FHG, UKASSEL, ENLITEAI, INESC TEC
KER 4	Domain-agnostic dynamic AI-assistant	ENLITEAI, INESC TEC, UvA, UKASSEL, FHG
KER 5	Human-AI co-learning and adjustable autonomy functions	ZHAW, TUD, POLIMI, UvA, FHNW
KER 6	Integrated autonomous AI-driven decision system	ZHAW, DB, SBB
KER 7	Evaluation protocol for AI	All
KER 8	Digital environments	IRTSX, UKASSEL, TUD, RTE, TenneT, DB, SBB, FLATLAND

TABLE 1 - LIST OF KERS AND PARNERS INVOLVED

The AI4REALNET partners worked together to achieve a first characterization of each KER. The KER characterisation template (Appendix 1) follows the framework as proposed by the Horizon Results Booster[2] . At this stage, each KER is defined according to:

- **General characterization**, including identification of the problem, alternative solutions in place, the unique selling points and the description of the KER;
- **Market characterization**, containing the identification of the target market, early adopters and recognition of the competitors already in the market; and
- **Go to market strategy**, with the description of the use model, timing and IPR background and foreground.

[1] https://intellectual-property-helpdesk.ec.europa.eu/system/files/2022-02/HEU%20Results%20platform.pdf
[2] https://www.horizonresultsbooster.eu/

Other dimensions will be added to the characterization of each KER, conducting to a Strategic Exploitation Plan, including a clear Business Model of each KER that will be presented in D5.4 – Exploitation plan and strategy phase 2 (M18).

The tables below (from Table 2 to Table 9) present the first characterisation of the eight KERs based on the information provided by the partners.

KER NO. 1

Conceptual AI Framework for Decision-Making in Critical Infrastructures	
Problem	To apply AI to the operation of critical infrastructures, it is fundamental to optimize the social-technical system (cooperation between humans and AI) under design and capture a set of constraints and functional and non-functional requirements that ensure trustworthiness and transparency and mitigate algorithmic aversion. Companies and organizations lack conceptual frameworks that support these systems' design, development, and testing, particularly for critical infrastructures characterized by high-stakes decisions traditionally performed by humans.
Alternative Solution	Presently, new AI-based recommenders or automation systems are being integrated without considering the full environment (and required changes at the technical and organizational level) since there is a lack of a framework to integrate this automation with humans in the same environment and without creating algorithmic aversion. Existing conceptual frameworks such as Joint Control Framework (JCF), Ecological Interface Design (EID), or Humane AI Ethical Framework only cover a part of the design needs, and other frameworks from the industry are mainly software-based and focused on AutoAI or low-code AI.
USP and UVP	The multi-disciplinary conceptual framework enables the co-design of the social-technical system considering the organization, AI developer, and user (e.g., a human operator) and focuses on critical infrastructures.
Description	Domain-general conceptual framework for applying, developing, and validating AI-based approaches in the operations of critical network infrastructures. It will a) augment decision-making in critical networks via human-AI interaction/co-learning and autonomous AI and b) address use cases from 3 different industries within a unified framework for sequential decision-making. Moreover, an adapted template from the ISO/IEC TR 24030 was created to describe in a technology-agnostic and standardized way six use cases for AI that can be replicated by other network operators in power grids, railways, and air traffic management.
Market: Target market	AI and automated systems; human-machine interfaces. *Customer Segments:* Network operators (of critical infrastructures); ICT/Control system providers; AI service providers.
Market: Early Adopters	Network operators (of critical infrastructures). They will be the ones to set the fundamental requirements for AI systems and how they should be integrated with the existing ecosystem.
Market: Competitors	As far as we know, there are no multidisciplinary AI conceptual frameworks like the one AI4REALNET is designing. These concepts can be found in the literature, standards, and industry initiatives but are fragmented, sometimes miss the human side, are not unified in a single framework, and do not cover the decision needs of critical infrastructures.

Go to Market: Use model examples	Public software repositories: The KER will be made openly available in GitHub and iterated along the project to create new versions. Contributions are also open to the AI community, following a similar approach to software components. AI4REALNET will also generate examples (project's use cases) of applying this framework, and combined with the algorithms from WPs 2-3, it will offer proof-of-concept of this framework for industry and academia.
Go to Market: Timing	1 Year after the end of the project.
Go to Market: IPR Background	Joint control framework (type: concept; LiU) Methodologies and approaches from Ecological Interface Design (type: concept; TUD)
Go to Market: IPR Foreground	Conceptual framework (All AI4REALNET partners), openly available in GitHub.

TABLE 2 - KER NO. 1 - CONCEPTUAL AI FRAMEWORK FOR DECISION-MAKING IN CRITICAL INFRASTRUCTURES

KER NO. 2

AI BUILDING BLOCKS: KNOWLEDGE-ASSISTED, HIERARCHICAL AND DISTRIBUTED	
Problem	Complex algorithms and heuristics have been applied to decision-making problems with little success, due to their inflexible nature, poor scalability, and long computational times. These effects are compounded by a loss of human domain expertise, which provides important insights into environmental dynamics and significantly improves solution quality and overall system flexibility. Solvers to complex planning and optimization problems tend to scale poorly to problem size. Realistically sized optimization problems can thus typically not be optimized exactly. Instead, solutions revolve around heuristics such as (1) following a manually designed strategy or (2) solving an abstracted version of the problem where certain details are left out or will be filled in at a later step. In either case, there might be a big gap in quality with the optimal solution.
Alternative Solution	Companies currently rely on human expertise for monitoring and interacting with critical infrastructure, using forecasts and simple models for environmental interaction. However, manually designed strategies often fall short, particularly with unfamiliar problem types. Traditional machine learning methods, which require extensive training time and struggle with the complexity seen in real-world network domains. Existing algorithms and heuristics, designed for specific domains, lack the flexibility to integrate with human operators effectively. In scenarios where these methods fail to produce viable solutions, humans are forced to take over, despite often lacking the capability to understand or solve these complex problems independently.
USP and UVP	AI methods are set to revolutionize how we approach realistic, varied problem formulations in planning and decision-making. These methods stand out for their scalability, adaptability to different problem types, efficiency with limited data, and ability

	to tackle stochastic or dynamic issues. This is a stark contrast to manual strategies, which may falter at unforeseen 'blind spots' not accounted for by human designers. The potential solution lies in reinforcement learning, which enhances scalability through innovative techniques. Specifically, problem decomposition (Task 2.2) breaks complex issues into manageable parts, while leveraging existing knowledge (Task 2.1) accelerates learning processes. Reinforcement learning, with its emphasis on scalability and adaptability, presents a promising avenue for overcoming these challenges, facilitating a more effective collaboration between automated systems and human supervisors. A key selling point of these AI techniques is their scalability and the capacity to harness existing knowledge — be it human domain expertise, heuristic approaches, or established solvers. By integrating these elements, AI can significantly enhance decision-making processes. This synergy between human insight and AI capabilities leads to superior outcomes than what either could achieve on their own, effectively merging the best of both worlds to tackle complex problems efficiently and innovatively.
Description	This KER is based on two fundamental concepts: a) exploit knowledge-based heuristics to enhance ML performance by using coarse solutions to guide early learning, identifying key solution space aspects for a general strategy with fewer data needs; this will improve ML performance in in low-data situations; b)improve RL scalability by factorization of the environment (considering spatial and/or temporal dimensions), achieve better convergence guarantees and enable distributed computation.
Market: Target market	AI based decision-making systems require a hierarchical or distributed approach that incorporates human domain expertise.
Market: Early Adopters	Network operators (of critical infrastructures). AI community (researchers, developers, and practitioners, corporate R&D) Integrators: and AI and service providers, ICT and control systems providers
Market: Competitors	Current approaches consist of complex algorithms and heuristics which are not yet capable of handling disturbances or stochasticity and therefore often deliver suboptimal results or fail altogether. Current approaches are therefore reliant on human operators to work alongside a system not designed to be understandable and manage cases which their current systems cannot. This unreliability is the key weakness of current systems. While there is significant research in the fields of hierarchical/distributed learning and integration of human feedback, there are few readily available, open-source modules which facilitate the design of such systems. Particularly the core issues of scalability, data availability and stochasticity limit most all available solutions. In this light, our products would be among the first of their kind.
Go to Market: Use model examples	Public software repositories: Release the AI building blocks as open-source software on platforms such as GitHub and the AI-on-demand platform. Base knowledge for future R&D projects: leverages the AI building blocks as a foundation for developing new and innovative AI solutions for network infrastructures and other domains. This can create new opportunities for collaboration, funding, and commercialization. Capacity building and consultancy: The project partners can offer training and advice on how to use and integrate the AI building blocks in specific domains and scenarios.

	Integration into commercial products: EnliteAI is a technology provider, that is already in the process of integrating RL-based optimization into the energy sector.
Go to Market: Timing	2 years after the end of the project.
Go to Market: IPR Background	Mixed IP strategy: open research, protective publications and maintain some innovations as trade secret.
Go to Market: IPR Foreground	Knowledge-assisted, Hierarchical and Distributed AI Building-Blocks.

TABLE 3 - KER NO. 2 - AI BUILDING BLOCKS: KNOWLEDGE-ASSISTED, HIERARCHICAL AND DISTRIBUTED

KER NO. 3

SOFTWARE XAI/HMI FUNCTIONS FOR TRANSPARENT, SAFE, AND TRUSTWORTHY AI	
Problem	In the AI4REALNET concept, humans are expected to collaborate with an AI agent in the same work environment, thus it becomes critical that the human operator is fully aware of the capabilities and limitations of the automated agent. The problem it is addressing: a) The lack of explainability, safety, and trustworthiness of AI solutions for critical network infrastructures; b) The need for effective human-machine interfaces (HMI) that can provide useful and understandable explanations of the AI behaviour, as well as support human-AI collaboration and co-learning. c) The challenge is designing and evaluating XAI/HMI functions that are tailored to the specific context, domain, and user needs of each use case.
Alternative Solution	Critical infrastructures management primarily rely on human expertise due to a mistrust in AI solutions, largely stemming from their lack of explainability. The complexity of these domains and the growing solution space challenge human capabilities, highlighting the need for AI integration. Efforts are being made to develop explainable and trustworthy AI tools, but their validation in safety-critical infrastructures remains incomplete, keeping AI's implementation limited in these areas.
USP and UVP	Integrating AI with human operators presents a competitive advantage by aligning AI constraints and interfaces with human needs and cognitive conditions. AI agents offer a significant benefit by exploring a larger solution space than human experts, leading to potentially optimal solutions. These agents also provide crucial information alongside their actions, such as highlighting critical geographical regions, helping operators understand the rationale behind decisions. This approach aims to build trust in AI solutions, ensuring they are valid and comply with grid constraints without necessarily achieving the global minimum. The AI4REALNET project emphasizes the development of explainable, safe, and trustworthy AI, adopting a "trustworthiness by design" approach. This method integrates trust as a fundamental requirement, making these AI solutions more robust than general XAI approaches. This strategy aims to streamline the adoption of AI across critical sectors, ensuring safety and efficiency through enhanced human-AI collaboration.

	As an example, in the ATM field, the creation of HMI software and XAI algorithms enhances flight trajectory efficiency and reduces workload for air traffic controllers through AI-generated solutions. This improved understanding allows humans to ensure the safety of AI solutions or adjust them for better outcomes, fostering a co-learning environment between AI and humans. The improvements in grid operation can lead to overall reduced system costs, including significant costs due to sub-optimal re-dispatching as well as unplanned outages.
Description	The approach includes: 1) Applying Social Sciences and Humanities (SSH) methodologies to design AI decision support, incorporating psychological insights into human cognition. 2) Developing explainable AI (XAI) to make AI actions understandable to operators, including policy clarity, decision explanation, action explanation, and early fault detection in extreme scenarios. 3) Investigating cognitive engineering for AI transparency and aligning AI and interfaces with human needs. 4) Design an ecological HMI tailored to the end user to support the understanding of the XAI algorithms.

Market: Target market	XAI & HMI
	Customer segments:
	• Integrators: AI service providers, ICT and control system providers,
	• AI community: researchers, developers, and practitioners, corporate R&D): XAI/HMI
	• Network operators (of critical infrastructures):
	  ○ ATM: Air Navigation Service Providers (ANSP), Aviation safety agencies (ICAO, EASA, among others).
	  ○ Power network: transmission system operators (TSOs) and distribution system operators (DSOs).

Market: Early Adopters	In the energy sector, smart grid operators, renewable energy companies, and energy management software providers are leading the adoption of XAI/HMI functionalities to enhance decision-making transparency in demand-response management, energy forecasting, and efficiency recommendations. Transmission grid operators that incur significant costs due to redispatching and system outages, can also be considering. Similarly, in the railway industry, urban transit authorities, freight rail operators, and rail infrastructure maintenance firms could embrace these technologies to improve overall operational efficiency. In ATM, ANSPs and their operators (strategic and tactical ATCOs), can benefit from the solution.
Market: Competitors	Critical infrastructure environments are in most cases fully controlled by a human operator, without the support of any automation, both in strategic and tactical ATC. Consequently, there are no systems supporting the understanding of automation (AI/optimisations/heuristic approaches). In the energy sector, GE Digital, Siemens Energy, and Schneider Electric are leading the charge with AI solutions focused on operational efficiency and reliability. For railways, Alstom Digital Mobility, Siemens Mobility, and Hitachi Rail stand out by offering AI-driven predictive maintenance and traffic management systems to enhance safety and efficiency. These companies are key competitors in adopting and developing XAI and HMI functionalities for transparent and trustworthy AI applications.

Go to Market: Use model	Public software repositories: Release the AI building blocks and the ecological HMI as open-source software on platforms such as GitHub and the AI-on-demand platform. Base knowledge for future R&D projects: leverages the AI building blocks as a foundation for developing new and innovative AI solutions for network infrastructures and other domains. This can create new opportunities for collaboration, funding, and commercialization. Capacity building and consultancy: The project partners can offer training and advice on how to use and integrate the AI building blocks in specific domains and scenarios.
Go to Market: Timing	2-3 years after the end of the project.
Go to Market: IPR Background	Methodologies and approaches from Ecological Interface Design (type: concept; TUD, INESC TEC, FHNW)
Go to Market: IPR Foreground	XAI algorithms (type: algorithms, UvA, POLIMI, IRTSX, ENLITEAI, ZHAW, FHG, UKASSEL)) Ecological HMI supporting the understanding strategic ATC in understanding solutions generated or suggested by the AI/XAI algorithms (type: software; TU Delft)

TABLE 4 - KER NO. 3 - SOFTWARE XAI/HMI FUNCTIONS FOR TRANSPARENT, SAFE, AND TRUSTWORTHY AI

KER NO. 4

Domain-Agnostic Dynamic AI Assistant	
Problem	In critical infrastructures and aligned with the AI Act risk-based approach, AI assistants can play an important role in supporting human operators in analysing and deciding in complex and dynamic operating scenarios. However, the AI assistant should be able to handle uncertainty and variability in the system (network) operation, including the impact of natural hazards, but also communicate to humans. The potential risks and confidence of recommendations made by the AI system to human operators. This gap hinders operators' ability to select the most trustworthy AI solutions based on past performance and to appropriately adjust their risk thresholds in alignment with the criticality of the decisions at hand, ultimately affecting the decision-making process and trust in AI-assisted operations. An important question is whether the uncertainty aspect of an AI assistant can be made in a domain-agnostic way, or whether the types of uncertainty are too domain-specific for a unified approach.
Alternative Solution	Domain-specific AI-assistants that augment human decision-making in real-time.
USP and UVP	Due to the near instantaneous speed of evaluation, the AI assistant offers a unique opportunity for reporting the issue and offering a solution nearly simultaneously. The AI assistant automatically proposes action recommendations and feedback to human operators. It will also be capable of adapting to the operator's preferences, needs, and cognitive load, as well as to the system's uncertainties and risks. This can significantly reduce the burden on operators, who are potentially freed from developing a solution from scratch and can instead spend their efforts verifying the proposed solution and considering minor adjustments.

Description	The system alerts the operator for needed interventions, offering recommendations that impact key performance indicators (KPIs) for operator selection. It aims to build trust through a methodology that defines the level of human involvement required, varying from full autonomy in standard modes to complete human control in critical situations, considering cognitive capacity. The system would also follow a methodology to estimate and convey decision uncertainty and risk to operators, such as choosing the AI algorithm with the highest trust based on past performance or adjusting human risk thresholds based on decision stakes.
Market: Target market	*Customer Segments:* Network operators. AI service providers; ICT and control system providers.
Market: Early Adopters	The early adopters are the critical infrastructure operators in the project: RTE and TENNET for the power grid, SBB and DB for the railway, and NAV for air traffic management. These companies already have AI in their roadmap and are conducting proof of concepts with academia and AI providers. Therefore, they offer an adequate environment for proof of concept and early construction of business cases for AI assistants.
Market: Competitors	AI assistants in critical infrastructures are in an early stage of development, and currently, there are no mature solutions in the market. However, start-ups are customizing their products to create AI assistants, and other sectors are already offering solutions such as Smart Virtual Personal Assistants or Google Assistant. With the emergence of natural language processing (NLP) and generative AI, a promising prospect arises for seamlessly integrating the AI assistant developed by AI4REALNET with other counterparts built on NLP frameworks.
Go to Market: Use model	Public software repositories: The project partners can release the AI building blocks as open-source software on platforms such as GitHub and the AI-on-demand platform. Base knowledge for future R&D projects: leverages the AI building blocks as a foundation for developing new and innovative AI solutions for network infrastructures and other domains. This can create new opportunities for collaboration, funding, and commercialization. Capacity building and consultancy: The project partners can offer training and advice to network operators, AI service providers, ICT and control system providers, and other potential customers on how to use and integrate the AI building blocks in their specific domains and scenarios.
Go to Market: Timing	2-3 years after the end of the project.
Go to Market: IPR Background	Managing power grids through topology actions: A comparative study between advanced rule-based and reinforcement learning agents (Paper in Energy and AI, Fraunhofer IEE /University of Kassel)
Go to Market: IPR Foreground	Smart alarm management for AI assistant that considers the operating context. (type: software; INESCTEC)

TABLE 5 - KER NO. 4 - DOMAIN-AGNOSTIC DYNAMIC AI ASSISTANT

KER NO. 5

Human-AI co-learning and adjustable autonomy functions	
Problem	The problem is the inability of current AI systems, particularly in RL environments, to effectively incorporate human decisions, understand optimal human behaviour, transparently communicate AI decision-making processes, and dynamically adjust autonomy based on the human operator's condition and preference. Furthermore, there's a need for AI to accommodate multi-objective optimization that aligns with human preferences, ensuring informed and contextually appropriate decision-making in critical operations.
Alternative Solution	Low TRL research has been conducted both on co-learning (AI based) and on adjustable autonomy (structured optimisations/heuristic approaches/AI based), these remain mostly unused in the industry. Most co-learning research is limited to the development of concepts and frameworks, rather than implementations. Alternative approaches involve or observe human experts during training and aim to replicate human behaviour or find optimal behaviour with respect to human goals.
USP and UVP	Our co-learning technology unlocks human-AI collaboration potential. It fosters a partnership where humans and AI learn from each other in real-time, enhancing decision-making. The platform, built on trust and adaptation, ensures AI responds to queries and anticipates needs. Human operators maintain control, enriching the AI with their expertise and gaining new knowledge for improved outcomes. Experience decision-making where human intuition and AI intelligence converge.
Description	The core AI technologies include: a) order-agnostic network architectures for RL that incorporate human data in their training or mimic human perturbations for decision-making with human input; b) inverse RL to deduce an optimal reward function incorporating to some degree human behaviour, while still exploring new solutions; c) deep RL with XAI to clarify AI decisions to humans; d) adjustable autonomy in RL, using preference, stress or fatigue levels to decide when to transfer control between AI and human operators. Additionally, RL is adapted for multi-objective settings, allowing for human-specified preferences and a preference learning module to enhance decision-making in critical operations.
Market: Target market	AI and automated systems; Human-machine interfaces *Customer Segments:* XAI/HMI/ATM researchers From ATM sector, ANSP, Aviation safety agencies (ICAO, EASA, among others) has been identified. Network Operators: the methods and systems developed are ideal for the complex multi-objective environments that e.g. railway network operators are confronted with, offering a quality-of-life improvement for their employees as well as improved performance.
Market: Early Adopters	ATM: ANSPs and their operators (strategic and tactical ATCOs). Network operators in the consortium will be “lighthouses” through their effort and a commitment to learn with AI, at tailoring human and machine roles dynamically, and by

	sharing with policy makers and "followers" new organizational architectures, processes, behaviours, and attitudes. AI Researchers and Developers: the novel co-learning and dynamic autonomy systems are of interest for researchers in AI and psychology, who can utilise the methods developed as building blocks in their own research.
Market: Competitors	Critical infrastructure environments are mostly controlled by human operators without automation support. There's a lack of co-learning and adjustable autonomy systems. While alternative solutions perform acceptably within their limited scope, they lack functionality, scalability, and flexibility. Co-learning methods, which are human-centric and future-oriented, improve motivation, facilitate learning, enhance performance, and provide system stability. Unlike alternative methods that lead to deskilling, co-learning aims to mitigate this.
Go to Market: Use model	Public software repositories: The project partners can release the XAI algorithms with co-learning and adjustable autonomy functions as open-source software on platforms such as GitHub and the AI-on-demand platform. Base knowledge for future R&D projects: leverages the XAI algorithms with co-learning and adjustable autonomy functions as a foundation for developing new and innovative AI solutions for network infrastructures and other domains. This can create new opportunities for collaboration, funding, and commercialization. Capacity building and consultancy: The project partners can offer training and advice to network operators, AI service providers, ICT and control system providers, and other potential customers on how to use and integrate the co-learning and adjustable automation functions in their specific domains and scenarios.
Go to Market: Timing	3-5 years after the end of the project.
Go to Market: IPR Background	Conceptual framework (type: concept; All AI4REALNET partners). XAI algorithms (type: algorithms; AI (UvA, POLIMI, IRTSX, ENLITEAI, ZHAW, FHG, UKASSEL)). Ecological HMI supporting the understanding strategic ATC in understanding solutions generated or suggested by the AI/XAI algorithms (type: software; TUD, POLIMI, ZHAW, FHG, UKASSEL, ENLITEAI).
Go to Market: IPR Foreground	XAI with co-learning and adjustable autonomy functions, and manual adjustable autonomy functions algorithms (type: algorithms; AI (UvA, POLIMI, IRTSX, ENLITEAI, ZHAW, FHG, UKASSEL)). Ecological HMI supporting the adjustable autonomy functions of the XAI algorithms (type: software; All AI4REALNET partners). Human-AI Co-Learning systems and adjustable autonomy functions (ZHAW, TUD, POLIMI, UvA).

