TNO Vector

The AI Data Robotics Association

Towards supporting innovation, competitiveness, and digital sovereignty by mapping the European AI-Data-Robotics ecosystem

White paper for the Adra Joint Topic Group on Ecosystem Mapping & Information Repository (EMIR)

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Summary

Globally, the EU lags in critical technologies, and the AI, data, and robotics (ADR) supply chain is among the ones most at risk of becoming less innovative, competitive, and more dependent on other nations. The current European approach is to create an 'ecosystem of excellence', in which excellent research, innovation and uptake strengthen the competitiveness and technological sovereignty. Moreover, the EU has set an ambitious 'moonshot' mission to establish itself as a global leader in trustworthy AI by 2030.

However, the diversity of research, development & innovation (RD&I) approaches and initiatives within the EU at regional, national, and international levels make it highly complex and dynamic. There are many initiatives at different societal levels and across different sectors. To work towards industrial competitiveness and digital sovereignty, the EU's ecosystem of excellence needs to overcome the fragmentation, limited investment and public funding, and uneven playing field. To successfully implement this mission, an ecosystem mapping initiative can provide a crucial foundation for alignment, strategic decision-making, resource allocation, and collaborative efforts. Effective and user-centric implementation of an ecosystem mapping can give the European ADR ecosystem a leading edge.

Gaining insight into the complexity and dynamics of this enormous ecosystem of excellence is a necessary step towards taking informed actions by stakeholders, including policy makers. An ecosystem mapping helps overcome this complexity, and if organized as a platform-based mapping, connected to other community services, it can provide sustainable alternative to manual expert-driven analyses. A combined effort to develop a platform-based ecosystem mapping is necessary to systematically provide decision-making information services that maximize the effectiveness of the European ADR ecosystem.

Vision

We strongly believe a mapping is a key element to overcome fragmentation of the European ADR ecosystem. As a European community platform, it is *for* the European ADR community, empowering a responsible ADR-powered society, compatible with European values and regulations, *by* the European ADR community, and *of* the European ADR community. The ecosystem mapping provides a shared language of the community, community building and engagement, coordinated information provisioning, focused channel towards policymakers.

The ADR ecosystem mapping provides reliable information services for the European ADR community, enabling navigation, publishing, monitoring, benchmarking, and matchmaking. It is continuously improved based on community needs. Stakeholders manage and maintain the mapping inclusively and sustainably, with community-supported research and technology topics, metrics, data sources, and criteria. As a key component of the European ADR community, the mapping serves as a testbed for state-of-the-art techniques in automation, learning, data collection, analysis, and visualization. This open-source project benefits from the expertise of dedicated developers and volunteers, ensuring ongoing enhancements and innovations in the ADR field.

To fulfil the vision for this mapping of the ADR ecosystem, involvement, and active participation underpinned by effective coordination is needed.

Community value
ADR ecosystem mapping offers significant value through shared language, community building, information coordination, and visibility channels. Its success depends on attracting data providers and users with valuable services. The user-centric mapping caters to diverse stakeholders, providing partnership clarity for companies and strategic input for policymakers. Data providers gain visibility while coordinators enhance reputation. Distribution channels are crucial for information dissemination. Ensuring continuity requires an operational strategy focused on user-centricity, broader activity integration, and continuous engagement. This collective effort from the ADR community increases the benefits to innovation and growth. By implementing these strategies, the mapping becomes an essential tool for advancing the ADR ecosystem's potential.

Joined coordination
To realize an effective ADR ecosystem mapping, stakeholder participation and coordination are crucial. This approach integrates the mapping within the broader innovation ecosystem. Engaging diverse stakeholders, promoting open participation, and tailoring information to user needs are initial steps. Collaborative mapping yields coherent results, with network effects driving expansion. Coordination provides momentum, increases efficiency, and avoids duplication. An up-to-date, intuitive platform infrastructure with an integrated business model is necessary to guide stakeholders. Key elements include data accuracy, autonomy, and editable organizational data. Data space elements can provide secure, standardized commercial data transactions, enhancing the mapping's utility and reliability.