TABLE 6 - KER NO. 5 - HUMAN-AI CO-LEARNING AND ADJUSTABLE AUTONOMY FUNCTIONS

KER NO. 6

Integrated Autonomous AI-Driven Decision System	
Problem	Many critical infrastructures are not suitable for full human control, nor is it always feasible to have a human agent collaborating with an AI agent. Current automation systems (complex algorithms and heuristics) are static and unable to adapt in dynamic environments. While expert knowledge often is considered in their development, this is limited to the design process and does not extend into the training process.
Alternative Solution	For better interpretability of autonomous systems in critical infrastructure, interfaces simplifying complex algorithms are needed. They should visually represent processes and outcomes for operator comprehension. This helps operators monitor performance and bridge technical operation with strategic decision-making, even without deep system design expertise.
USP and UVP	AI capable of independently navigating complex, high-risk networks such as railways or ATM. Autonomous AI learning to imitate and expand on human behaviour, enabling it to act in and safely navigate human-dominated systems. Explainability and transparency make autonomous agents certifiable, auditable and enable human operators to maintain accurate mental models while performing supervisory duties.
Description	The technology involves multi-agent RL, with each agent tasked with: a) achieving an individual goal, b) seeking the optimal global solution, and c) communicating with relevant agents to embody swarm behaviour. Training incorporates human expertise by having agents initially mimic human interactions, then progressively tackling more complex network setups. Despite AI's autonomy, accountability to a human overseer is crucial, facilitated by XAI methods for performance assessment and enhanced transparency through detailed protocolling and logging for failure analysis.
Market: Target market	*Target Market:* Explainable and transparent automation in complex environments. *Customer segments:* ▪ Regulators: particular interest in automated technologies being explainable / transparent, as this is essential for regulation / certification / auditability considerations. ▪ Operators of critical infrastructure: particularly in critical infrastructure, where intricate systems and time pressure can make decision-making difficult for human operators, explainable autonomous AI can allow for performance and capacity improvements while still safeguarding safety. ▪ Other sectors: any sector which requires transparent decision-making can derive value from the explainable AI systems developed.
Market: Early Adopters	Operators of critical infrastructure: critical infrastructure is highly regulated and subject to safety and security considerations which hinder automation. For these reasons, explainable and transparent autonomation provides significant value potential. AI researchers / R&D: the autonomous decision systems developed can be adapted for implementation into other areas or serve as a basis for continued development.

Market: Competitors	Currently, critical infrastructure environments are in most cases fully controlled by a human operator, without the support of any automation. Consequently, there are no readily available co-learning and adjustable autonomy systems.
Go to Market: Use model	Public software repositories: Release AI building blocks on platforms like GitHub and the AI-on-demand platform, adopting an open-source model. Base knowledge for future R&D projects: These AI building blocks also serve as a versatile foundation for future research and development endeavours. They enable the pursuit of innovative AI applications across various domains, fostering opportunities for new collaborations, funding, and pathways to commercialization. Capacity building and consultancy: The project partners can offer training and advice to support the effectively utilize and integrate AI building blocks within their unique operational contexts. Support services: offering maintenance services and customization options: These services aim to support organizations in leveraging open-source AI solutions, aligning with current industry practices where the value lies in personalized adaptation and ongoing support.
Go to Market: Timing	3.5 years after the end of project
Go to Market: IPR Background	None
Go to Market: IPR Foreground	Autonomous AI Decision Systems (Type: algorithm; ZHAW, DB, SBB)

TABLE 7 - KER NO. 6 - INTEGRATED AUTONOMOUS AI-DRIVEN DECISION SYSTEM

KER NO. 7

Evaluation Protocol for AI	
Problem	The problem addressed is the need to comprehensively evaluate AI's performance, safety, and overall impact on stakeholders and communities to maximize benefits and minimize harm. There is a need to comprehensively evaluate AI's technical performance, safety, and overall impact on the social-technical systems, stakeholders (including citizens), and communities to maximize benefits and minimize the risks. This involves assessing the current ecosystem of AI usage and understanding to ensure technology advances are equitable and beneficial across all affected groups. In addition to quantitative and qualitative KPI, an evaluation protocol for critical infrastructures is needed so that AI developers and end-users can test different dimensions, in particular robustness, resilience, safety, user experience and acceptability, and trustworthiness, along different dimensions, and identify required organisational changes.
Alternative Solution	AI-based solutions adopted by the industry are being mainly tested following best practices in software development and testing. However, classical software and AI testing are different in many aspects, namely: i) software testing detects bugs in the code, while AI testing seeks to correct bugs in input data, learning process and structure, and model's

	hyper-parameters; ii) the behaviour of AI can change with input data and historical data update, while the behaviour of a software code is, in general, fixed; iii) test inputs may have different forms in AI, e.g., input data (for training and operation), model's functions; iv) AI tends to give more false positives in detected bugs; v) in AI bugs may be present in data, code, mathematical algorithm, which requires the active involvement of the AI engineer in the testing phase. Presently, new AI-based recommenders or automation systems are being researched without a structured framework and evaluated without a structured protocol, therefore incurring in the risk of not being comprehensive, impacting their performance and safety.
USP and UVP	This protocol distinguishes itself by not only evaluating AI in isolation but also considering the ecosystem in which AI operates, aiming for equitable and positive outcomes for all affected parties. It provides a comprehensive and rigorous framework to evaluate AI in critical network infrastructures, considering both quantitative and qualitative aspects, as well as human user experience and acceptability. This protocol will be associated to three digital environments (Grid2Op, Flatland, BlueSky), which offers to AI developers a complete package for evaluating their AI algorithms between 4 and 5, and that can be further upgraded to higher TRL.
Description	The evaluation protocol will capture the wide spectrum of AI performance, safety, and impact to ensure that all affected stakeholders and communities reap the benefits of the technology, rather than any harm, by looking at the current ecosystem in which AI is used and understood.
Market: Target market	*Target market:* AI and automated systems. *Customer segments:* AI developers; AI service providers In ATM segments, aviation safety agencies (ICAO, EASA, among others), Network operators of critical infrastructures (ANSP); ICT/Control system providers; AI service providers; universities and research institutes aiming to develop AI.
Market: Early Adopters	The early adopters are the critical infrastructure operators in the project: RTE and TENNET for the power grid, SBB and DB for the railway, and NAV for air traffic management. Therefore, they offer an adequate environment for proof of concept. The early adopters will be industries which fall under the high-risk category of the AI Act.

Market: Competitors	Microsoft created the Fairness, Accountability, Transparency, and Ethics in AI (FATE) initiative, but it is mainly to study the societal implications of AI and is driven to develop techniques that comply with the FATE principles by design. IBM is following a similar approach. Partnership on AI involves major companies like Amazon, Facebook, Google, and others, and has a Safety Critical AI Program. This program launched a AI incident database and the SafeLife AI learning environment for training non-destructive agents. Finally, there are different standardization WG working in verification methods. One example is ISO/IEC 24029-2 ("Artificial intelligence (AI) — Assessment of the robustness of neural networks — Part 2: Methodology for the use of formal methods"). Another is the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, which published the 7000-2021 – IEEE Standard Model Process for Addressing Ethical Concerns during System Design. As far as we know, there are no multidisciplinary AI evaluation protocols like the one AI4REALNET is designing. Evaluation criteria can be found in the literature, standards, and industry initiatives but are fragmented, sometimes miss the human side, are not unified in a single protocol, and do not cover the needs of critical infrastructures. For the final evaluation, competitors might be certification agencies and technical standards, both to be expected to be developed in the next years.
Go to Market: Use model	Public software repositories: The KER will be made openly available in GitHub and iterated along the project to create new versions. Contributions are also open to the AI community, following a similar approach to software components. AI4REALNET will offer proof-of-concept of this evaluation protocol for industry and academia, by applying it on the algorithms and use cases from WPs 1-2-3. Base knowledge for future R&D projects: leverages the XAI algorithms with co-learning and adjustable autonomy functions as a foundation for developing new and innovative AI solutions for network infrastructures and other domains. This can create new opportunities for collaboration, funding, and commercialization. Capacity building and consultancy: The project partners can offer training and advice to network operators, AI service providers, ICT and control system providers, and other potential customers on how to use and integrate the co-learning and adjustable automation functions in their specific domains and scenarios. Regulators might use the protocol to assess the trustworthiness dimensions of an AI.
Go to Market: Timing	2-3 years after the project end
Go to Market: IPR Background	Levels of Autonomy Cognitive Control (LACC) and Levels of Automation (LOA) (Type: Matrix (LOA) ; LIU)
Go to Market: IPR Foreground	Evaluation protocol and software scripts.

TABLE 8 - KER NO. 7 – EVALUATION PROTOCOL FOR AI

KER NO. 8

Digital Environments	
Problem	The problem addressed is the lack of accessible, specialized digital environments for AI development and benchmarking in critical infrastructure sectors such as electricity, railway, and ATM networks. This gap hinders innovation, collaboration, and the iterative improvement of AI applications, leading to underutilization of AI's potential in enhancing the efficiency and reliability of these essential services.
Alternative Solution	There are currently no open-source digital environments that enable the testing of AI algorithms. Some research has been done on the development of AI test-benches, but source codes are not publicly available. The alternative to accessible digital AI environments is to have isolated, disunified efforts spread across research institutes and industry partners. This would make benchmarking nearly impossible given the effort required to adapt AI software to different frameworks for apples-to-apples comparisons. It also hinders progress when each individual effort must spend time developing their own digital environment, rather than starting from a well-supported, open-source environment and focusing instead on the AI tools and agents.
USP and UVP	Enable the development, testing, and validation of novel AI algorithms for sequential decision-making problems in complex and dynamic systems, as well as the engagement and co-creation with the AI community and other sectors. A stable set of scenarios that can be used as a benchmark over long periods of time is essential to marking progress in developing AI solutions and comparing the performance of different approaches. A well-supported, well-documented and open-source digital environment can be more easily extended to new use cases or challenges, as well as a more realistic solution space. An example of this is the electrical network, where the Grid2Op digital environment has progressively extended its solution space to include topology switching actions, redispatching, and battery control.
Description	Open-source and AI-friendly digital environments for electricity, railway, ATM networks, enabling AI development and benchmark. Open code will be made available to boost further refinements, applications and increase reusability in future projects on platforms such as GitHub.
Market: Target market	Target Market: AI-based decision-making systems which require a hierarchical or distributed approach that incorporates human domain expertise. *Customer Segments:* AI service providers, / ICT and control system providers AI community, corporate R&D (network service providers), researchers, developers and practitioners
Market: Early Adopters	SMEs that are relying on their AI know-how but lack direct access to a real-world network (and corresponding network simulations), may have the most to benefit from an open-source digital environment with which to develop their AI solutions.

Market: Competitors	In regard to the ATM sector, the AAM-Gym platform was developed at MIT Lincoln Laboratory as a testbed for AI algorithm for ATM research, using BlueSky as backhand. This is however not open source. In the electrical grid domain, there are few if any competing digital environments that simulate the operational scenarios addressed in Grid2Op. Continual focus on user-friendliness and good documentation can help to avoid competing environments that split the efforts of the field.
Go to Market: Use model	Operators training and internal testing/benchmarking of AI. Open-source software Capacity building and consultancy: The project partners can offer training and advice to network operators, AI service providers, ICT and control system providers, and other potential customers on how to use and integrate the Digital environment for AI development and testing in their specific domains and scenarios. Public software repositories: The project partners will release the Digital environment for AI development and testing as open-source software on platforms such as GitHub and the AI-on-demand platform. Base knowledge for future R&D projects: leverages the Digital environment for AI development and testing as a foundation for developing new and innovative AI solutions for network infrastructures and other domains, internally to AI4REALNET and externally. This can create new opportunities for collaboration, funding, and commercialization. The digital environment can be used as a testbed for proving out AI solutions before deploying them in real-world cases. These environments should have interfaces and APIs that are close enough to real-world systems that AI agents can be easily transferrable to a similar environment in an operational control room.
Go to Market: Timing	3 years after the end of the project
Go to Market: IPR Background	BlueSky: open Air Traffic Management simulator (type: open-source software; Partner: TU Delft). Flatland: Code in open source to facilitate enhancement and reusability in future projects (type: code, Partner: Flatland) Pandapower: an open-source python tool for convenient modelling, analysis, and optimization of electric power systems: Partners: Fraunhofer IEE / Uni Kassel. Grid2Op (Type: digital environment; Partner: RTE)
Go to Market: IPR Foreground	Digital environment for AI development and testing (type: open-source software; All AI4REALNET partners)

TABLE 9 - KER NO. 8 – DIGITAL ENVIRONMENTS

Table 10 presents AI4REALNET's Technological Contributions (TE) for each KER along with their expected TRL and ownership.

TE for each KER		
KER 1	Conceptual AI framework for decision-making in critical infrastructures	TE4 (TRL5) | Grid2Op digital environment – electricity network (RTE, IRTSX, TENNET, FHG) TE5 (TRL5) | Flatland digital environment – railway (SBB, DB)

		TE 6(TRL5) | BlueSky digital environment – ATM (TUD)
KER 2	AI building blocks: knowledge-assisted, hierarchical, and distributed	TE1 (TRL5) |Maze –RL (ENLITEAI) TE8 (TRL4) |Knowledge Assisted AI tools (UvA) TE11(TRL4) |Hierarchical and distributed RL (POLIMI)
KER 3	Software XAI/HMI functions for transparent, safe, and trustworthy AI	TE10 (TRL4) | RL variants applied to the energy sector (UKASSEL, FHG)
KER 4	Domain-agnostic dynamic AI-assistant	TE2 (TRL4) | Human in the loop utilities (ENLITEAI) TE8 (TRL4) |Knowledge Assisted AItools (UvA) TE9 (TRL4) |Multi-criteria methodology for risk-aware management of electricity networks (INESC TEC)
KER 5	Human-AI co-learning and adjustable autonomy functions	TE3 (TRL4) |Joint continual human-ML from preferences (ZHAW) TE7 (TRL4) | Inverse RL (POLIMI) TE10 (TRL4) | RL variants applied to the energy sector (UKASSEL, FHG)
KER 6	Integrated autonomous AI-driven decision system	TE1 (TRL5) |Maze –RL (ENLITEAI) TE3 (TRL4) |Joint continual human-ML from preferences (ZHAW) TE8 (TRL4) |Knowledge Assisted AI tools (UvA)
KER 7	Evaluation protocol for AI	TE4 (TRL5) | Grid2Op digital environment – electricity network (RTE, IRTSX, TENNET, FHG) TE5 (TRL5) |Flatland digital environment – railway (SBB, DB) TE6(TRL5) | BlueSky digital environment – ATM (TUD)
KER 8	Digital environments	TE4 (TRL5) |Grid2Op digital environment – electricity network (RTE, IRTSX, TENNET, FHG) TE5 (TRL5) |Flatland digital environment – railway (SBB, DB) TE6(TRL5) | BlueSky digital environment – ATM (TUD)

TABLE 10 - AI4REALNET TECHNOLOGY CONTRIBUTIONS AND EXPECTED TRL

As the project advances, we will review and evaluate the presented characterization. The next steps will apply Design Thinking methodology for validation and gathering more inputs to characterize each KER's potential exploitation. Workshops will be implemented with all partners participating in each KER to discuss and redesign the Value Proposition, IP and Go to Market strategy. This iterative approach ensures that we refine and enhance our understanding of each result's relevance, routes for exploitation and business models, scalability, market viability, and adoption conditions. Through continuous refinement and adaptation, we are poised to unlock the full potential of our KERs, catalyzing their future utilization and fostering meaningful impact. Later in this document, we will outline the initial exploiting routes for the KER´s.

3. INTRODUCTION TO OPEN-SOURCE

Open-source software (OSS) is freely available software that can be used and shared within specific copyright guidelines. It plays a crucial role in the AI market by facilitating adoption, reducing bias, and influencing competitive dynamics. Through its collaborative and community-driven development model, OSS serves as a catalyst for innovation and ensures fairness and transparency in AI technologies. This approach fosters usability, functionality, and collective intelligence, allowing for simultaneous design and testing phases that bypass traditional intellectual property constraints (Nichols & Twidale, 2003; Kogut & Metiu, 2001). Both the public and private sectors benefit from OSS, as it provides the flexibility and creativity necessary for innovation. Additionally, OSS projects often set de facto standards, promoting interoperability, and reducing compatibility issues across software and platforms. Standardization will be crucial for the seamless integration of technologies in diverse software landscapes (Henley & Kemp, 2008).

Finally, the open model ensures the longevity and independence of OSS projects, making them not reliant on the financial or strategic decisions of any single entity. Although AI initiatives face several challenges that must be addressed to realize their full potential. These challenges range from technical hurdles, such as data access and algorithm complexity, to broader issues, such as community engagement, legal and ethical considerations, societal challenges to gain social acceptance and trust in the technology from both citizens and civil servants, and risk management (Europarl Europe, 2021).

3.1 INTELLECTUAL PROPERTY RIGHTS IN OSS

Before navigating through OSS and its valorisation strategy, it is important to be aware of the intellectual property rights that can cover the different intellectual property assets produced in AI4REALNET. Particularly, how the different rights are influenced or not by the freedoms given by open-source licenses (freedom to use, modify, and distribute the original and derivative work).

These rights are manifested in various forms, including:

- **Copyrights** protect the creative expression and not ideas. Among the works protected by copyrights are computer programs and electronic databases, if the last have an original structure. Hence copyrights, are the primary rights covering software and electronic databases, and OSS licenses are legal documents, where the owner of the rights permits others to use, modify, and distribute their work, under certain conditions, as long as the 4 freedoms are kept.
- **Patents** can also play a significant role in OSS, particularly in areas such as software algorithms, in which patent claims can affect the use and distribution of OSS. Some OSS projects require contributors to grant patent licenses to all software users, preventing any single entity from facing innovation through patent litigation.
- **Trademarks** protect the names and logos associated with OSS projects, ensuring that the software's identity and reputation are not misused. While not directly affecting the

software's code, trademarks help maintain quality and trust in OSS projects by ensuring that only genuine versions or distributions carry the project's name.

Before introducing IPR into OSS, it's crucial to understand the different types of open-source licenses and how they affect intellectual property rights. The upcoming chapter provides an overview of the most common open-source licenses that could be relevant to AI4REALNET project needs and objectives.

3.2 OVERVIEW OF DIFFERENT OSS LICENSES

This chapter aims to highlight the differences between OSS licenses, to offer a clear understanding of how different licenses might impact our software's use, distribution, and modification. OSS and IPR need to coexist, especially with the use of permissive OSS modules. However, careful consideration is necessary to distinguish between two types of OSS licenses:

- **"Permissive" OSS licenses:** typically give the freedom to make, use, modify, and share software, but with the right to develop proprietary derivative works. They typically have very light-touch requirements, such as keeping copyright notices and disclaimers in the code. Examples include BSD, MIT, and Apache.
- **"Restrictive OSS licenses:** typically give the freedom to use, modify and share the software, but with a requirement to provide a license to the modified software on the same terms. Examples include Gnu General Public Licence (GPL) and Mozilla Public License (MPL).

By comparing various licensing options, we aim to ensure that the chosen license not only matches our project's objectives but also promotes sustainability and community engagement within the legal and operational frameworks. Table 11 presents a visual summary of the different licenses and their characteristics. A short description of common licensing is available in Appendix 2.

License	Commercial use	Distribution	Modification-on	Patent use	Private use	Disclose source	License and copyright notice	Network use is distribution	Same license	State changes	Liability	Trademark use	Warranty
EUPL	X	X	X	X	X	X	X	X	X	X	X	X	X
MIT	X	X	X		X		X				X		X
MPL	X	X	X	X	X	X	X		X		X	X	X
GPL	X	X	X	X	X	X	X		X	X	X		X
APACHE 2.0	X	X	X	X	X		X			X	X	X	X
BSD 2nd	X	X	X		X		X				X		X
BSD 3rd	X	X	X		X		X				X		X
LGPL	X	X	X	X	X	X	X		X	X	X		X
AGPL	X	X	X	X	X	X	X	X	X	X	X		X
EPL	X	X	X	X	X	X	X		X		X		X

TABLE 11 - VISUAL SUMMARY OF THE LICENSE'S CHARACTERISTICS

AI4REALNET seeks to achieve a next generation of decision-making methods that aim at trustworthiness in AI-assisted human control with augmented cognition, hybrid human-AI co-learning and autonomous AI, with the resilience, safety, and security of critical infrastructures. This implies a paradigm shift in how software is developed, distributed, and utilized, emphasizing the availability of source code for anyone to modify and distribute under specific licenses.

Table 12 lists the technological contributions, included in each KER, and their AI Building Block and licensing options already considered. The full description of TE can be found in Appendix 3.

KERs	Technological Contributions	AI Building Blocks | Software	IPR Management
KER1: Conceptual AI framework for decision-making in critical infrastructures	▪ TE4 (TRL5; RTE, IRTSX, TENNET, FHG) ▪ TE5 (TRL5; SBB, DB) ▪ TE6 (TRL5; TUD)		Copyright Creative commons[3]

KER2: AI building blocks: Knowledge-assisted, hierarchical, and distributed	▪ TE1 (TRL5; ENLITEAI)
	▪ TE8 (TRL4; UvA)
	▪ TE11 (TRL4; POLIMI)
		▪ Knowledge-assisted AI approaches
		▪ Hierarchical and distributed RL
			▪ Open-source license compliance
			▪ Copyright
			▪ Open-source license:
			  ▪ MIT
			  ▪ GPL
			  ▪ MPL-2.0
			  ▪ EUPL

KER3: Software XAI/HMI functions for transparent, safe, and trustworthy AI	▪ TE1 (TRL5; ENLITEAI)
	▪ TE10 (TRL4; UKASSEL, FHG)
		▪ Transparent, explainable, and trustworthy AI
		▪ AI Power decision-maker software:
		  ▪ Human-in-the-loop decision-making under risk and model uncertainty
		  ▪ Multi-objective decision-making with AI
		  ▪ Interactive AI to augment decision-making
		  ▪ Integrated autonomous AI-driven decision systems	

KER4: Domain-agnostic dynamic AI-assistant	▪ TE1 (TRL5; ENLITEAI) ▪ TE2 (TRL4; ENLITEAI) ▪ TE8 (TRL4; UvA) ▪ TE9 (TRL4; INESC TEC) ▪ TE10 (TRL4; UKASSEL, FHG)	▪ Full human control (AI-assisted): Domain-agnostic dynamic AI-assistant	
KER5: Human-AI co-learning and adjustable autonomy functions	▪ TE1 (TRL5; ENLITEAI) ▪ TE3 (TRL4; ZHAW) ▪ TE7 (TRL4; POLIMI) ▪ TE8 (TRL4; UvA) ▪ TE10 (TRL4; UKASSEL, FHG)	▪ Interactive optimisation/co-learning between AI and humans components	
KER6: Integrated autonomous AI-driven decision system	▪ TE1 (TRL5; ENLITEAI) ▪ TE3 (TRL4; ZHAW) ▪ TE8 (TRL4; UvA)	▪ AI capable of independently navigating complex, high-risk networks	

[3] https://creativecommons.org/

KER7: Evaluation Protocol for AI	▪ TE4 (TRL5; RTE, IRTSX, TENNET, FHG)
	▪ TE5 (TRL5; SBB, DB)
	▪ TE6 (TRL5; TUD)
			▪ Open-source license compliance
			▪ Copyright
			▪ Open-source license:
			  ▪ MIT
			  ▪ GPL
			  ▪ MPL-2.0

KER8: Digital Environments	▪ TE4 (TRL5; RTE, IRTSX, TENNET, FHG) ▪ TE5 (TRL5; SBB, DB) ▪ TE6 (TRL5; TUD)		

TABLE 12 – KERS, TECHNICAL CONTRIBUTIONS, BUILDING BLOCKS AND OSS LICENSES

In the upcoming chapter, we will explore how we preview strategically use Open Source IPR Strategy to safeguard intellectual property rights while uncovering the essential pathways for exploiting our key results within AI4REALNET.

4. IPR STRATEGY AND KEY EXPLOITATION ROUTES

Implementing a methodology to ensure that IPR considerations are embedded in open-source strategies involves a systematic approach. AI4REALNET is adopting the following methodology:

- **Continuously Assess the Project Goals and Needs**: Assessing the goals and needs along the development of the project allows to understand the intended use, distribution model, potential commercialization avenues, and any unique requirements related to IP.
- **Integration of IPR Considerations into Development Processes:** Integrate IPR considerations into the project's development processes and workflows.
    - **Identification of IPR Risks and Opportunities:** Conduct a comprehensive analysis to identify potential risks and opportunities related to IP. This includes assessing the project's licensing needs, patent landscape, trademark considerations, and potential conflicts with partners and third-party IP.
    - **Selection of Appropriate Licenses and Policies:** Based on the continuous assessment, review the previous selection of the OSS licenses, and consider factors such as compatibility with existing licenses, partners' motivations, preferences, and alignment with project goals.
- **Guidelines for code policy:** The project will establish clear guidelines for external contributions, including code submissions, documentation, and community participation.
- **Create Governance Structure:** It is our purpose to develop a governance model to outline the structure, processes, and mechanisms by which decisions are made, resources are allocated, and the project results are managed.
- **Community and Stakeholders Engagement:** throughout the project, and in collaboration with other Tasks, we will invest in activities to attract and engage with developers, users, and other stakeholders. These activities could involve hosting events, webinars, creating forums or mailing lists, and participate in sectorial events. Similarly, we will facilitate knowledge sharing and collaboration through joint projects, and partnerships between internal teams, external contributors, and other organizations.

By following this methodology, the open-source strategy proposed in AI4REALNET project can effectively embed IPR considerations into their strategies, fostering a sustainable and legally compliant development ecosystem.

4.1 KEY EXPLOITATION ROUTES

Routes for exploiting KERs refer to pathways for leveraging the potential benefits or outcomes identified within a project or initiative. These routes typically involve actions or plans aimed at maximizing the value or impact of the KERs.

Below, Table 13 outlines possible routes that will be explored in the next phases of the project.

Route	How	Who
IPR Licensing Agreements	Analyse OSS IPR Strategy Licensing for AI Blocks, TE, and KER	ALL
Spin-off Companies	Creating spin-off companies dedicated to developing and commercialising specific KERs or technologies.	INESC TEC, IRTSX, FHG, UKASSEL, POLIMI, UvA, TUD, ZHAW, FHNW, LiU
Collaborative Research and Development	Exploring partnerships with industry players to jointly develop and implement AI building blocks, TE and KERs into new products, services, or processes.	INESC TEC, IRTSX, FHG, UKASSEL, POLIMI, UvA, TUD, ZHAW, FHNW, LiU
Industry Partnerships	Forming partnerships with industry players to jointly develop and implement KERs into new products, services, or processes.	RTE, TENNET, DB, SBB, and NAV, ensure internal and external exploitation channels for the results of the project.
Public-Private Partnerships (PPPs)	Collaborating with public and private entities to further develop and deploy KERs in real-world applications. *Examples of PPP already in execution or planned: Adra-e, AI4EUROPE, projects funded under CL4-2022 HUMAN02-01, European network of AI excellence (e.g., ICT-48-2020), and ICT-49-2020*	ALL
Knowledge Transfer and Exchange	Organizing workshops, seminars, and conferences to share project findings, KERs, and best practices with a broader audience. Participation in conferences and events. Liaison and cross-fertilisation with stakeholders, projects	INESC TEC, RTE, TENNET, SBB, DB, NAV
Training Programs	Developing training programs to disseminate knowledge and skills acquired during the project to relevant stakeholders.	INESC TEC, IRTSX, FHG, UKASSEL, POLIMI, UvA, TUD, ZHAW, FHNW, LiU
Open Innovation and Collaboration Platforms	Use open-access platforms or repositories to share project data, software, and other KERs with the broader research community and industry stakeholders. *Strategies considered: Use of public software repositories (GitHub via AI-on-demand platform) to facilitate enhancement and reusability in future projects, scientific publications.*	UvA, POLIMI, ZHAW, ENLITEAI, TUD, ZHAW, FHG, UKASSEL, ENLITEAI, INESC TEC, LiU, FHNW, DB, SBB
Collaborative Networks	Joining collaborative networks and consortia to exchange knowledge, resources, and expertise with other European projects and initiatives. *Networks established within the project partners: CLAIRE and ELLIS General Assemblies/thematic workshops; EPRI AI and Electric Power Summit; JRC AI Watch (energy & mobility); OECD-AI; SESAR events (AI); CIGRE WG on AI; CANSO Strategic Technology Workgroup; and Europe's Rail.*	Grid2op (RTE, TENNET, IRTSX, UKASSEL), Flatland (DB, SBB, FLATLAND), BlueSky (TUD)

Policy Influence and Advocacy	Generating policy briefs and recommendations based on project findings and KERs to influence decision-making at the national and European levels.	ALL
Advocacy Campaigns	Engaging in advocacy campaigns to raise awareness of the project's outcomes and promote the adoption of KERs by relevant stakeholders and policymakers. *Examples: Open digital environments and competitions (Flatland, L2RPN, etc.); Participation in conferences and events. Liaison and cross-fertilisation with stakeholders, projects*	RTE, TENNET, SBB, DB, NAV
Venture Capital, Funding Opportunities, and European Funding Programs	Pitching project outcomes and KERs to venture capitalists, angel investors, and other funding sources to secure additional financing for further development and commercialization. Explore the European Funding Programs.	RTE, TENNET, DB, SBB, and NAV

TABLE 13 - POTENTIAL ROUTES FOR EXPLOITATION

In the next phase of the exploitation activities, workshops with partners will be implemented to design a detailed strategy aligned with the characteristics and motivations of each partner. The last version of the Exploitation plan will include a clear strategic approach for exploitation, per each KER including a roadmap for implementation.

5. PARTNER'S INDIVIDUAL EXPLOITATION PLAN

The present section will detail how each of the consortium partners envisages their role in the future exploitation of the results of AI4REALNET. At this stage, each partner defined their individual motivation and exploitation plan. Particularly, they provided an outline of their organization, described their context, and elaborated on their focus area. Secondly, under the exploitation strategy, the partners have specified their exploitation goals and identified their planned exploitation activities. The information below was collected from each partner through the same template (Appendix 4).

In the upcoming phases, we will engage in discussions with all partners to meticulously analyze this information. This collaborative effort will inform the development of a comprehensive Strategic Roadmap for Exploitation. Our overarching objective is to foster dialogue and ensure that all exploitable results effectively progress to the market adoption stage. The order of presentation follows the AI4REALNET proposal.

INESC TEC

PARTNER DESCRIPTION

INESC TEC is a private, non-profit Research and Technology Organization (RTO) dedicated to scientific research and technological development, technology transfer, advanced consulting and training, and pre-incubation of new technology-based companies.

As an institution operating at the interface between the academic and business worlds, bringing academia, companies, public administration, and society closer together, through its "managed science" model, INESC TEC leverages the knowledge and results generated as part of its research through technology transfer projects seeking impact in value creation and social relevance. The dual mission of INESC TEC is to excel in research, seeking social relevance and international influence, and to foster pervasive intelligence, contributing to the competitiveness and internationalization of Portuguese companies and institutions.

ECOSYSTEM

INESC TEC has a relevant role in the European Knowledge and Innovation Communities (KICs) – EIT Raw Materials, EIT Manufacturing and EIT Digital. It is strengthening of a base of operations outside Portugal, to increase the capacity to promote projects, secure funding, and attract human resources at an international level. The operation in Brazil, with the creation of INESC P&D Brazil and its recognition by the Brazilian Science and Technology agencies as a Brazilian ICT (Institution of Science and Technology), and the creation of INESC Brussels Hub and a service for international relations

contribute to increasing INESC TEC ecosystem outside Portugal. Moreover, in the area of AI, INESC TEC is a member of the euRobotics, ETSI and AIOTI associations and also a member of the ADRA PPP.

INESC TEC is leading the DIH ATTRACT (Digital Innovation Hub for ArTificial InTelligence and High-PeRformAnce CompuTing[4]), which mission is to promote and support experimentation, testing, development and adoption of solutions using AI and high-performance computing, as well as to address training needs, while boosting the innovation ecosystem in these fields. This is enabling the creation of a national ecosystem for AI.

Focus area

INESC TEC's vision is to be a relevant international player in Science and Technology in the domains of Computer Science, Industrial and Systems Engineering, Networked Intelligent Systems, and Power and Energy. Research and development; technology transfer via software licensing or creation of start-ups; mainly in AI, electrical and computer engineering, and informatics.

One example of a start-up launched by INESC TEC in AI is iLoF that commercializes a cloud-based library of optical fingerprints, powered by photonics and AI, provides non-invasive tracking, screening and stratification for drug discovery, adapted to each clinical trial needs.

Exploitation Strategy: Exploitation Goals

Centered on the research exploitation model, INESC TEC primary goal is to leverage the acquired research expertise for continual application in forthcoming research endeavors and demonstration activities. This involves not only creating a robust repository of knowledge but also actively contributing to the development and maintenance of open-source code. This code is strategically developed and disseminated to captivate the attention of diverse entities from academia, start-ups, and SMEs from the AI community. On the top of the developed software and experience in testing AI technologies, the commercial exploitation of the results as a service is also expected, leveraging our long-term partnerships with operators of critical infrastructures such as EDP, REN in power grids, NAV in air traffic control, or EPAL in water distribution.

Exploitation Strategy: Planned exploitation activities

The activities are the following:

- Enhance and create new partnerships with key stakeholders in academia, industry, and RTO to facilitate the exchange of ideas, resources, and expertise. The participation in the Associations (e.g., AIOTI and ADRA) and leadership of a DIH will be instrumental, as well as the involvement of INESC Brussels HUB and contributions to the AI-on-demand-platform.
- Increase the involvement in open-source initiatives by developing and maintaining high-quality code repositories. This should include regular updates, community engagement, and responsiveness to user feedback.

[4] https://attract.inesctec.pt/

- Leverage from INESC TEC experience in preparing advance courses for industry and provision of consultancy services using the R&D knowledge, to organize capacity building programs for industry and organization and also offer specialized consultancy in the area of AI for operation of critical infrastructures.
- Design technology transfer programs aimed at transitioning research findings from AI4REALNET into practical applications in a timeline of 2-3 years after the project. The idea is to depart from the 6 project's use cases but collaborate with collaborate with industrial partners from and outside the consortium to identify new use cases where AI brings added value and co-develop solutions that address real-world challenges.
- Actively contribute to academic publications, conferences, and industry events to showcase our research findings.
- Explore partnerships with start-up and SMEs to support the growth of their products by integrating the knowledge generated during the project, in the areas of simulation for AI testing, and evaluation frameworks for AI (e.g., robustness, resilience, interpretability).

Beyond the project duration, INESC TEC expects to promote demonstration projects showcasing the practical applications of our research. This will generate tangible examples of the value proposition of our work to attract industry partnerships and additional funding.

IRTSX

PARTNER DESCRIPTION

The Institute for Technological Research (IRT) is an interdisciplinary thematic institute that develops economic sectors related to its field through a balanced strategic public-private partnership. For this, it manages research programs coupled with technology platforms, conducts research and development projects at the international level, contributes to the engineering of initial and continuous trainings (qualifying professional training and/or degree delivering); and ensures the exploitation of the obtained results. The functioning of the Institute is based on two fundamental aspects: Bringing talents together. The institute brings together all the partners involved in its projects under one roof, thus creating a melting pot of interaction between stakeholders in the public and industrial research sectors. Pooling of skills and platforms. SystemX is consolidating its technological platforms by pooling the components and infrastructures of its research projects and is developing expertise in the service of its public and private partners.[5]

ECOSYSTEM

Comprising the University of Claude Bernard Lyon 1, three graduate engineering schools (INSA Lyon, Polytech Lyon and CPE Lyon) several University Institutes of Technology, the Lyon Campus is one of the main sites of research of the Auvergne-Rhône-Alpes region with nearly 2,000 researchers. IRT SystemX aims to expand its R&D activities in the areas of new mobility, energy and digital security,

[5] https://www.irt-systemx.fr/en/about/systemx-irt/

in collaboration with the Lyon Metropole, renowned scientific centres, industrial players in the region and competitiveness clusters of the region involved in digital technologies in line with the activities of SystemX, such as the CARA and ECC4IU clusters.[6]

FOCUS AREA

The integration of data science and AI into technology and industry is transforming how we observe, interact with, and understand complex systems. This transformation is highlighted across key areas:

- Data Science and AI are crucial for modelling complex systems efficiently, using statistical learning techniques adaptable to various data types for classification, detection, prediction, and causality research.
- Human-Digital Interaction is evolving with digitalization, emphasizing the need for interfaces that enhance human cognitive capabilities and simplify tasks.
- Scientific Computing underlines the importance of precise physical modelling for realistic simulations, balancing model accuracy and computational resources through methods like model reduction and distributed computing.
- Optimization bridges descriptive analytics to prescriptive insights, exploring modelling spaces to identify valuable subsets, despite data volume, uncertainties, and time constraints.
- Systems Engineering approaches the design and operation of complex systems holistically, considering both technological and organizational complexities to meet stakeholder needs throughout a system's lifecycle.
- Safety in systems engineering faces challenges from integrating heterogeneous components, impacting system dependability, and highlighting the need for improved safety and security measures.
- Digital Security and Blockchain call for a shift towards designing systems that are robust, resilient, and trusted from the start, in response to evolving cyber threats.
- IoT and Networks reflect the shift towards adaptive, intelligent, and autonomous network architectures to meet increasing digital service demands, emphasizing less centralized data collection and connectivity.[7]

EXPLOITATION STRATEGY: EXPLOITATION GOALS

To be defined.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

Mainly interested in the research exploitation model, aspiring re-utilisation of the research know-how acquired in future research activities. From a commercial exploitation model, IRTSX are interested in founding spin-offs and start-ups to commercially exploit the developed research results (Source: Proposal).

[6] https://www.irt-systemx.fr/en/about/ecosystem/
[7] https://www.irt-systemx.fr/en/areas-of-competence/

FRAUNHOFER

PARTNER DESCRIPTION

The Fraunhofer Institute for Energy Economics and Energy System Technology (Institut für Energiewirtschaft und Energiesystemtechnik, IEE) is one of 76 institutes comprising the Fraunhofer Society, a German research organization dedicated to applied research and partially funded by the German government. Growing out of an existing Fraunhofer institute, Fraunhofer IEE was established in Kassel as an independent branch in 2018 with a focus on research and industrial applications for the sustainable transformation of renewable-based energy systems.

ECOSYSTEM

Fraunhofer IEE enjoys a close collaborative relationship with partners in industry in Europe and beyond, earning a significant portion of its revenue from industry contracts, with the rest coming from publicly funded sources. Concerning the electrical grid domain, Fraunhofer has a close working relationship with electrical grid operators, spanning from the low- and medium-voltage distribution operators to high- and extra-high-voltage transmission grid operators. The institute also maintains close collaboration with its spin-off company Retoflow, and expects to foster additional spin-offs in the future. Finally, Fraunhofer IEE is a member of the FVEE Renewable Energy Research Association, the DERlab (European Distributed Energy Resources) network, and the European Energy Research Alliance EERA.