Embedding in a community platform
Ecosystem mapping is not merely a standalone tool but a crucial enabler for broader ADR ecosystem development. To maximize its long-term impact, it must be integrated into wider ADR activities, providing valuable insights and potential additional services. Rather than viewing it in isolation, the mapping should be seen as a foundational step enabling community access to people, services, and assets. This integration requires a coordinated effort beyond the mapping itself and a long-term perspective to ensure stability and direction. Given the existence of multiple valuable mapping initiatives, it is essential to carefully consider the positioning and purpose of the ADR ecosystem mapping. Ultimately, connecting this mapping to broader EU ADR initiatives is crucial for optimizing its effectiveness and fostering a more cohesive and dynamic ADR ecosystem across Europe.

The ADR Ecosystem consisting of multiple layers and multiple functions
The ADR innovation ecosystem operates across three distinct layers: European, national, and regional, each with specific priorities. The European layer coordinates and aligns activities, the national level ensures a competitive innovation base aligned with Member State interests, and regional actors support place-based capacities. Key organizations operate within and across these layers, with some entities, like RTOs, having multi-layer focuses. Despite the need for connections across layers, coordination remains challenging. This misalignment significantly impacts the efficiency of the 'single market', and improved integration and collaboration is needed across the ecosystem's layers to enhance innovation outcomes and competitiveness in the ADR sector.

As the ADR ecosystem is complex and large, it can be understood better through 'system functions' rather than individual actors. By focusing on functions, we gain a clearer overview of ecosystem dynamics, identifying areas needing strengthening or where overlaps occur.

Essential functions range from coordination and alignment to contributing to the RD&I foundation through research, infrastructure setup, and framework conditions. As involving multiple actors across different layers, suggests that explicitly mapping organizations' primary functions could provide a clearer overview of mandates.

Approach

We introduce an approach for ecosystem mapping. First, an ecosystem mapping must provide a current and clear topics structure, a relevant and measurable definition of metrics. Next, data is collected from reliable sources, and visualized in a useful and insightful way for its users. This is supported by deployment of infrastructure, features, and services to facilitate access to innovation resources. Funding is critical for sustainability, with a diversified financial model recommended. Governance is another essential part of the approach, as it supports efficient organization, data quality, trust, and collaboration. A user-centric approach, automated processes, and stakeholder involvement in co-design and feedback loops ensure continuous improvement. Coordination with regional, national, and international innovation networks strengthens the platform's role within the ecosystem. This mapping framework will support connections, insights, and better alignment in the ADR ecosystem.

Roadmap

So far, several major steps have been taken towards the envisioned ecosystem mapping. First, a prototype has been developed in the VISION project and integrated with the AI-on-Demand Platform. This provides an excellent foundation for further development. Second, the Joint Topic Group of Adra named ‘Ecosystem Mapping and Information Repository’ (EMIR) has been established by TNO, University of Twente and University College Cork, to achieve an aligned view on the ecosystem mapping. EMIR is inspired by the VISION project, Adra-e and AI-on-Demand platform while noting that similar efforts in the larger ADR domain have been undertaken by RODIN, DIHNET.EU, DIH4AI, etc.

In the short term (0-6 months), a governance model is established that can lead the development of a minimum viable product (MVP) of the Adra JTG EMIR. In the medium term (6-18 months), further validation of the business model and funding sources is required, while the MVP is further developed. This also asks for a establishing a clear business case for the mapping to address the value and sustainability of the approach. The long-term (18-36 months) is focused on operation, maintenance, and continuous development of the ecosystem mapping.

Conclusion

To address the challenges to European technological competitiveness, a coordinated mapping of the Artificial Intelligence, Data, and Robotics (ADR) ecosystem in Europe is needed. As these technologies play a vital role in economic growth and addressing societal challenges, a fragmented approach.

Despite previous efforts, there remains a lack of clarity regarding the various actors, topics, and services within the ADR landscape. We propose a vision and roadmap for creating a European ecosystem mapping that is inclusive and aligned with European values, aiming to empower the ADR community while fostering collaboration among stakeholders, through community platforms.

To ensure effective mapping, several elements should be considered, such as delivering added value, connecting to existing activities, and adopting a comprehensive approach. This includes a focus on data collection, user-centric insights, and long-term sustainability. An implementation plan is suggested to guide future actions and encourage stakeholder participation in the mapping initiative. Ultimately, the conversation on a unified mapping of the ADR ecosystem in Europe needs to be started, aiming for greater impact through collective efforts.