Fraunhofer IEE also enjoys close collaborative partnership, as well as shared personnel, with the University of Kassel and its Energy Management and Operation of Electrical Networks (e2n) department. The relationship allows mutual benefit in the form of shared expertise and rapid technology transfer from the domain of academic research into real-world industry projects. Fraunhofer IEE also collaborates closely with the universities of Hannover and Darmstadt.

FOCUS AREA

With around 450 employees, Fraunhofer IEE has a wide range of research areas, including energy informatics, energy economics and system design, grid stability and integration, energy storage and thermal energy technologies, and energy meteorology. Most relevant to the main goals of AI4RealNet, Fraunhofer IEE specializes in electrical grid planning and operation, developing tools to efficiently operate electrical grids in transmission and distribution networks with a growing proportion of distributed energy resources. Fraunhofer IEE pursues a strategy of grid operation with a heavy focus on decentralized automation and an exploitation of modern artificial intelligence solutions.

Key to the strategy of Fraunhofer IEE is the development of open-source tools for energy system management. One such project is pandapower, an open-source tool for modelling and simulating electrical grids developed at Fraunhofer IEE and the University of Kassel. Pandapower has become a leading grid modelling software package, reaching in 2024 the milestone of 500,000 downloads since

its release in 2016. Fraunhofer IEE continues to maintain and expand the capabilities of pandapower and exploits its expertise to offer custom pandapower-based software solutions to industry clients.

Exploitation Strategy: Exploitation Goals

First and foremost, Fraunhofer IEE plans to use its involvement in the AI4RealNet project to further develop our expertise in artificial intelligence and reinforcement learning, with the goal of applying our knowledge to a wide array of applications in energy systems and grid operation. Artificial intelligence is a powerful tool whose benefit has been demonstrated in nearly every area of research at Fraunhofer IEE, and we expect the experience gained in AI4RealNet will contribute to Fraunhofer's overall focus on AI.

In addition, we have current and planned future projects at Fraunhofer IEE that overlap with the grid use cases covered in AI4RealNet, and therefore expect to build on the solutions developed in this project. Fraunhofer IEE strategically pursues the model of open-sourcing its software and offering its expertise as a service to clients in industry, with pandapower as the prime example. In the AI4RealNet project, we aim to adopt a similar strategy in which the open-source AI software developed within the project will serve as a basis from which we can offer our expertise and know-how to clients to develop real-world deployments of the AI models.

Exploitation Strategy: Planned exploitation activities

Fraunhofer IEE plans the following steps to fulfil its exploitation goals:

- Contribute to the development and refinement of the open-source frameworks (both the general AI framework as well as those specific to the grid use cases), to support the development of high-quality, community-based tools that can be used as the basis for real-world projects.
- Strengthen the partnership between our institute and the project partners and stakeholders in the AI4RealNet project to mutually benefit from our various areas of expertise, and seek potential opportunities for future collaborations on AI-related research projects.
- Develop open-source reinforcement-learning based grid operation tools that align with the goals of the AI4RealNet project, but which also may serve as the basis for application in real-world industry projects.
- Apply the principles learned in the AI4RealNet use cases for other automation processes in the focus areas at Fraunhofer IEE.
- Contribute to the dissemination and publication of academic research papers and other material to demonstrate the results of the AI4RealNet project and generate increased interest in AI projects for critical infrastructure.

With this strategy, Fraunhofer IEE is eager to serve as one of the bridges between scientific research and deployment of AI in real-world applications.

UNIVERSITY OF KASSEL

PARTNER DESCRIPTION

The University of Kassel is a modern university in northern Hesse with a wide range of bachelor's, master's, and pedagogy programs. This young institution, founded in 1971, stands out for forming unusual multidisciplinary and multi-layered networks within Germany under the 'independent comprehensive university' model, maintaining a focus on nature, technology, culture, and society. That is why UNIKASSEL offers the best conditions for innovative and multidisciplinary research through the multi-layered approach, which focuses on both short and long-term solutions. Within this framework, numerous students and researchers are currently working on various projects to achieve the sustainability goals of the Paris Climate Agreement.

ECOSYSTEM

Among the different departments of the University is the e2n department (Energy Management and Operation of Electrical Networks) as well as the Intelligent Embedded Systems (IES) department. The former is part of the Competence Center for Decentralized Electric Power Supply Engineering (KDEE) and is closely linked to the Fraunhofer Institute for Energy Economics and Energy System Technology (IEE) at the Kassel site through personnel links. Within the ecosystem there is also the ITeG department (Research Center for Information System Design), which focuses on social responsibility regarding the design of IT systems so that IT system designs are socially acceptable in the long term.

FOCUS AREA

The projects developed in e2n are focused on the technically and economically optimized design, control and operation of the future decentralized energy supply system (Smart Grid) with a high share of renewable energies, an important challenge of the energy transition for ensuring a secure, cost-efficient and sustainable energy supply. The IES department focuses on developing deep learning techniques for various application areas such as automotive driving, experimental physics, renewable energy, and energy systems.

More specifically, the principal focus areas of UKASSEL are the following:

- Control and design of generators, consumers, storage units and network resources for the provision of energy and network services.
- Methods for energy and grid management / automation solutions in decentralized supply structures with different aggregation and incentive concepts.
- Methods for automated network planning / optimized system design.
- Solutions for robust system behaviour in case of failure and for network reconstruction.
- Methods for enhancing the efficiency and reliability of the energy sector, with a particular focus on automated grid control.

In the context of the AI4REALNET project, among the innovation resources developed by UKASSEL are the operation, control, and planning of electrical networks through various artificial intelligence techniques, with a particular focus on reinforcement learning.

Exploitation Strategy: Exploitation Goals

The goals of UKASSEL are primarily focused on research rather than commercial exploitation. UKASSEL aims to continuously apply its acquired research expertise in forthcoming research opportunities. This encompasses showcasing the acquired knowledge and developed code by contributing to open-source code repositories. Additionally, UKASSEL aims to disseminate its findings through publications in reputable journals and presentations at conferences, further enhancing the visibility and impact of its research outcomes. Through these measures, we intend to attract the interest of various stakeholders, including academia and industry within the AI community. Furthermore, an essential objective is to utilize the developed research methods within the project to secure new funding and create proposals for future research projects.

Exploitation Strategy: Planned exploitation activities

The activities are:

- Strengthen and forge novel partnerships with key stakeholders in academia, industry, and Research and Technology Organizations (RTOs) to foster the exchange of ideas, resources, and expertise.
- Increase and enhance contributions to open-source repositories, including both general AI frameworks and projects in the grid control domain.
- Identify and develop extensions for the power grid use cases and seek collaborations with industry and research partners to prepare the acquisition of successor projects that utilize AI to solve complex novel problems in power systems.
- Maximize the visibility and impact of the conducted research work by fostering collaboration and knowledge exchange within the broader community through targeted submissions to journals, participation in conferences, and networking within industry circles.
- Leverage the knowledge generated throughout the project, aiming to attract funding and craft compelling proposals for innovative projects in the field of Reinforcement Learning for power system control, focusing on aspects such as robustness, trustworthiness, and explainability.

POLIMI

PARTNER DESCRIPTION

The Polytechnic University of Milan (Politecnico di Milano, abbreviated as Polimi) is a public institution and the largest technical university in Italy, with about 47,000 students. The university offers undergraduate, graduate and higher education courses in engineering, architecture and design. Founded in 1863, it is the oldest university in Milan.

Polimi is committed to achieving excellence in research. The path to excellence is developed along the following actions: supporting basic and industrial research activities; developing strategic partnerships with academia and industry worldwide to make a significant contribution to society; developing new interdisciplinary lines of research to address societal challenges; and incorporating scientific developments and research results into university education. Polimi departments are responsible for implementing the mission in their scientific fields.

ECOSYSTEM

Polimi is a public scientific-technological university that trains engineers, architects and designers. It has always focused on quality and innovation in teaching and research, developing a fruitful relationship with the economic and productive reality through experimental research and technology transfer.

Research is increasingly linked to teaching and constitutes a priority commitment that enables the Polimi to achieve results of high international level and to realize the meeting between the university and the business world. Moreover, research activity constitutes a parallel path to that of cooperation and alliances with the industrial system.

Knowing the world where one is going to work is a prerequisite for the training of students. Relating to the needs of the world of production, industry and public administration helps research to tread new ground and confront the need for constant and rapid innovation. The alliance with the industrial world, in many cases fostered by the Polytechnic Foundation and consortiums in which the Polytechnic participates, allows the University to go along with the vocation of the territories in which it operates and to be a stimulus for their development.

The challenge being played out today projects this tradition of strong territorial roots beyond the country's borders, in a confrontation that develops first and foremost at the European level with the aim of contributing to the creation of a "single market" of education. Polimi participates in numerous research and training projects, collaborating with the most qualified European and international universities, from North America to Southeast Asia to Eastern Europe. Today, the push for internationalization sees Polimi participating in the European and global network of leading technical universities and offering numerous exchange and double degree programs and several courses of study entirely in English. Currently, Polimi has 437 H2020 projects, 223 Horizon Europe, 68 ERC grants, 105 spin-offs and ≈ 3.000 patents.

FOCUS AREA

The Department of Electronics, Information and Bioengineering is one of the largest ICT departments in Europe with more than 1.000 members (300 professors, 200 research assistants, 500 PhD students). The main research areas are Computer science and engineering, Electronics, Electrical Engineering, Bioengineering, Systems and Control, Telecommunications.

In particular, the AIRLab (Artificial Intelligence and Robotics Laboratory) is one of the longest-standing research groups in Italy working on Artificial Intelligence, Robotics and Machine Perception. AIRLab's theoretical and applied research covers a wide spectrum of topics. Many AIRLab projects are funded either by European or national agencies or by companies. Professors and researchers from AIRLAB will contribute to the development of artificial intelligence solution to the challenges offered by the AI4REALNET project.

The Department of Management, Economics and Industrial Engineering cover other academic areas: Economics, Business management and Organization; Political, Industrial and Regional economics; Production systems, Industrial plants and Logistics. It counts around 500 members. Researchers from this department will help addressing economics and regulation aspects of the AI4REALNET project.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

POLIMI strives for excellence in teaching, research, and innovation to maintain high academic standards and reputation. It fosters a culture of research and innovation to contribute to advancements in science, technology, engineering, and mathematics (STEM) fields. It builds partnerships with industry to facilitate technology transfer, applied research, internships, and job placements for students. POLIMI promotes international collaborations, exchange programs, and partnerships with universities and research institutions worldwide to enhance global competitiveness and diversity. It integrates sustainable practices into operations, curriculum, and research initiatives to address environmental challenges and promote sustainable development. It provides opportunities for faculty and staff professional development, including training, workshops, and conferences to enhance teaching effectiveness, research productivity, and leadership skills.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

The following exploitation activities are considered:

- Continuing Education and Professional Development. Develop online and blended learning programs, collaborate with industry organizations, and provide customized training solutions to offer advanced training and upskilling opportunities to professionals in the workforce in the area of AI for operation of critical infrastructures.
- Technology Transfer and Commercialization. Establish technology transfer offices, create industry partnerships, support student entrepreneurship programs, and file patents for promising innovations in order to bridge the gap between research and industry. For example, bringing research findings from AI4REALNET into practical applications in a timeline of 2-3 years after the project.

- Consulting and Technical Expertise. Establish consulting centers, create platforms for faculty expertise, and build strong relationships with potential clients to provide consulting services to government agencies, businesses, and other organizations (e.g., stakeholders of the AI4REALNET projects).
- Community Engagement and Outreach. Develop community-based research projects, offer STEM programs, and organize public lectures and workshops to engage a wider community. address technical challenges, promote STEM education, and provide educational resources. For example, POLIMI will organize webinars that collect AI knowledge in the domain of AI4REALNET and make them available to the public.

UNIVERSITY OF AMSTERDAM

PARTNER DESCRIPTION

The University of Amsterdam (UvA) is the Netherlands' largest university, offering the widest range of academic programmes. At the UvA, 42,000 students, 6,000 staff members and 3,000 PhD candidates study and work in a diverse range of fields, connected by a culture of curiosity.

The University of Amsterdam promotes an open and curious attitude. The UvA wants to equip students not only with knowledge, but also with the skills to navigate a dynamic world. This requires diversity of perspective, agility and resilience. Students have the freedom to ask questions and engage in debate. We do this with respect for the contribution, background and beliefs of each and every individual, so that everyone feels welcome and safe.

The University of Amsterdam considers digitalisation in research transformative to research in all disciplines and the teaching of the future. For this reason, the UvA invests in new areas of expertise, teamwork and a state-of-the-art infrastructure for research and new, innovative teaching methods. This leads to closer cooperation between disciplines – helped by our strength in artificial intelligence, data science and complexity – and to a smart combination of on-campus and online teaching, allowing for more interaction and a more intensive learning experience.

ECOSYSTEM

The informatics institute (IvI) of the University of Amsterdam is part of a thriving ecosystem around computer science and AI in the Amsterdam region. This includes knowledge institutes, which includes the Vrije Universiteit Amsterdam, the Amsterdam University of Applied Science, and the Centrum Wiskunde & Informatica research institute. Furthermore, the ecosystem includes big technology firms, such as Booking.com, TomTom, Microsoft, Google, and Qualcomm, as well as a productive scene of start-ups and companies of various sizes such as ZetaAlpha, Rhite, UbiOps, ALLAI, BrainCreators, databricks, codam, UIpath, Sensity, etc.

The university of Amsterdam is involved in various networks. For example, the university is strongly involved in the local unit of the ELLIS Society. The informatics institute partners with companies and

the public sector in over 15 collaborative 'labs' with multiple PhD students and experienced researchers working on collaboratively defined problems. The institute was and is also part of collaborative projects such as the national "Efficient deep learning" and "Hybrid intelligence" projects and the ERC-funded ELISE network.

Focus area

The informatics institute focuses on four research teams: Artificial Intelligence, Computational Science, Data Science, and Systems & Networking. The Artificial Intelligence and Data Science themes are directly relevant for AI4REALNET. The Amsterdam Machine Learning Lab specifically focusses on research in machine learning, artificial intelligence, and its applications to large scale data domains in science and industry. In line with the aims of AI4REALNET.

Exploitation Strategy: Exploitation Goals

The informatics institute (IvI) of the University of Amsterdam aims to create societal impact through its research and education and aims to develop further collaborations with highly innovative industry. The IvI further embraces open science.

Exploitation Strategy: Planned exploitation activities

As part of furthering the institute's exploitation goals as it relates to the AI4REALNET project, the following steps will be taken. Advancing open science will be pursued by releasing high-quality open-source code repositories, and publishing and participating in high-quality open access venues such as journals and conferences. This allows wide and inclusive access to research results, and most effectively allows the research community and industry to build on obtained research. Research results with innovation potential can be pursued with new industrial partners or existing partners within the consortium or external to it such as Bosch, Tomtom, Ortec, Tennet, Qualcomm, NS, etcetera. Such further steps could be pursued within a public-private partnership with support of the Dutch Research Council, or more small scale in the joint supervision of interns.

DELFT UNIVERSITY OF TECHNOLOGY

Partner description

The Delft University of Technology (Technische Universiteit Delft, TU Delft) is the largest university of technology in the Netherlands, with over 26,000 students. Born from a tradition of 180 years in civil engineering, we have developed a broad research portfolio that, divided across 40 departments and eight faculties, spans practically the entire range of engineering sciences: Architecture and the Built Environment, Civil Engineering and Geosciences, Electrical Engineering, Mathematics & Computer Science, Industrial Design Engineering, Aerospace Engineering, Technology, Policy & Management, Applied Sciences, Mechanical, Maritime and Materials Engineering.

Our main tasks include providing scientific education, conducting scientific research, transferring knowledge to society and promoting social responsibility. Our mission is to contribute to solving global challenges by educating new generations of socially responsible engineers and expanding the frontiers of the engineering sciences. The acronym "DIRECT" (Diversity, Integrity, Respect, Engagement, Courage and Trust) represents the core values that we, as the TU Delft community, seek to uphold in our daily activities.

The Faculty of Aerospace Engineering conducts research in 5 departments: Space Engineering, Control & Operations, Flow Physics and Technology, Aerospace Structures and Materials. The individuals involved in AI4REALNET bring expertise from the Air Traffic Management (ATM) and Communication, Navigation & Surveillance (CNS) chair, and from the Aerospace Human-Machine Systems (AHMS) chair.

ECOSYSTEM

The Faculty of Aerospace Engineering enjoys a long and varied tradition of collaboration with the aerospace sector, both in teaching and research. This includes Dutch and European research projects, in many cases in collaboration with businesses, strategic partnerships with industrial parties, but also fostering local entrepreneurship. We host TU Delft's Aerospace Innovation Hub, a community of aerospace related startups, academics, students, corporates, and industry professionals aiming to support innovations in space technology, in solutions enabling the long-term sustainability of aviation, and in novel drone technology.

At the Control & Operations department, we are involved in various projects via European funding programmes such as Horizon2020, Clean Sky and SESAR. ATM and AHMS research is being conducted within the abovementioned projects and in co-operation with Eurocontrol, LVNL, KLM, DLR, NLR and many universities across the world. Additionally, AI spin-off companies of the TU Delft are located on TU Delft Campus.

FOCUS AREA

The ATM/CNS chair focuses on studying innovative solutions to aid air traffic controllers, but also on studying the dynamics of air transportation as a complex system of inter-acting aircraft, spanning across the several domains: conventional air transport, unmanned aerial vehicles and personal air mobility. Methodologies used are big data analysis and traffic simulations, often in combination with the BlueSky open ATM Simulator and data from our ADS-B receiver on top of the roof of our building. The AHMS chair focuses on supporting the human operator in manual and supervisory control tasks, through developing innovative human-machine interfaces and clever automation tools. Relevant expertise includes the design of air traffic control ecological interfaces, creating visual representations of the data that aid the understanding of the nature of a control problem and support creative decision-making. Our objectives within AI4REALNET are the development of an (open-source) extension to the BlueSky open ATM Simulator for the development and testing of AI algorithms on historical or custom ATM scenarios and subsequently, the development of explainable AI algorithms coupled with ecological user interfaces that will aid air traffic controllers in planning of optimised air traffic flows, to safely and efficiently increase the capacity of the airspace.

Our goals therefore align with AI4REALNET activities on development of a common framework for AI tools aiding the optimisation of critical infrastructure, on the development of the AI testing platforms and on the development of transparent, safe and trustworthy AI through explainable AI techniques.

Exploitation Strategy: Exploitation Goals

The primary goal of the Delft University of Technology is to provide scientific education to our students. As such, the assets and knowledge that will be developed through this project might be integrated in our educational program, as part of course materials and tools. In addition, our goal is to contribute to the body of research in the fields of ATM/CNS and AHMS. As such, assets and knowledge developed within AI4REALNET will be used by us for scientific publications and presented at relevant conferences.

Beyond the project duration, the activities of AI4REALNET are likely to foster additional research, for which the gained knowledge and assets will be exploited. Results of the project will not be exploited financially by TU Delft.

Exploitation Strategy: Planned exploitation activities

The planned activities are the following:

- Scientific publications related to the conceptual framework for AI for ATM.
- Scientific publications related to the BlueSky platform for the development and testing of AI algorithms.
- Research and scientific publications related to XAI algorithms for long term, strategic flight planning, to find optimal solutions in terms of safety, efficiency, consistency, predictability and understandability.
- Research and scientific publications related to ecological interface design supporting human understanding of the solutions generated by the XAI algorithms for the above-described cases, as well as supporting their ability to steer the outputs in desired directions.
- Development of educational material related to the above to be presented to the students of TU Delft.
- Research and academic publications on other scenarios exploiting the newly developed open-source BlueSky AI testbed.

LINKÖPING UNIVERSITY

Partner description

Linköping University is different from many other universities in that it has multidisciplinary departments reporting directly to the vice-chancellor. This is conducive to thinking along new lines and conducting research and education across disciplinary borders. Linköping University is a government agency, and is governed by laws, ordinances and decisions taken by the Swedish parliament and government.

Innovation is Linköping University's only tradition. Since becoming Sweden's sixth university in 1975, we have conducted world-leading research and boundary-crossing education in close and productive collaboration with society and industry. For almost five decades we have guided curious, innovative students towards influential roles and successful careers, while our researchers have tirelessly investigated the world around us and published groundbreaking findings about its complex nature and functions. With our new strategic plan for 2030, Linköping University continues its conviction that innovation is our only tradition. I very much look forward to implementing the strategy, and together with you carrying out and experiencing the innovation we are aiming for together.

ECOSYSTEM

Linköping University has four faculties: The Faculty of Arts and Sciences, the Faculty of Medicine and Health Sciences, the Faculty of Science and Engineering, and the Faculty of Educational Sciences. Didacticum, the Center for Medical Image Science and Visualization (CMIV), the National Supercomputer Centre (NSC), ECIU@LiU and NAISS are examples of centres at LiU. [8]

FOCUS AREA

Linköping University (LiU) is embarking on a strategic journey to shape the future through education, research, and collaboration. As navigation through rapidly evolving societal and global landscapes, is committed to six paramount areas of focus that will guide our efforts and ensure our contribution to a sustainable and inclusive future. Open and Inclusive; Learning and Knowledge Creation; The Students Shape the Future; Excellence and Impact: Dynamic working methods and a culture of innovation are ingrained in our DNA. LiU is committed to supporting academic excellence in research and education, aiming for significant impact within and beyond our academic disciplines. Our long-term goal is to continue being a beacon of innovation and excellence; Sustainable Societal Transformation: LiU stands ready to contribute with new knowledge and innovations for a sustainable future. [9]

EXPLOITATION STRATEGY: EXPLOITATION GOALS

To be defined.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

Mainly interested in the research exploitation model, aspiring re-utilisation of the research know-how acquired in future research activities. From a commercial exploitation model, we are interested in founding spin-offs and start-ups to commercially exploit the developed research results (Source: Proposal).

[8] https://liu.se/en/about-liu/organisation
[9] https://liu.se/en/about-liu/vision-and-strategy

ENLITEAI

PARTNER DESCRIPTION

enliteAI is a technology provider for Artificial Intelligence specialized in Reinforcement Learning and Computer Vision/geoAI. Our customers are medium-sized and large enterprises from the DACH region from a wide range of industries. enliteAI is always looking for motivated employees who actively support us on our way.[10]

ECOSYSTEM

enliteAI is an active member of ELISE - European Learning and Intelligent Systems Excellence. ELISE is part of the EU Horizon 2020 ICT-48 portfolio and originated from ELLIS, a network of artificial intelligence research hubs and associated Fellows. Based on the highest level research, it spreads its knowledge and methods in academia, industry and society. The network invites all ways of reasoning, considering all types of data applicable for almost all sectors of science and industry. ELISE contributes to the European AI and the ELLIS community on many fronts, e.g. through mobility programs, research program workshops, company collaboration, and policy work. [10]

FOCUS AREA[11]

- Detekt is a modern geospatial data platform supporting the entire mobile mapping and asset management life cycle.
- Maze, one of the first open-source frameworks for applied Reinforcement Learning.
- Power Grid Optimization by achieving adaptability and reliability with reinforcement learning.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

To be defined.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

Interested in the commercial exploitation model, providing the project results to the end users. We are interested in the technological exploitation model, delivering products and/or services built on top of the project results. Use the project's results to improve business performances and open new opportunities, with a sustainable business model (Source: Proposal).

[10] https://www.enlite.ai/company

[11] https://www.enlite.ai/

RTE

PARTNER DESCRIPTION

RTE ("Réseau de Transport d'Electricité") is France's Transmission System Operator (TSO), in charge of 105 000 km of high and ultra-high-voltage lines and 50 interconnections with neighbouring European countries: the transmission system links electricity producers to the consumers and links France to its European neighbours, while guaranteeing the constant balance between production and consumption and between imports and exports.

RTE oversees 3 main missions – develop, maintain, and operate the electrical system to: enlightens the public authorities by publishing schedules and forecasts, support and accelerate the energy transition; provide everyone with 24/7 access to safe and clean electricity.

RTE is a public utility composed of 9 500 employees, among which 500 are involved in real-time operations (flow management & balancing). It was established in 2000 in application of the law requiring establishment of a TSO separated from generation utility.

ECOSYSTEM

Alongside its fellow European TSOs, RTE is building and strengthening cross-border connections to increase its capacities for exchange with its neighbours. Within ENTSO-E – the European Network of Transmission System Operators for Electricity, composed by 40 member TSOs representing 36 countries – RTE works closely together with its fellow TSOs to maintain the European network's security of supply. Together with Elia (the Belgian TSO), RTE founded in 2008 a new company – CORESO – that is operating as one of the European Regional Coordination Centres (RCCs) to coordinate high-voltage electricity flows and support European TSOs ensuring the security of electricity supply. At France's level, RTE is also actively coordinating its activities with the different Distribution System Operators (DSOs). In France, RTE's activities are regulated by CRE ("Commission de Régulation de l'Energie"), the French National Regulation Authority (NRA).

To successfully complete the energy transition in accordance with the EU's objectives, transmission systems must continuously come up with novel solutions. RTE's R&D department includes around 140 people and allows RTE to be actively involved in European research programs seeking to develop technological innovations, standardization activities, and worldwide cooperation through more than a hundred partnerships.

RTE is also strongly involved in international experts' community, such as CIGRE, where it is convening a Working Group on the impact of the growing use of machine learning/Artificial Intelligence in the operation and control of Power Networks from an Operational perspective.

RTE strongly supports open science and open source. It is an active member of Linux Foundation Energy (LFE), which is an open-source foundation supporting projects provide a unified approach to developing non-differentiating code to enable the world's power systems to transform rapidly to electrification. For example, LFE is hosting OperatorFabric, a project initiated by RTE in 2019 which is

a modular, extensible, industrial-strength platform to facilitate operational activities for utilities in electricity, water, and other domains. The Grid2Op framework is another open-sourced digital environment developed by RTE, that will be used in AI4REALNET project.

RTE and its fellow TSOs also work together with electricity stock exchanges to couple the different markets and consolidate Europe's electricity market.

Focus area

RTE is preparing grid operations for 2030 horizon with higher shares of renewable energy in the electric system which increases situations atypicality, complexityand modelling risk. Starting from the strong conviction that the human operators (dispatchers) must remain at the center of the decision making for managing the flows, RTE is working on several R&D projects to enhance the human decision making with the help of virtual assistants. To promote open science and improve attractivity of the AI community, RTE has run multiple challenges to create a near real-time assistance module for the dispatchers that offers recommendations for strategies aimed at safely managing overloads on the electrical lines: see Paris Region AI Challenge for Energy Transition, April 2023.

Exploitation Strategy: Exploitation Goals

RTE considers that the current paradigm shift under the Energy Transition will have a direct impact on its control centers, forcing them to handle weather-based energy resources, new interconnections with neighbouring transmission networks, more markets activity, active distribution networks, micro-grids, and greater amounts of available data: such changes require more assistance to human operators to manage the future power system.

AI4REALNET project is directly linked with other projects already carried out by RTE in the domain of assisted decision making for grid operators, with a human-centered approach.

Thus, RTE expects to reuse the results and acquired knowledge from the project (see KERs of the project) in future research work, but also in internal projects with high Technical Readiness Levels (TRL). RTE should benefit from the theoretical work done with the other academical and research partners to facilitate integration of AI systems in control rooms. Besides, by addressing several use cases for critical infrastructures operation, the results of the project should attract the community of AI researchers in a broader way than if only the electricity use cases were addressed. AI4REALNET project will also bring new features to the open-source Grid2Op framework, that will in turn serve the whole open-source community.

Exploitation Strategy: Planned exploitation activities

The activities are the following:

- Disseminate results via conferences, technical reports, position papers, public consultations,
- Internal dissemination action towards operation department and control room staff,

- Reuse the results and acquired knowledge from the project in future research work, but also in internal projects that shall improve the management of the power system in the Energy Transition context (leveraging on the electricity use cases studied in the project),
- Update of open-source repo for Grid2Op with new features (and update of open-source repo for other complementary tools of Grid2Op with new features as the case may be),
- Continue organizing AI competition leveraging on AI4REALNET notoriety and dissemination of its results.

TENNET

PARTNER DESCRIPTION

As the Transmission System Operator (TSO) for the Netherlands, and a significant part of Germany, TenneT owns and operates over 25,000 kilometres of high-voltage lines and cables. We deliver electricity to 43 million domestic and business users, safely and reliably, 24 hours a day and 365 days a year. With over 7,400 employees in two countries, we are driven by our mission to ensure the lights stay on and that power is available, at the flick of a switch, whenever and wherever you need it.

To do this, we design, build, maintain and operate a high-voltage grid stretching across land and sea. This carries electricity from where it is made – including a rapidly increasing proportion of wind and solar energy – to where it is used. We carry it over ground, underground, under the sea and across borders, over our rapidly expanding high-voltage grid. With a service level as high as 99.99963 %, we are one of the best in the world at our job.

ECOSYSTEM

As international TSO, we are literally connected to many of our stakeholders and other organisations in the electricity system. We collaborate with other European TSOs we are either directly or indirectly connected to, Distribution System Operators (DSOs), connected parties such as generation and load units and market parties to collaboratively maintain a reliable grid. This collaboration consists of several topics from alignment on network development planning to grid operations. Many of these collaborations and alignments are part of our involvement in the European Network of Transmission System Operators for Electricity (ENTSO-E), Regional Control Centres (RCC) or Cigré. Additionally, the ministries and regulators are important stakeholders for TenneT.

FOCUS AREA

As the energy transition accelerates, the TenneT grid is stretched to its limits more than ever before and will be even more in the future. Higher electricity demand and production, variable and more unexpected production peaks due to renewables both in centralized and decentralized locations and increasing cross-border exchanges increase the demand for transport capacity and result in congestion if not acted upon. Therefore, TenneT's major focus is on expanding the grid and implementing assets

to effectively transport and manage the increased power flows in the future. In 2023, TenneT has delivered around 8 billion of investments in electricity grid expansion.

However, as grid expansion is very costly, TenneT also increases its focus on using the existing assets more efficiently. This will not only limits the required grid expansion, but also eases the pressure on the grid for the coming years that are needed to build the electricity grid of the future. The Control Room of the Future program at TenneT has therefore initiated the GridOptions project that aims to optimise the grid by providing decision support on remedial actions to manage congestion to provide the required transport capacity in a reliable and efficient way.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

The goal of TenneT's involvement in the AI4REALNET project is twofold. Firstly, the goal is to bring in our experience with the development of AI algorithms that can propose remedial actions for congestion management. Secondly, the goal is to leverage the outcomes of AI4REALNET, on the level of AI models as well as improvements in the Human Machine Interface, and integrate relevant outcomes in our decision support tool.

As TenneT is innovating with an open mindset, TenneT is collaborating with other European TSOs to share developed functionalities as this increases the output of TenneT and the other TSOs. As AI4REALNET is an open-source project, this fits well within the TSO collaborations.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

To ensure the results of AI4REALNET will be leveraged to benefit society, TenneT will implement relevant outcomes of the project into its internal decision support tooling. During the project, the TenneT colleagues working on the internal decision support tool will therefore also work on AI4REALNET. This makes that the AI4REALNET results will be used as soon as they are available during the project.

DEUTSCHE BAHN

PARTNER DESCRIPTION

The Deutsche Bahn AG is the national railway company of Germany, and a state-owned enterprise under the control of the German government. Headquartered in the Bahntower in Berlin, it is a joint-stock company (AG) and the largest railway company in the world. Deutsche Bahn is the second-largest transport company in Germany, after the German postal and logistics company Deutsche Post. [12] The rail infrastructure expertise of Deutsche Bahn is concentrated under the umbrella of DB Netze Track.

[12] https://ir.deutschebahn.com/en/db-group/about-us/

The DB Netze Track Business Unit consists of the companies DB Netz AG, DUSS GmbH, DB Fahrwegdienste GmbH and DB RegioNetz Infrastruktur GmbH.[13]

ECOSYSTEM

To be defined.

FOCUS AREA

DB Group is a leading provider in the mobility and logistics sector, and primarily consists of the Integrated Rail System and the two major international subsidiaries DB Schenker and DB Arriva. The Integrated Rail System includes passenger transport activities in Germany, rail freight transport activities, the operating service units, and the rail infrastructure companies. As a prerequisite for the further shift in the mode of transport towards rail, the highest priority is to increase operating quality with a view to increasing capacity. To achieve these objectives, the coalition agreement of the Federal Government stipulates, among other things, that the infrastructure companies DB Netz AG and DB Station&Service AG within DB Group be merged into a new infrastructure division focusing on the common good.[14]

EXPLOITATION STRATEGY: EXPLOITATION GOALS

To be defined.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

Widely use the project's results to improve their business performances and open new business opportunities. More specifically, the integration of already operational tools and technologies with the project's AI algorithms. Use project results in standardization activities and policy making actions (Source: Proposal)

NAV

PARTNER DESCRIPTION

The Air Navigation of Portugal — NAV Portugal, E.P.E., is a public business entity responsible for providing air traffic services - Air Traffic Control Service, Flight Information Service, and Alerting Service - within the two major areas under Portugal's responsibility: The Flight Information Regions (FIRs) of Lisbon and Santa Maria. NAV Portugal, E.P.E.'s mission is to provide air traffic services within the FIRs under the responsibility of the Portuguese State, ensuring compliance with applicable national and international regulations and the highest standards of safety, optimizing the utilization capacities of

[13] https://www.deutschebahn.com/en/group/business_units/DB_Netze_Track-6929422
[14] https://ibir.deutschebahn.com/2022/en/group-management-report/db-group/organizational-structure/

airspace and airport infrastructures, improving the efficiency of the services provided, and promoting environmental sustainability.[15]

Ecosystem

National Context: ANAC - Portuguese Civil Aviation Authority and GPIAAF - Aircraft And Rail Accidents Prevention and Investigation Office. At an international context: ICAO - United Nations Civil Aviation Organization; EUROCONTROL, the European air navigation safety organization; NAV is a founding member of CANSO - Civil Air Navigation Services Organization; ESSP - European Satellite Services Provider; COOPANS - Cooperation Between Air Navigation Service Providers.[16]

Focus area

Air traffic management support system, aeronautical infrastructure, Safety, free route airspace, Critical Incident Stress Management (CISM).[17]

Exploitation Strategy: Exploitation Goals

To be defined.

Exploitation Strategy: Planned exploitation activities

Widely use the project's results to improve their business performances and open new business opportunities. More specifically, the integration of already operational tools and technologies with the project's AI algorithms. Use project results in standardization activities and policy making actions (Source: Proposal)

ZHAW

Partner description

The ZHAW Centre for Artificial Intelligence (CAI) is a hub for excellence in applied AI research and application. Our mission is to advance human-centric and trustworthy AI research in Switzerland, thereby providing students with career opportunities in the AI sector, attracting young talent and addressing the great challenges of our time through innovative use of AI. We believe in the power of interdisciplinary collaboration and engaging in dialogue with the research community, with our students, and with our industry partners. We offer expertise in the following areas: Autonomous Learning Systems (Reinforcement learning, multi-agent systems, and embodied AI), Computer Vision, Perception and Cognition (Pattern recognition, machine perception, and neuromorphic engineering), Trustworthy AI (Trustworthy machine learning, Robust deep learning, AI & society), AI Engineering

[15] https://www.nav.pt/en/about-us/what-we-do
[16] https://www.nav.pt/en/about-us/national-and-international-context
[17] https://www.nav.pt/en/services/traffic-management-support-air-systems

(MLOps, Data-Centric AI, Continuous Learning), and Natural Language Processing (Dialogue systems, text analytics, and spoken language technologies). The CAI conducts method-oriented applied research and development at the highest level in the field of machine learning and is committed to a human-centred approach to artificial intelligence, which actively shapes the ethical dimension. Together with the ZHAW Institute of Data Analysis and Process Design (IDP), we drive an ambitious agenda in applied responsible AI research.

ECOSYSTEM

ZHAW created the first interdisciplinary academic research center for data science in continental Europe, the ZHAW Datalab, in 2013. Out of this initiative, a thriving national and European ecosystem around data-intensive products and services emerged, including the national association Data Innovation Alliance (with the goal to bring businesses and research institutions together to co-create innovation), the IEEE Swiss Conference on Data Science (a unique business and academic conference on all aspects along the data science value chain), and the European Association for Algorithmic Fairness. Furthermore, we have been instrumental in the formation of the Confederation of Laboratories for Artificial Intelligence Research in Europe (CLAIRE), host the Swiss office of CLAIRE in Zurich, and member of large European research excellence networks like TAILOR (Developing The Scientific Foundations For Trustworthy AI Through The Integration Of Learning, Optimisation And Reasoning) and AI4Media.

FOCUS AREA

Research and development; technology transfer via applied R&D projects in collaboration with industry or creation of start-ups; mainly in AI, data science, and informatics.

One example of a start-up launched by ZHAW in AI is AlpineAI that makes generative AI and large language models safe and valuable in a corporate or governmental context. One example of an applied R&D collaboration is the DISTRAL project on industrial process monitoring for injection molding with distributed transfer learning in conjunction with Kistler Instrumente AG.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

Mainly focused on the research exploitation model, aspiring re-utilization of the research know-how acquired in future research and development activities that attracts interest from academia, start-ups, and SMEs from the AI community. On top of the developed software and experience in deploying AI technologies, the results' commercial exploitation with partners is also expected.

Centered on the research exploitation model, ZHAWs primary goal is to leverage the acquired research expertise for continual application in forthcoming applied research and development endeavors as well as in teaching. This involves not only creating a robust repository of knowledge but also contributing to the development of open-source code and open access publications. Such results are explicitly disseminated to captivate the attention of diverse entities from academia, start-ups, and SMEs also beyond the core AI community. On top of the developed software and experience in AI technologies, the commercial exploitation of the results by industrial partners is also expected,

leveraging our long-term partnerships with operators of critical infrastructures such as SBB or via the Flatland Association.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

The following activities are planned:

- Enhance and create new partnerships with key stakeholders in academia and industry to facilitate the exchange of ideas, resources, and expertise. The participation in associations (e.g., CLAIRE, Flatland) will be instrumental, as well as the involvement in the national Swiss data-based business ecosystem.
- Leverage ZHAW experience in preparing advanced courses for industry and provisioning of consultancy services using the gained R&D knowledge, to organize capacity-building programs for industry and organizations and also offer specialized consultancy in the area of AI for operation of critical infrastructures (and generally human-AI collaboration).
- Leverage our established strength in technology transfer to transition the research findings from AI4REALNET into practical applications on a timeline of 2-3 years after the project. The idea is to depart from the 6 project's use cases but collaborate with industrial partners from and outside the consortium to identify new use cases where AI brings added value and co-develop solutions that address real-world challenges.
- Actively contribute to academic publications, conferences, and industry events to showcase our research findings.
- Explore partnerships with start-up and SMEs to support the growth of their products by integrating the knowledge generated during the project, in the areas of human-AI collaboration and socially compatible deployment of AI, as well as in evaluation frameworks for AI (e.g., robustness, resilience, interpretability).

Beyond the project duration, ZHAW expects to promote demonstration objects showcasing the practical applications of our research. This will generate tangible examples of the value proposition of our work to attract industry partnerships and additional funding.

FHNW

PARTNER DESCRIPTION

Excellent practice-oriented research at first hand. The FHNW (Fachhochschule Nordwestschweiz) is one of the leading universities of applied sciences and comprises 9 universities in the fields of life sciences, applied psychology, architecture/construction and geomatics, design and art, music, education, social work, technology, and economics.

The FHNW School of Applied Psychology (APS) was established over fifteen years ago. It is now one of the leading centres of excellence for occupational, organisational, and business psychology in German-speaking Europe. The school's key objective is to make use of professional and scientific psychology in

society, the economy and the world of work and business. The APS has 7 different design and innovation fields: 1) designing flexible work, 2) diversity and multiple perspectives in organisations, 3) innovative market offers and consumptions, 4) personnel assessment and development, 5) reliability, safety, and security, 6) social and digital interaction, and 7) work and health.

With innovative, research-based psychology, the APS makes an interdisciplinary contribution to the humane design of the working and professional world and to the development and dissemination of humane offers in its fields of design and innovation. The APS is at the forefront of testing and practicing the technically sound design approaches and innovations that it develops together with its project partners.

ECOSYSTEM

The ecosystem of the School for Applied Psychology (APS) is diverse and engages in different areas. We pride ourselves on providing a modern infrastructure that fosters innovation and collaboration. Here are some key aspects of our ecosystem and how we connect with relevant key players:

- Research projects: Our research groups are involved in a large number of national and international applied research projects. The aim is to generate scientifically sound benefits for business and society. Our interdisciplinary research partners are universities and other research institutions as well as partners from industry. In these networks, we work on interdisciplinary projects to develop solutions with the aim of making work more humane and thus contributing to increasing the effectiveness and efficiency of work organizations. We share the findings from our research through publications and presentations with the scientific community as well as with society.
- Collaboration & partnerships with key players in society: We share the latest findings from research and development in applied psychology with society by periodically organizing several regional and national events and exchange platforms where we present and discuss our latest findings with representatives from academia, industry and authorities (especially regulators). We are also involved in expert groups and academies (e.g. Swiss Academy of Engineering Science (SATW), where Prof. Dr. Toni Wäfler is a member of the Industry 4.0 expert group) and cooperate with local promotion agencies.
- Digital Innovation Lab: is a place where we work on user experience, usability, virtual technologies and innovation. We are also researching the use of social robotics in various applications. Our Robo-Lab provides cutting edge research on social robotics.

FOCUS AREA

The APS is active in teaching at BA and MA level, postgraduate continuing education, applied research and development (R&D) and services. It continuously integrates the state of the art in science and research into its activities.

- APS focuses the domains of work and business and their interfaces with other areas of life. We work closely with the other specialist disciplines that are active in these domains.

- The primary goal of APS activities is to research and design the fit between people, technology and organization. On the one hand we pursue a human-oriented approach to the design of work, with the aim of designing working conditions humane (adapting work to people). On the other hand, we are equally concerned with selection and qualification of human workforce (adapting people to work).
- APS prefers to support proactive, innovative design projects aimed at the (further) development and promotion of organizational, social, and personal resources.

Exploitation Strategy: Exploitation Goals

The APS focuses on integrating research findings into programs at BA and MA level, as well as into postgraduate continuing education, with a particular emphasis on incorporating practical insights into teaching. A further key priority is to ensure that the knowledge generated directly informs projects at regional, national, and international levels. This approach ensures that APS research outcomes make a direct and sustainable contribution to the development of educational and project solutions across different contexts.

Exploitation Strategy: Planned exploitation activities

- Dissemination of the results in conferences, journals, and position paper.
- Integration of the results into educational and further educational programs.
- Integration of results and acquired knowledge from the project into future research.

SBB

Partner description

Connecting Switzerland, SBB is the backbone of the Swiss public transport system. SBB have been transporting goods and people for over 100 years. SBB connects people, goods and places, bringing millions of people together and linking up cities, cantons and rural regions. Day in, day out, our connections are there for Switzerland. SBB is a reliable partner of the Swiss government, cantons, municipalities and suppliers. Integrated rail is the heart of what we do. It comprises the business areas of passenger services production, passenger services markets, real estate, infrastructure and freight services. This is SBB's core business, run in the interest of our customers. Its foundation is the railway infrastructure with its rail, energy and telecoms networks. With over 150 careers and more than 34,227 employees, SBB is one of Switzerland's largest employers. Our employees make SBB the backbone of the public transport system and ensure that our customers reach their destination safely, reliably and on time. By 2030, SBB intends to be economically stable and to better anticipate customer needs, providing a public service for Switzerland. SBB also aims to deliver targeted and smart growth in areas where rail has its strengths, to be a leader in sustainability and to provide a railway run by people, for people.

ECOSYSTEM

The corporation is led in an entrepreneurial manner. A performance agreement between Swiss Federal Railways and the Swiss Confederation defines the requirements and is updated every four years. At the same time the compensation rates per train and track-kilometre are defined. A subsidiary, SBB GmbH, manages passenger transportation in Germany, specifically operating the Wiesentalbahn and Seehas services. Other subsidiaries include THURBO, RegionAlps, AlpTransit Gotthard AG, Cisalpino, and TiLo, with the latter being a joint venture with Italian authorities. Swiss Federal Railways also has significant stakes in Zentralbahn and Lyria SAS.

FOCUS AREA

Swiss Federal Railways is divided into three divisions. The divisions manage the relevant operational businesses. These divisions are: Passenger traffic, Infrastructure, Real estate.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

SBB aim is to significantly overhaul and improve its work in four dimensions by 2030 to provide an integrated and robust railway service:

- Make the railway system more flexible for our customers – trains will run according to demand, with additional services provided on the basis of the tried-and-tested clock-face schedule. Integrate different forms of mobility into our digital platforms and our railway stations.
- Achieve smart growth in their core business; that means using rail's natural strengths – i.e. fast passenger and freight transport over longer distances and in the conurbations.
- Increase efficiency and make SBB economically sustainable in the long term. By doing so, SBB pretend to make a valuable contribution to the sustainable financing of the system and to providing public transport as a public service that meets demand.
- Be leaders in all areas of sustainability. Our railway is to be run by people, for people: for customers, employees and society. SBB plans to contribute to achieving Switzerland's sustainability goals via our service design, investment and procurement activity.[18]

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

Widely use the project's results to improve their business performances and open new business opportunities. More specifically, the integration of already operational tools and technologies with the project's AI algorithms. Use project results in standardization activities and policy making actions (Source: Proposal)

[18] https://company.sbb.ch/en/the-company/profile/strategy.html

FLATLAND

PARTNER DESCRIPTION

The purpose of the Flatland Association and the Flatland framework is to empower industry partners, academic researchers and the broader Flatland community to achieve an unprecedented level of interdisciplinary research and translation into industry applications. It is our mission to open new avenues for innovation dedicated to solving a class of resource allocation problems applied to various industry use cases by actively inviting and enabling all kinds of methodological approaches.

Our vision is that Flatland is a central hub for open research, providing a space for both highly specialised interest groups and cross-disciplinary exchange. To that end, Flatland provides a rigorous, technical problem formulation and the standard benchmark recognised by both industry and the academic research community.

Our expertise lies in a) the development of a digital environment to simulate use cases related to research allocation problems with a focus on railway and the vehicle rescheduling problem, b) the enabling of machine learning approaches to tackle the challenges of these use cases, and c) in facilitating translation of machine learning research into industry practice.

ECOSYSTEM

Flatland is at the intersection between research and industry. Flatland has a strong network with the members of the Flatland Association and is part of a larger ecosystem with industry partners, technology companies as well as of research institutions all over the world. Further, Flatland has a strong community of machine learning and operations research researchers and software developers who have an integral part in the development of the open-source Flatland framework.

FOCUS AREA

Digital environment for machine learning research; resource allocation problem with focus on railway use cases; problem formulation for industry use cases and translation of research results to industry application.

EXPLOITATION STRATEGY: EXPLOITATION GOALS

Flatland's main goal is to utilize the extension of the Flatland framework and the acquired knowledge from the six use cases to provide open-source tools and industry problem benchmarks to foster applied machine learning research long-term.

EXPLOITATION STRATEGY: PLANNED EXPLOITATION ACTIVITIES

The following activities are planned:

- Extension of the Flatland framework for applications across industry use cases to enable machine learning research beyond the scope of the AI4REALNET project and into future use cases by providing a high-quality and well documented open-source code repository.
- Extend the Flatland Association's network into new industries and grow the Flatland community to connect relevant stakeholders and foster industry-research collaborations.
- Run a machine learning competition with the AI4REALNET use cases during the project to attract interest and get novel solutions to the use cases.
- Create a platform with ongoing long-term benchmarks for the use cases that allow the community and academic partners to experiment with the use cases and develop novel solutions beyond the end of the AI4REALNET project. Further, the benchmarks serve as a model for other industry partners on how to utilize open research to tackle real-world challenges.
- Active contribution to scientific publications.

As a conclusion, this chapter provides an overview of the motivations driving our partners towards exploiting the AI4REALNET results. We have identified the drivers driving our partners' enthusiasm for exploitation. We have pinpointed the factors driving their enthusiasm for exploitation and highlighted the collaborative efforts crucial for our project's success and impact. Additionally, we have showcased the unique networking conditions that can enhance the project effectiveness and impact.

6. STAKEHOLDERS AND RELATED INITIATIVES

A Stakeholder is defined as an entity that can influence or is impacted by the decisions of another organisation. This includes individuals, groups, or organisations with a legitimate relationship to the organisation[19]. As stakeholders hold in-depth knowledge of their own needs and are essential to creating trustworthy systems tailored to specific applications, we plan to engage them, since the beginning of the project, to support the project's efforts and results. Stakeholder collection and identification will occur throughout the project, with periodic reinforcements facilitated by all seventeen partners through an online survey. We've selected the LimeSurvey Platform, a dependable open-source survey tool, for this purpose (full detail of all questions in the survey, see Appendix 5). The survey was launched in January and has captured 48 stakeholders so far, as reflected in the preliminary list of stakeholders, according to the different application fields of the project (Figure 1 to Figure 5).

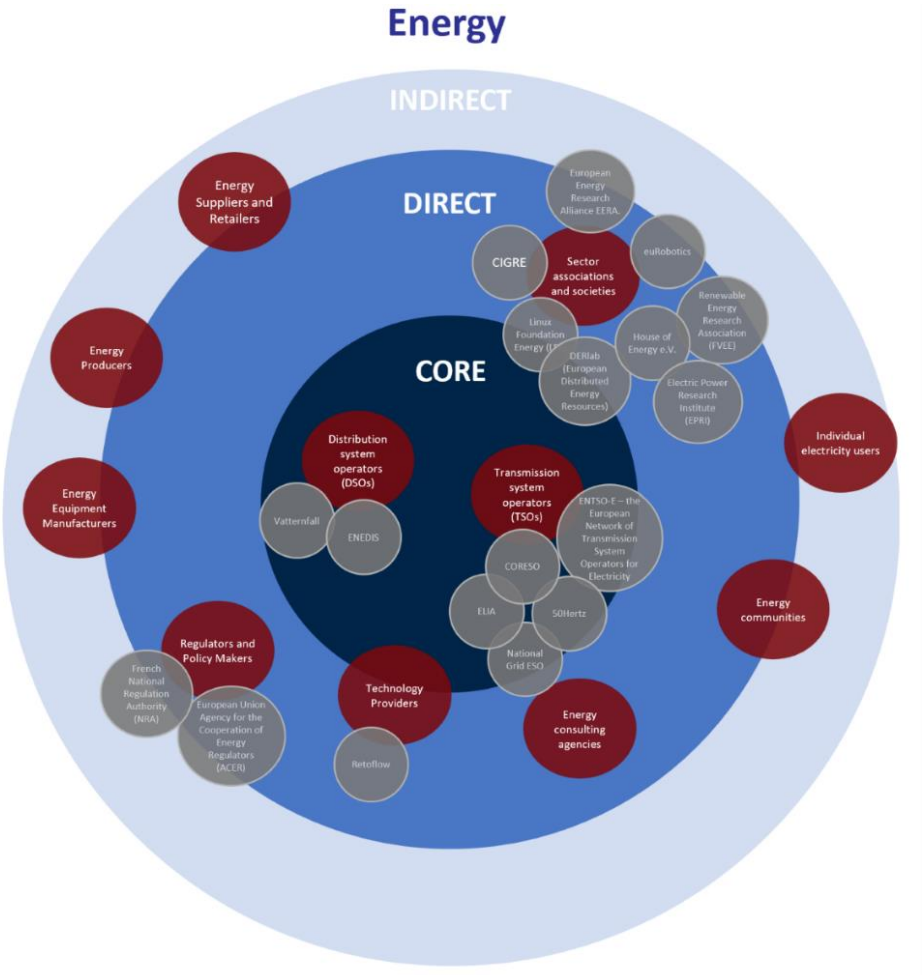

FIGURE 1 - ENERGY SECTOR STAKEHOLDERS IDENTIFIED

[19] Stakeholder | European Foundation for the Improvement of Living and Working Conditions (europa.eu)

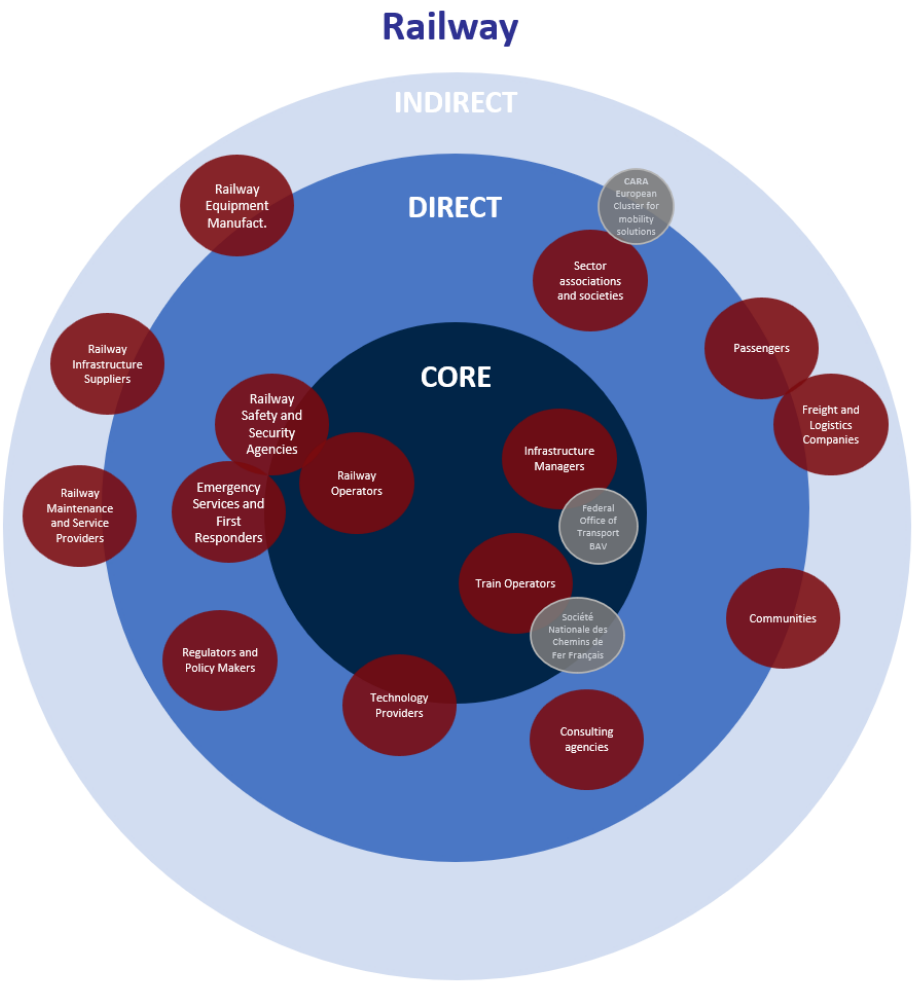

FIGURE 2 - RAILWAY SECTOR STAKEHOLDERS IDENTIFIED

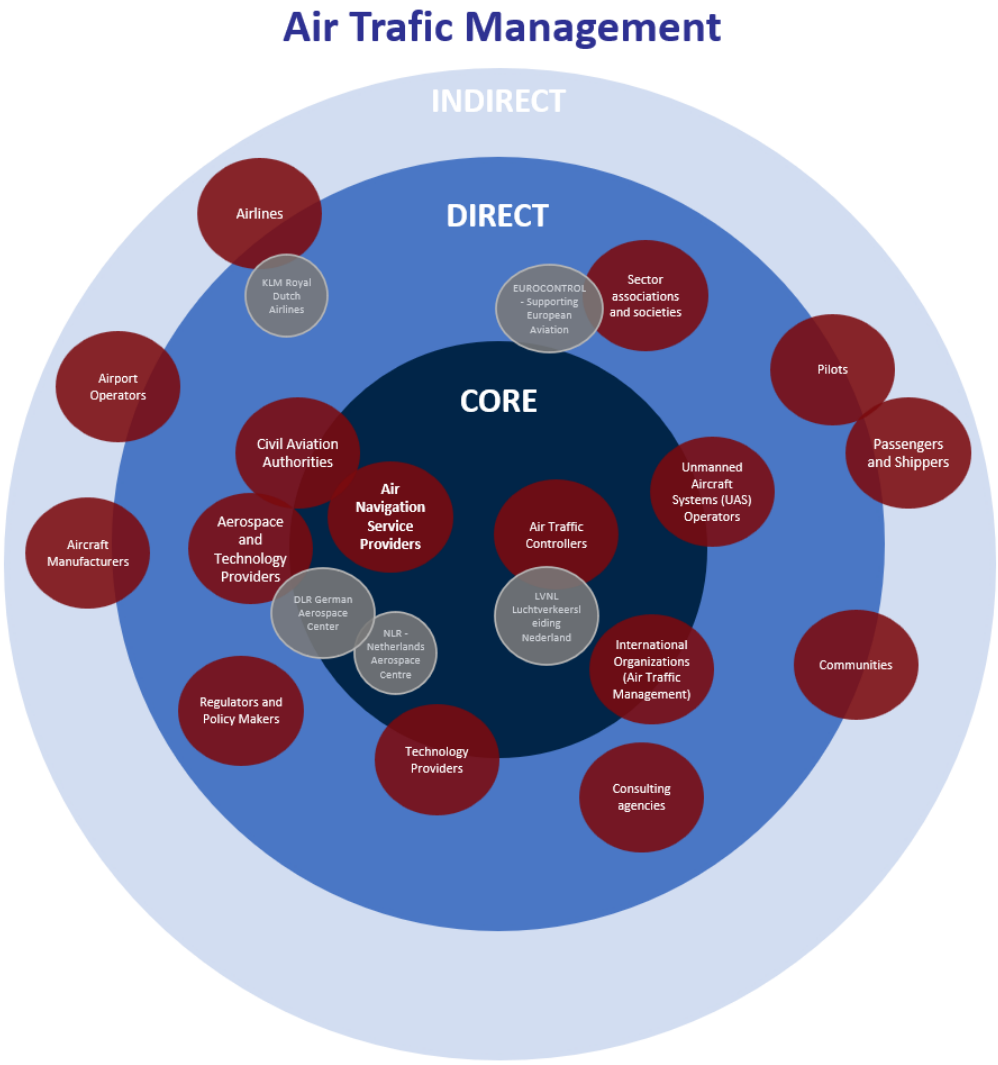

FIGURE 3 - AIR TRAFFIC MANAGEMENT SECTOR STAKEHOLDERS IDENTIFIED

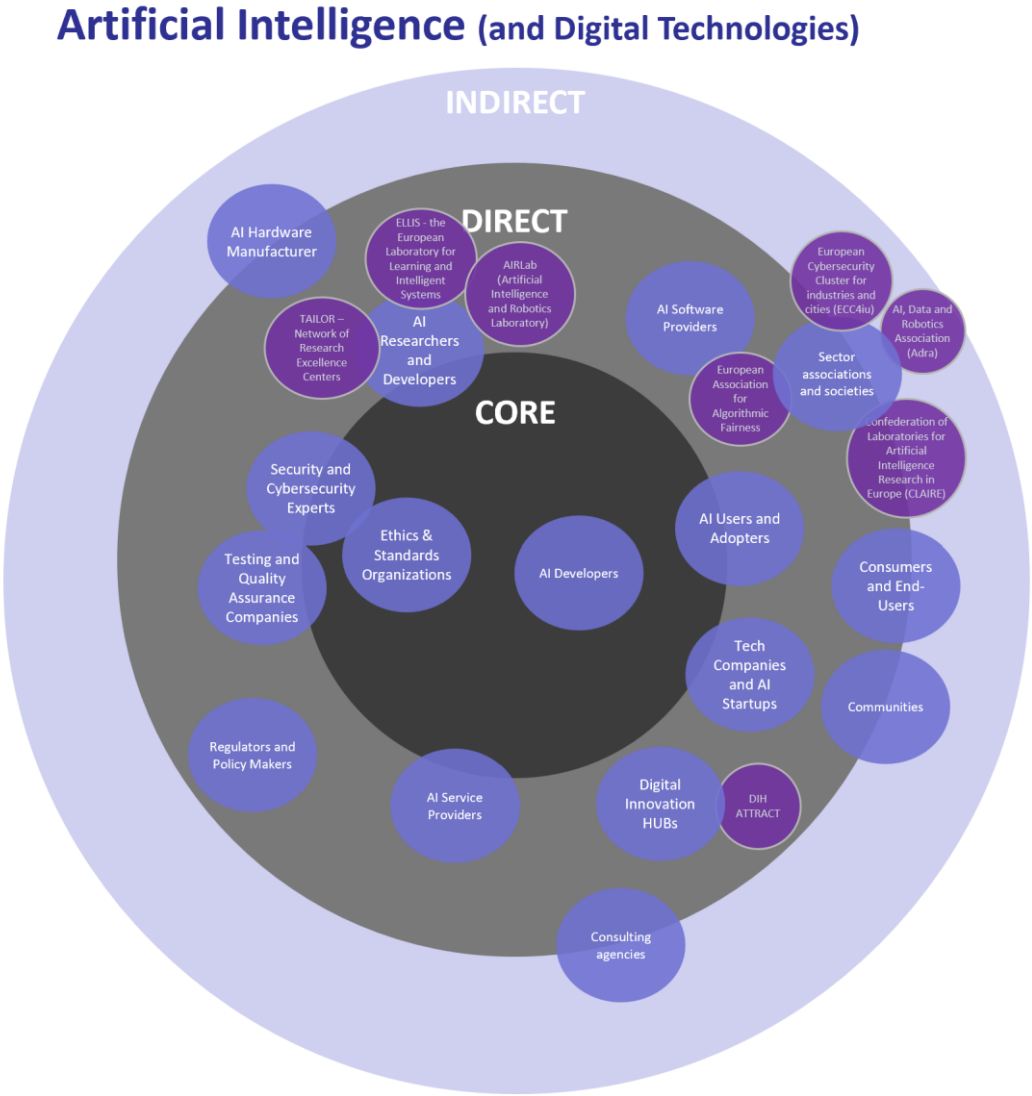

FIGURE 4 - AI SECTOR STAKEHOLDERS IDENTIFIED

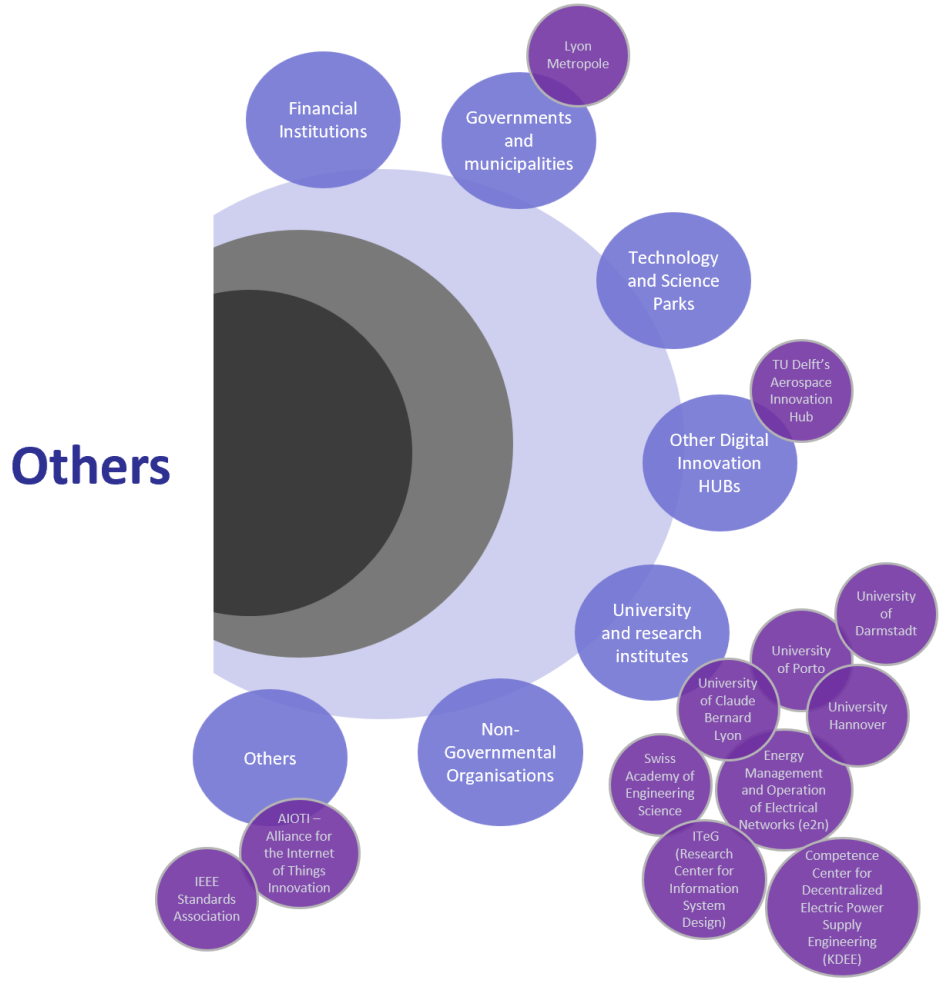

FIGURE 5 - OTHER STAKEHOLDERS IDENTIFIED

This process will continue throughout the project. By nurturing collaborations with the stakeholders, our objective is to cultivate a dynamic innovation ecosystem that fosters the advancement of technological innovation within the domain of AI applied to Critical Systems.

Additionally, we will pinpoint strategic opportunities to collaborate with related initiatives that align with our objectives, thereby accelerating the future utilization and adoption of AI4REALNET outcomes. During the development of the proposal and the project, AI4REALNET partners identified and committed to collaborate with initiatives that are strategically important for achieving the full impact of the results. These initiatives include Ai4Europe|AI-on-Demand, Adra-e, EurAI, Horizon Results Booster, EDIH, among others.

In Appendix 6 we provide a brief characterization of the initiatives and outline potential relationships that will be established to foster and capitalize on the exploitation results of the project in collaboration with Dissemination activities of the project.

7. MARKET OVERVIEW AND INITIAL BUSINESS MODEL

MARKET POTENTIAL

Open Source and AI Trends:

The global market for open-source services is expected to grow rapidly. It reached $25.6 billion in 2022 and is projected to reach $54.1 billion by 2027, according to research by MarketsandMarkets (2022)[20]. In 2021, interviews with IT leaders worldwide found that 65% of enterprises plan to start using open-source software. The main reasons cited for this shift are the agility, flexibility, and reliability of open-source services, along with lower overall costs (Cormier, 2022). The same source valued the global Human Machine Interface market $3369.8 million in 2024 and estimated that it would reach $5674.8 million by 2031[21].

Additionally, the community effect and the increasing number of open-source software vendors, coupled with advancements in technologies are contributing to this trend. Open-source software is particularly crucial in the development and implementation of AI. A complete landscape of players building open-source tools for AI development is presented in the following image (Figure 6), with more than seventy players of more than 15 categories, including AI development platforms.

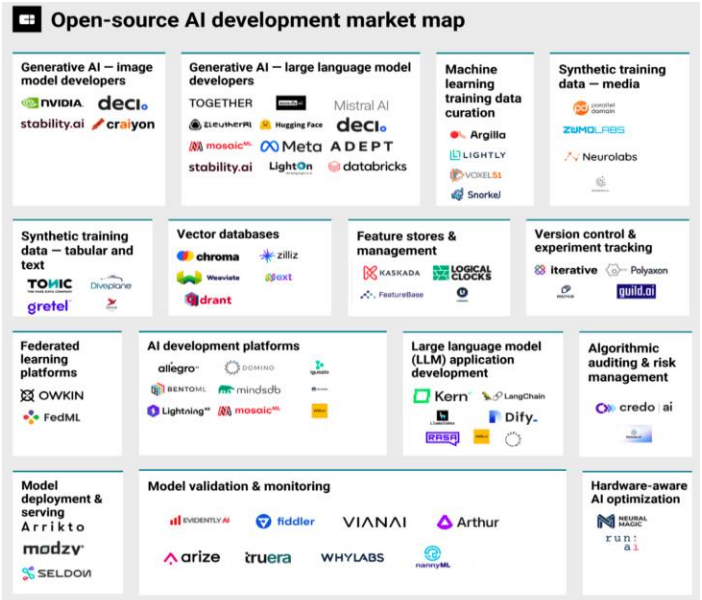

FIGURE 6 – OPEN-SOURCE AI DEVELOPMENT ECOSYSTEM

Source: https://www.cbinsights.com/research/open-source-ai-development-market-map/

[20] https://www.marketsandmarkets.com/Market-Reports/open-source-services-market-27852275.htmlgad_source=1&gclid=CjwKCAiA6KWvBhAREiwAFPZM7lkjdm_eNkWycG4aJFkM3tU7rhNYCLfYZVVC9USRfJMx9qqE2t0f9RoCRBwQAvD_BwE

[21] https://www.linkedin.com/pulse/2031-human-machine-interface-hmi-market-size-share-jcjtf/

A study conducted by Economist Intelligence Unit in 2021 shows that European companies see AI/ML as their top IT investment priorities over the next years. Accenture highlights that businesses that successfully apply AI could increase profitability by an average of 38% by 2035.[22]

Energy:

According to Prescient Strategic Intelligence (2019), the global AI in the energy management market was valued at $4,439.1 million in 2018 and was expected to generate $12,200.9 million revenue in 2024, exhibiting a compound annual growth rate (CAGR) of 19.8% during the forecast period. Another report on AI in Energy Market Size for the period of 2021-2031[23], the energy market is projected to reach $19.8 billion by 2031. The drivers pointed for the market growth are an increase in demand to make grids smarter to satisfy the requirements of changing energy systems.

AI is being employed more and more in the trading of power, smart grids, and the fusion of the transportation, heat, and electricity industries. AI services also support the integration of AI solutions into core business functions and processes. The application fields pointed out by the report are safety and security, demand forecasting, renewables management, robotics, and infrastructure, among others. By application, the safety and security segment is the highest revenue contributor to the market, with a CAGR of 18.0%, as shown in Figure 7.

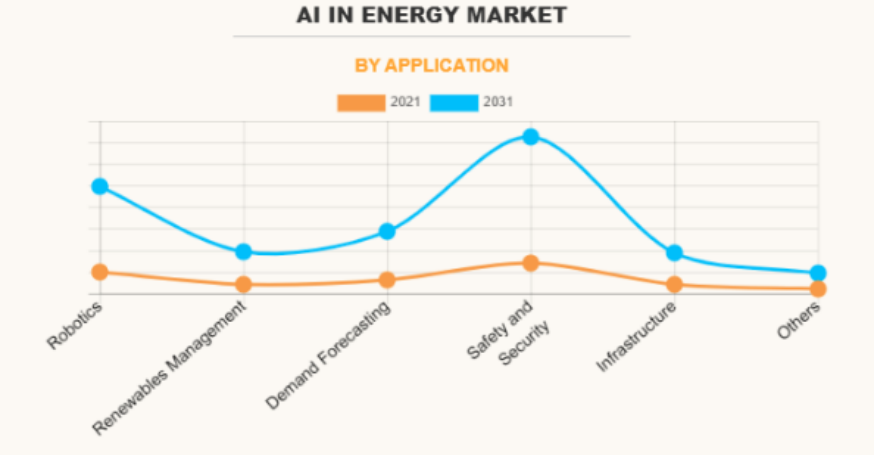

FIGURE 7– EXPECTED REVENUE BY AI APPLICATION IN ENERGY MARKET

Source:https://www.alliedmarketresearch.com/ai-in-energy-market-A12587

Major key players in this sector have been identified: ABB ltd., Accenture plc, Amazon Web Services Inc., Autogrid Systems, Inc., C3.ai, Centrica plc, Cisco Systems Inc., General Electric, HCL Technologies, Huawei Technologies Co., IBM Corporation, Intel Corporation, Mitsubishi Electric, Schneider Electric, and Senseye.

[22] https://www.cbinsights.com/research/open-source-ai-development-market-map/

[23] Source: "AI in Energy Market Size, share, Competitive Landscape and trend analysis by component type, by application, by end user, by deployment type: Global opportunity analysis and industry forecast for 2021-2031" report, retrieved from: https://www.alliedmarketresearch.com/ai-in-energy-market-A12587

Air Traffic Management:

Driven by rising air passenger traffic, the global ATM market is projected to grow from $11.50 billion in 2021 to $16.11 billion in 2028 at a CAGR of 4.93%, (Markets and Markets, 2022)[24]. In 2018 the Thales Group announced the OneSKY program with AI as one technology to manage 11% of the world's airspace, according to Fortune Business Insights report (2022). According to International Air Transport association (IATA), investment capital of around USD 1,2 to 1.5 trillion is estimated to be spent in infrastructure development up to 2030 (Fortune Business Insights, 2022).[25] New airports will need efficient air traffic management services, equipment, and software solutions in the forthcoming years. This is expected to boost air traffic management and consulting market growth during the forecast period.

Several airports around the world are incorporating AI technology into their air traffic control systems to improve efficiency, safety, and capacity. While the specific implementations and extent of AI usage may vary, here are a few examples of airports that are known to be utilizing AI technology in air traffic control[26]:

- London Heathrow Airport, United Kingdom: Heathrow Airport has been exploring the use of AI and machine learning algorithms to optimize runway operations, predict flight delays, and manage air traffic flow. The airport has collaborated with tech companies and research institutions to develop AI-powered solutions for air traffic management;
- Singapore Changi Airport, Singapore: Changi Airport has implemented AI-based systems to enhance runway scheduling, aircraft movement planning, and air traffic flow management. The airport leverages predictive analytics and machine learning algorithms to optimize runway utilization and minimize delays;
- In Norway, the "Remote Towers" solution was implemented in in 15 airports in 2019, and in 2021 in six more. For pilots operating aircraft, there are no differences in procedures;
- Helsinki Airport, Finland: Helsinki Airport has deployed AI-driven software solutions to improve air traffic management, aircraft routing, and runway operations. The airport utilizes AI algorithms to analyze real-time data, predict traffic patterns, and optimize flight trajectories for maximum efficiency;
- Seattle-Tacoma International Airport, United States: Sea-Tac Airport has adopted AI technology to optimize air traffic flow, reduce congestion, and improve safety.
- Dubai International Airport, United Arab Emirates: Dubai Airport has invested in AI-based air traffic control systems to enhance operational efficiency and capacity. The airport employs AI algorithms for airspace optimization, traffic prediction, and route planning, enabling smoother and more efficient aircraft movements.

[24] https://www.marketsandmarkets.com/Market-Reports/air-traffic-management-market-160955838.htmlgad_source=1&gclid=CjwKCAjw17qvBhBrEiwA1rU9w1lTSI9jgBIXBqsAw6wzkXoCEgHqx1hUTPKJOx6nOSrx3nF5avWQhRoCkMUQAvD_BwE

[25] https://www.fortunebusinessinsights.com/industry-reports/air-traffic-management-market-101813

[26] https://www.linkedin.com/pulse/ai-powered-digital-towers-future-airport-operations-agus-setiawan-zqumc/

However, there are, according to the same report, some restraining factors such as high costs associated with the deployment of ATM and consulting solutions that involve huge hardware costs, such as monitors, communication systems, displays, radars, surveillance systems, navigation, and others. These systems comprise modern technology and complex engineering for development. Another key restraining factor to this market growth is the rising sophisticated cyber-security attacks at airports, in a scenario with heavy reliance on ICT and navigation systems to run operations.

In conclusion, the integration of AI-powered systems in airport operations has revolutionized various aspects of airspace management, conflict detection, and decision support. By leveraging AI technologies, such as machine learning and predictive analytics, airports are equipped to enhance controller decision-making processes. These systems provide real-time insights and predictions, facilitating proactive measures to mitigate potential conflicts and optimize traffic flow. Furthermore, the utilization of AI enables more informed and timely decisions, improving overall efficiency and safety within airport operations. As a result, airports can achieve smoother traffic management, precise route planning, and ultimately enhance the overall passenger experience.

The key sector payers are: Thales Group, Raytheon Technologies Corporation, Indra Sistemas, S.A., L3Harris Technologies, Inc., Northrop Grumman Corporation, Honeywell International, Inc., BAE Systems PLC, Saab AB, Lockheed Martin Corporation, and Capgemini S.E.

Railway:

According to Markets and Markets Research (2022), the global digital railway market is expected to expand at a CAGR of 8.4% through 2024, and Straits Research expects global IT spending in railways to increase at a 9.8% CAGR through 2026[27]. The driving factors are the penetration of digital infrastructure and the requirement for automated and autonomous rail operations.[28] However, high installation costs and infrastructure changes to the existing system are expected to restrain the market's growth during the forecast period. According to KBV report (2022) the pointed market growth factors are[29]:

- Increasing the number of rail passengers in recent years: Railway operators require a variety of digital railway solutions, such as traffic management tools, passenger information systems, and passenger analytics, to effectively manage passenger traffic and deliver high-quality transportation services to an increasing number of passengers. These solutions improve client travel experiences while boosting the effectiveness of railroad operations.
- Increasing demand for cutting-edge transportation infrastructure: As an effect of globalization, travel needs ask for an increase in speed, security, and dependability. Therefore, regardless of the distance traveled or the anticipated number of steps needed to reach the destination, the next railway transportation ecosystem must provide solutions to satisfy the demand from source to destination with a high quality of service. People's needs are evolving continuously, necessitating the development of more accessible travel options.

[27] https://www.marketsandmarkets.com/Market-Reports/digital-railway-market-206122052.html

[28] https://airwaysmag.com/artificial-intelligence-air-traffic-control/

[29] https://www.kbvresearch.com/digital-railway-market/

- Market constraints: The absence of robust rail infrastructure in developing countries that still don't have the resources to upgrade their train systems. Investment in rail infrastructure becomes more important than the digitization of the infrastructure for nations lacking robust train networks. The deployment of cutting-edge digital technology requires a robust train infrastructure and a robust communication system. Only when used at a particular degree of scale are some digital technologies, like traffic management or passenger analytics, effective.
- Market outlook: The Digital Railway Market is bifurcated into solutions and services (Figure 8). The solution segment acquired the highest revenue share in the Digital Railway Market in 2021. To maintain a good service level across their network, transportation companies are under pressure to strengthen and invest in their current infrastructure and resources as the number of rail trips increases year over year.

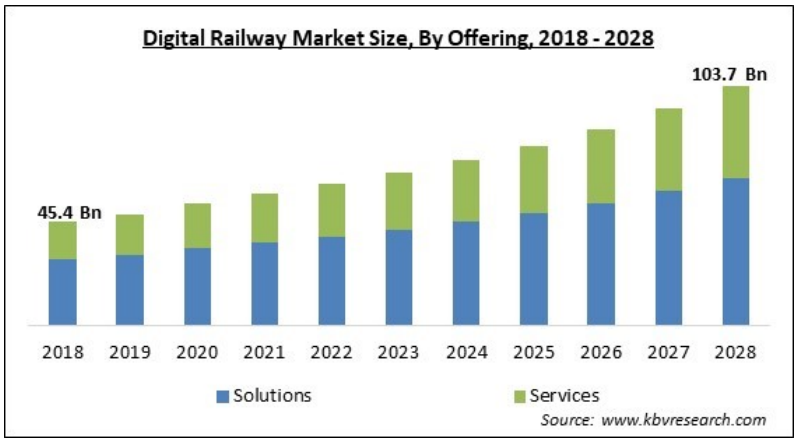

FIGURE 8 - DIGITAL RAILWAY MARKET SIZE – SOLUTIONS AND SERVICES

Source: https://www.kbvresearch.com/digital-railway-market/

In conclusion, the integration of AI technology within AIREALNET key application markets holds immense potential for revolutionizing operational efficiency, safety, and sustainability. By harnessing AI's capabilities, these industries can benefit from real-time decision-making, leading to enhanced reliability and cost-effectiveness. Moreover, AI-powered solutions offer the opportunity to mitigate risks and improve resilience in complex and dynamic environments, ensuring smoother operations and minimizing disruptions. As the AI4REALNET project delves into these domains, it is poised to unlock transformative opportunities that drive innovation, foster collaboration, and ultimately pave the way for a smarter, more connected future across critical infrastructure sectors.

INITIAL BUSINESS MODEL

This section introduces the Business Model AI4REALNET grounded on the framework of Business Model Canvas (BMC) (Osterwalder & Pigneur, 2010). AI4REALNET will adopt the concept of the open business model, as a subclass of business models that explore ecosystem collaboration and will be a decisive and novel element of value creation. The design of the business model and exploitation roadmap will take special attention to technology adoption requirements (legal, technological, ethical,

organizational), respect the community practices and settings, and will consult with representatives of the open-source supply chain.

The following revenue streams are considered: a) dual licensing & 'open core' (IP-based), b) service-based, c) voluntary donations. The 'open core' model will build on the KERs, presented in chapter 2 into its freely available open core (freemium), and other features that help enterprises extract additional value from the solutions, such as enhanced interface, adapters with third-party software, security, and high availability, go into the commercial license. The service-based model will be mainly focused in using the open-source software to upsell consultancy services (expertise in XAI, robustness and safety assessment of AI, RL), maintenance, integration with third-party software, and provide advanced training courses. Moreover, since AI4REALNET creates social and environmental value, a donation model to maintain the open-source code can also be set up. The business model will be revised during the project, mainly to adapt to up-to-date real-life conditions and feedback from different stakeholders. Having this first BMC as departing point (Figure 9), scenarios will be constructed with the key partners taking into account the different segments of market trend analysis and value propositions.

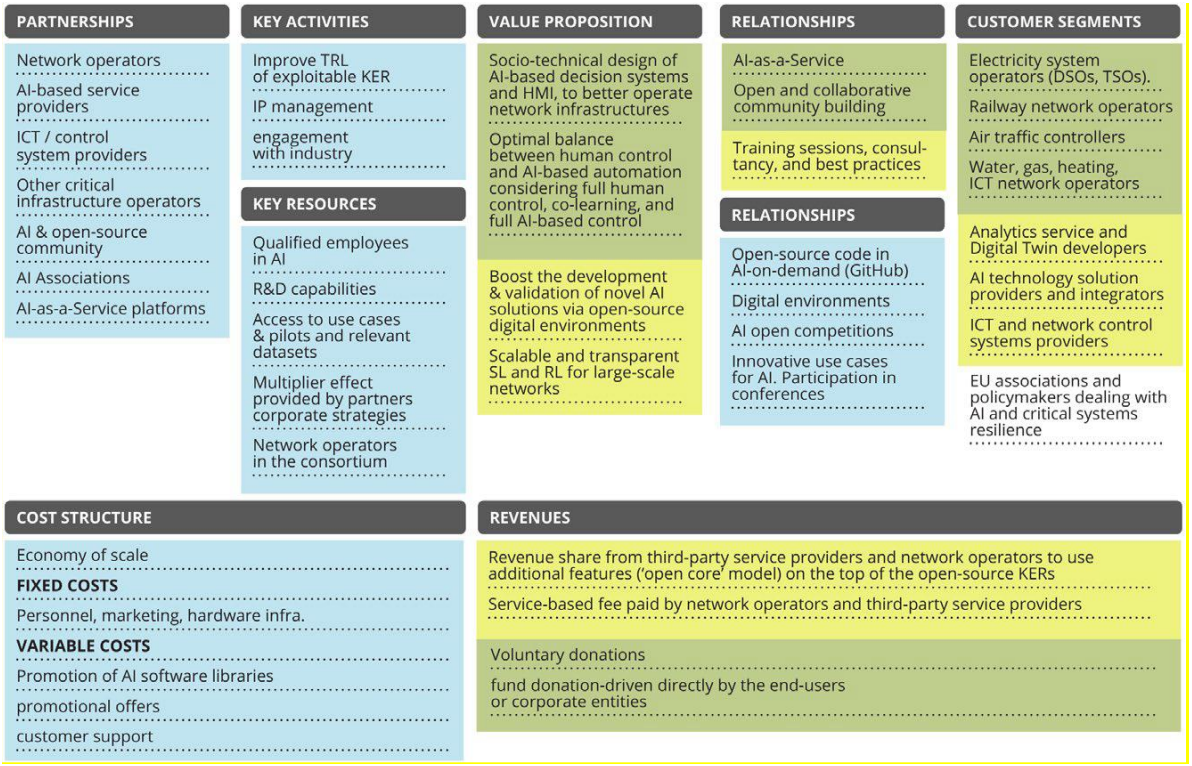

FIGURE 9 – INITIAL BUSINESS MODEL

This initial iteration of the BMC serves as a foundational step in our project journey, laying the groundwork for further exploration of its potential outcomes. Moving forward, we will implement a lean start-up methodology to gather validation inputs from users and stakeholders. This approach will enable us to unlock the full value and impact of the project by iteratively refining our strategies based on real-world feedback. By embracing this methodology, we aim to maximize the effectiveness of our efforts and ensure that we realize the project's objectives to their fullest extent.

8. CONCLUSION AND NEXT STEPS

In crafting the initial version of our exploitation plan for the key exploitable results derived from our AI4REALNET project, we have laid the foundation for unlocking the full potential of our research and innovation endeavours. Through a collaborative and participative approach of all partners, we have identified a multitude of routes for exploiting the KERs, each presenting unique opportunities for maximizing the impact of AI4REALNET project.

As we move forward, our focus will be on implementing the next steps outlined in the proposal. This involves delving deeper into the various routes identified, conducting thorough assessments of their feasibility and potential outcomes, and charting a course that aligns closely with our overarching objectives. We will proceed with the Lean Startup methodology, ensuring user centred process of reviewing and validating. We will prioritize intellectual property management, safeguarding our valuable KERs through open-source strategies, to ensure their long-term sustainability and impact. It is in our plan to identify the value proposition, establish the open-source components, the customer segments, revenue mechanisms, revenue model and develop an extensive BMC for each KER. At the same time, we will continue to identify and engage with stakeholders, including project partners, potential end-users, and the wider scientific community. Their feedback will be invaluable in refining the exploitation strategies.

With ongoing exploitation activities, AI4REALNET aims to realize the full potential of project outcomes. We are committed to advancing a vision that encompasses making meaningful contributions to society and fostering innovation-driven growth through collaborative discussions with all partners and stakeholders.

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APPENDICES

APPENDIX 1 – KER CARACHTERIZATION TEMPLATE

KER Name	
Problem	*Describe the problem you are addressing (the problem your potential users have).* *Potential users are the people, companies, organisations, etc. that you expect will use the result (and generate an impact). They are your "Customers".*
Alternative Solution	*Describe how your "customer" has solved the problem so far.*
Unique Selling Point (USP) Unique Value Proposition (UVP)	*Describe the competitive advantages, the innovative aspects. What does your solution do better, what are the benefits considering what your user/customer wants, how does your solution solve his/her problem better than alternative solutions, what distinguishes the KER from the competition/current solutions?*
Description	*Describe in a few lines your result and/or solution (i.e. product, service, process, standard, course, policy recommendation, publication, etc.). Use simple wording, avoid acronyms, make sure you explain how your UVP is delivered.*
Market: Target market	*Describe the market in which your product/service will be used/can "compete", answering the following questions:* *- What is the target market?* *- Which are the customer segments?*
Market: Early Adopters	*Early adopters are the "customers" you are willing to address first. They are usually the ones that feel the problem harder than all the others. (they are not the project partners).*
Market: Competitors	*Who are your "competitors" (note: they are the ones offering "alternative solutions")?* *What are their strengths and weaknesses compared to you?*
Go to Market: Use model	*Explain what is your "use model", how the KER will be put in use (made available to "customers" to generate an impact). Examples of use models: manufacturing of a new product, provision of a service, direct industrial use, technology transfer, license agreement, contract research, publications, standards, etc. Note training is a service.*
Go to Market: Timing	*What is the time to market?*
Go to Market: IPR Background	*What is the Background (type/ partner)?*
Go to Market: IPR Foreground	*What is the Foreground (type/ partner)?*

APPENDIX 2 – OSS LICENSES UNDER CONSIDERATION

Description of the licenses under consideration
The European Union Public License (EUPL) is an open-source license tailored to the legal framework of the European Union. It is specifically designed to be compatible with various national laws of EU member states, making it unique among open-source licenses. The EUPL allows the use, modification, and redistribution of licensed software, both within the EU and internationally, under the same terms as the license itself. A key feature of the EUPL is its compatibility with other popular open-source licenses, such as the GPL, allowing for the integration of EUPL-licensed software with projects under different licenses. This compatibility is facilitated through a list of compatible licenses explicitly mentioned in the license text, aiming to foster greater interoperability, and sharing within the open-source community.
The MIT License is one of the most popular and permissive open-source licenses. It allows users nearly unrestricted freedom to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software, provided that the original license and copyright notice are included with any substantial distribution of the software. Its permissiveness encourages widespread use and incorporation into both open and proprietary projects.
The GPL is a copyleft license that requires any modified versions of GPL-licensed software, or any software that incorporates GPL-licensed components, to be also licensed as GPL. This ensures that the software and any derivatives remain free for all users. The GPL aims to guarantee the freedom to share and change all versions of a program—to ensure it remains free software for all its users.
The Mozilla Public Licence (2.0) MPL is a free and open-source license that seeks a balance between permissive and copyleft licenses. It requires that modifications to licensed files be made available under the MPL but allows the combination of the MPL-licensed code with proprietary code. This makes it more flexible for integration into larger projects.
Other Open-Source Licenses
EUPL, MIT, GPL and MLP are the privileged licenses considered under the AI4REALNET project. Nevertheless, other licenses can be further contemplated: ▪ **Apache License 2.0:** The Apache License 2.0 is a permissive license like the MIT License but includes an explicit grant of patent rights from contributors to users. It allows for the use, reproduction, modification, distribution, and sublicensing of the software. When modifications are made and distributed, it requires a changelog to be included, making it clear how the software has been altered. ▪ **BSD Licenses (2-clause and 3-clause):** The BSD licenses are a family of permissive free software licenses. The 2-clause license, also known as "Simplified" or "FreeBSD" license, and the 3-clause license, known as "New" or "Revised" BSD license, both allow for almost unrestricted freedom similar to the MIT License. The main difference between them is the 3-clause license includes a non-endorsement clause that prohibits the use of the name of the project or its contributors for promotional purposes without permission. ▪ **GNU Lesser General Public License (LGP**L): The LGPL is a more permissive variant of the GPL designed mainly for software libraries. It allows non-(L)GPL licensed software to use LGPL licensed libraries without the whole software becoming subject to the GPL's terms. This encourages the use of free libraries in proprietary software, enhancing their adoption. ▪ **GNU Affero General Public License (AGPL):** The AGPL is similar to the GPL but includes provisions for software used over a network. It requires operators of networked services to provide source code to the users of those services, closing a loophole in the GPL that did not require such sharing for software used over a network. ▪ **Eclipse Public License (EPL):** The EPL is an open-source license used by the Eclipse Foundation for its projects. It allows the software to be used, modified, and distributed freely, provided that the original code and any modifications are made available under the EPL. The EPL is designed to be

	commercially friendly, allowing the code to be incorporated into proprietary products under certain conditions.
Licensing Conditions	
Commercial use: Usage of the licensed material and its derivatives for commercial purposes is permitted;	
Distribution: The licensed material is allowed to be shared;	
Modification: Alterations to the licensed material are permitted;	
Patent use: Patent rights from the contributors are expressly granted through this license, which also clarifies that it does NOT extend any patent rights owned by contributors	
Private use: The licensed material can be utilized and altered for personal use.	
Disclose source: When distributing the licensed material, its source code must be provided.	
License and copyright notice: The distribution of the licensed material must include a copy of the license and the copyright notice.	
Network use is distribution: The right to obtain the source code is granted to users interacting with the licensed material over a network.	
Same license: When distributing the licensed material or its modifications, the same license must be applied. In certain instances, a license that is similar or related may be acceptable.	
State changes: Documentation of modifications made to the licensed material is required	
Liability: A limitation of liability clause is included in this license	
Trademark use: The license explicitly specifies that it does NOT convey any trademark rights, addressing the common misconception that licenses without such a declaration might implicitly grant trademark rights	
Warranty: This license makes it clear that it does not offer any form of warranty.	

APPENDIX 3 – LIST OF TECHNOLOGICAL CONTRIBUTIONS

Technological contributions, target TRL and AI4REALNET partner
TE1 (TRL5) |Maze –RL (ENLITEAI)
TE2 (TRL4) | Human in the loop utilities (ENLITEAI)
TE3 (TRL4) |Joint continual human-ML from preferences (ZHAW)
TE4 (TRL5) | Grid2Op digital environment – electricity network (RTE, IRTSX, TENNET, FHG)
TE5 (TRL5) |Flatland digital environment – railway (SBB, DB)
TE6 (TRL5) | BlueSky digital environment – ATM (TUD)
TE7 (TRL4) | Inverse RL (POLIMI)
TE8 (TRL4) |Knowledge Assisted AI tools (UvA)
TE9 (TRL4) |Multi-criteria methodology for risk-aware management of electricity networks (INESC TEC)
TE10 (TRL4) | RL variants applied to the energy sector (UKASSEL, FHG)
TE11(TRL4)|Hierarchical and distributed RL (POLIMI)

APPENDIX 4 – TEMPLATE TO COLLECT PARTNERS INDIVIDUAL EXPLOITATION PLAN

PARTNERS' EXPLOITATION PLAN
CONTEXT
PARTNER DESCRIPTION Provide a brief description of your institution, its vision and mission. Add some background information and your core competencies. ECOSYSTEM What is your ecosystem and how do you connect to other relevant stakeholders in your region and beyond? Additionally, list some existing networks. FOCUS AREA What are your focus areas? Further, if possible, how do they align with the project's mission and activities?
EXPLOITATION STRATEGY
EXPLOITATION GOALS Describe your institution's exploitation goals. PLANNED EXPLOITATION ACTIVITIES Describe the concrete actions and steps to achieve their exploitation goals.

APPENDIX 5 – STRUCTURE OF THE SURVEY FOR STAKEHOLDERS' IDENTIFICATION AND CARACTERIZATION

Stakeholders Survey
The survey has a total of 7 questions. The first 4 questions identify the Stakeholder organisation and the person of contact:
1. Stakeholders' organisation name. **2.** Stakeholders' organisation country. **3.** Name of the person of contact from that organisation. **4.** Person of contact email address.
Then, the survey asked about the Field of Activity of that Stakeholder. This question is a multiple-choice question, and the guideline set was to choose only one option. In exceptional circumstances, a maximum of two choices could be selected
5. Field of Activity ☐ Energy ☐ Railway ☐ Air Traffic Management ☐ Artificial Intelligence ☐ Other
The stakeholders' identification acquires an added value once we classify them properly. In this process, we reviewed the literature to identify the various types of stakeholders, either core, direct or indirect, for the five areas identified above.
6. Stakeholder Classification: Table below lists the different categories for each field of activity.

Field of Activity	**Stakeholder Classification**
Energy Sector	☐ Communities ☐ Consulting companies ☐ Consumers ☐ Distribution system operators (DSOs) ☐ Energy Producers ☐ Energy Suppliers and Retailers ☐ Equipment Manufacturers ☐ Regulators and Policy Makers ☐ Sector associations and societies ☐ Technology Providers ☐ Transmission system operators (TSOs) ☐ Other (open question)

Railway sector	☐ Communities ☐ Consulting companies ☐ Emergency Services and First Responders ☐ Equipment Manufactures ☐ Freight and Logistics Companies ☐ Infrastructure Management ☐ Passengers ☐ Railway Infrastructure Suppliers ☐ Railway Maintenance and Service Providers ☐ Railway Operators ☐ Railway Safety and Security Agencies ☐ Regulators and Policy Makers ☐ Sector associations and societies ☐ Technology Providers ☐ Train Operators ☐ Other (open question)
ATM sector	☐ Aerospace and Technology Providers ☐ Air Navigation Service Providers ☐ Air Traffic Controllers ☐ Aircraft Manufacturers ☐ Airlines ☐ Airport Operators ☐ Civil Aviation Authorities ☐ Communities ☐ Consulting companies ☐ International Organizations (Air Traffic Management) ☐ Passengers and Shippers ☐ Pilots ☐ Regulators and Policy Makers ☐ Sector associations and societies ☐ Technology Providers ☐ Unmanned Aircraft Systems (UAS) Operator ☐ Other (open question)
Artificial intelligence	☐ Communities ☐ Consulting companies ☐ Consumers and End-Users ☐ Developers ☐ Ethics & Standards Organizations ☐ Hardware Manufacturer ☐ Regulators and Policy Makers ☐ Researchers ☐ Sector associations and societies ☐ Security and Cybersecurity Experts ☐ Service Providers ☐ Software Providers ☐ Tech Companies and AI Startups ☐ Testing and Quality Assurance Companies ☐ Users and Adopters ☐ Other (open question)

Other group of stakeholders	☐ Digital Innovation HUBs ☐ Financial Institutions ☐ Governments and municipalities ☐ Non-Governmental Organisations ☐ Technology and Science Parks ☐ University and research centres ☐ Other (open question)

The last question is a matrix to supports the project management categorise and manage stakeholders and their interaction. The Power Interest Grid, also known as the Power Interest Matrix, is a method of stakeholder management that analyses the power and influence of the stakeholders in a project (Bryson, 2004; Mitchell et al., 2021). Once the stakeholders are identified, they are plotted on the grid based on two key parameters: their power and their interest. Power refers to the ability of the stakeholder to influence the project, while interest refers to the level of concern the stakeholder has in the project.

It is a dynamic tool that that proves to be useful in segregating and prioritising the identified stakeholders and developing targeted strategies for managing each stakeholder.

7. Power-Interest grid	**Low**	**Medium**	**High**
Power: how strong is the stakeholders' capacity to block or boost the project?			
Interest: how interested is the stakeholder in what we are doing?			

APPENDIX 6 – RELATED INITIATIVES

AI4Europe| Ai-on-demand **https://aiod.eu/**	
Description The AI-on-Demand platform (AIoD) is a community-driven channel designed to empower European research and innovation in Artificial Intelligence (AI), while ensuring the European seal of quality, trustworthiness and explainability.	**Opportunity for collaboration:** ▪ Provide use-cases and AI assets (e.g., open-source software, digital environments) to AI-on-demand platform catalogue to demonstrate unique capabilities of AI developments that drives futures business planning and compile lessons learnings. ▪ Organization of ecosystem engagement events to share knowledge, discuss relevant topics, and to foster synergies between the different initiatives. Those events can be uses to gather information from exploitation overview. ▪ Providing use-cases and AI assets (e.g., open-source software, digital environments) for strengthening AI-on-demand platform catalogue and sustain the AI4REALNET concept/software beyond the lifetime (> M42)
Adra-e https://adra-e.eu/ or a sustainable European ecosystem	
Description Adra-e project supports the AI, Data and Robotics Association and Partnership to create the conditions for a sustainable European ecosystem.	**Opportunity for collaboration** ▪ Sharing Events: Spread the word and provide access to various events. ▪ Publishing Open Resources: Share valuable assets, educational materials, and resources openly. ▪ Showcasing Success Stories: Highlighting successful cases and practical examples through exhibitions.
EurAI - European Association for Artificial Intelligence **https://www.eurai.org/**	
"An international association with scientific and educational objectives called European Coordinating Committee for Artificial Intelligence (ECCAI) is hereby established.". In a General Assembly celebrated in 2015 the name was changed to the "EUROPEAN ASSOCIATION FOR AI (EurAI)".	▪ Proposing Advanced Courses: Submit proposals for advanced training programs. ▪ Accessing Future Funding: Apply for funding opportunities for ongoing research and development projects. ▪ Sharing Scientific Research: Publish research findings and apply for awards. ▪ Joining the Community: Become an active member of the community.
EDIH (European Digital Innovation Hubs) **https://digital-strategy.ec.europa.eu/en/activities/edihs**	
Description "European Digital Innovation Hubs (EDIHs) are one-stop shops supporting companies and	**Opportunity for collaboration:** ▪ Access to technical expertise and testing, as well as the possibility to 'test before invest'

public sector organisations to respond to digital challenges and become more competitive. EDIHs support companies to improve business/production processes, products, or services using digital technologies."	▪ Providing innovation services, such as financing advice, training, and skills development are central to successful AI adoption.
Horizon Results Booster **https://www.horizonresultsbooster.eu/**	

Description
Horizon Results Booster (HRB) is an initiative of the European Commission which aims to bring a continual stream of innovation to the market and maximise the impact of public funded research within the EU.
 	
It supports projects eager to go beyond their Dissemination and Exploitation (D&E) obligations - steering research towards strong societal impact and concretising the value of Research and Innovation (R&I) activity for societal challenges.
 	
To achieve this, HRB offers free consulting services to closed or ongoing research projects funded by FP7, Horizon 2020, or Horizon Europe programmes.
	Opportunity for collaboration:
	▪ Portfolio Dissemination & Exploitation Strategy
	  ▪ Publishing key project results
	  ▪ Creating the portfolio of results; design and execute a portfolio dissemination plan (module B)
	  ▪ Improving AI4REALNET existing exploitation strategy (module C)
	▪ Access support services to improve business model.
	▪ Access to Assistance, coaching and mentoring for go-to-market activities development.

Following the exploitation routes identified in Chapter 2.3, some exploitation routes should be explored by collaborate within these initiatives.

Exploitation Routes	Purpose	Initiatives, Networks, and Associations
Providing AI assets (open-source software from WPs 1-4).	Enhancing the AI-on-demand platform catalogue Sustainability beyond project's lifetime	AI4Europe
Share challenges and use cases. Contribute to improving the synergies between HE funded projects in AI	Accelerating development: Stimulate innovation within the AI landscape. Facilitating investment: As a bridge for potential investors and stakeholders Driving market uptake: Guide and influence the direction of AI-based decision systems	Adra-e (CSA) AI, Data and Robotics Association (Adra) ELLIS CLAIRE
Establish meaningful interaction and knowledge exchange with AI start-ups, SMEs, and Digital Innovation Hubs.	Create a mutually beneficial environment and drive innovation within the AI landscape. Knowledge Exchange: Leveraging the expertise and experience within AI DIHs	EDIH - European Digital Innovation Hubs EEN - Enterprise Europe Network