Contents

1 Introduction

1.1 European prosperity enabled by the AI-Data-Robotics ecosystem

The European Union is lagging globally in many critical technologies and the gap is widening. In particular, the AI, Data and Robotics (ADR) supply chains are most at risk[1]. The danger is that the EU becomes less innovative, less competitive, and more dependent on other nations – especially in the key enabling technologies of ADR. The EU is already leading in several industries with a 26% market share in robotics in 2021, a leading position in the trustworthy AI movement, and a strong data value ecosystem supported by data spaces[2]). But the European innovation gap requires more collaboration to leverage on regional strengths and combined power[3]. With €6.7 billion of overall private investment in AI in 2023, EU businesses invest less than one tenth of the US, and this spending gap is widening[4]. Moreover, ADR are considered key enabling technologies for tackling societal challenges in area such as healthcare, sustainability, agriculture, and mobility. Hence, to bring the collecting EU innovation power together, a coordinated approach is needed.

The European response to this problem requires additional effort. The response is characterized by multi-sectoral and multi-level initiatives and with different degrees of federation. First, there are different views on which pathway the EU should follow to catch up, let alone, become a global leader. Second, while the amount of investment is often emphasized, merely matching the level of private (or public) investment will not solve this problem, especially in a fragmented capital market. However, most private investment in ADR comes from a handful of powerful US companies, but in Europe, this is not a desired future, as is demonstrated by the European legislation to create a fair digital market and the pursue of digital strategy sovereignty.

European ambitions to become a globally leading digital economy have guided efforts to create a European ecosystem of excellence along the ADR value chain[5]. Meanwhile, mission-driven approaches and large-scale initiatives on ADR are being explored[6], with calls for bolder ambitions, quick actions, and further investments. This is confirmed by the Draghi report, published in September 2024, which pushes for large investment in Europe competitiveness, including ADR.

To increase international competitiveness and promote economic security, the EU needs to overcome a fragmented market, limited investment and public funding and an uneven playing field for business. Through deliberate interventions, the functioning of the European

[1] DIGITALEUROPE (2024). The EU's Critical Tech Gap: Rethinking economic security to put Europe back on the map.

[2] Fredrik Heintz, Nabil Belbachir, and Edward Curry, "Strategic Orientations Towards an AI, Data, Robotics Roadmap 2025-2027", May 2023, Brussels - Adra

[3] See Mario Draghi report for EC (2024), 'The future of European competitiveness Part A | A competitiveness strategy for Europe'

[4] Stanford University Human-Centered Artificial Intelligence (2024). Artificial Intelligence Index Report 2024.

[5] European Commission (2020). White paper on Artificial Intelligence – A European approach to excellence and trust.

[6] Renda, A. (2024). Towards a European Large-scale Initiative on Artificial Intelligence. CEPS.

innovation ecosystem can be improved and directed towards the twin transitions of sustainability and digitalization. More concretely, it is expected that by 2030, Europe has full sovereignty over its development and deployment of trustworthy, safe, and robust Artificial Intelligence (AI), Data and Robotics, compatible with EU values and regulations[7].

1.2 The challenge of understanding and achieving cohesion in the ADR ecosystem

To achieve European leadership in AI, Data and Robotics (ADR) we must ensure that research, development, innovation, and uptake take place in a strong, cohesive, and effective ecosystem. The ADR ecosystem of Europe is rich and fast developing, but to achieve the biggest impact, we need alignment and cooperation to support excellence, adoption, entrepreneurial activity, and societal adoption. This need is widely acknowledged, considering the variety of initiatives to promote research and innovation.

The European 'Ecosystem of Excellence' (fig. 1.1) refers to large set of initiatives from the European Commission, Member States, sectors, regions, research networks or industrial networks, which differ in goal, technological focus, and scale. Across Europe, many different initiatives are active. Public-private partnerships have been established to structure the ecosystem aiming at committing public and private resources to joint R&I programs, such as the BDVA, ADRA, euRobotics and EuroHPC Joint Undertaking. Regionally, Digital Innovation Hubs (DIH) and European Digital Innovation Hubs (EDIHs) emerged, aimed at supporting Small and Medium Enterprises (SMEs) in the uptake of digital technology. A related service is provided by Testing and Experimentation Facilities (TEFs), but these focus on testing. The efforts of research networks such as CAIRNE or ELLIS aim to promote excellent research. Many EU projects, funded under Horizon 2020 and Horizon Europe, also contribute by bringing together researchers around specific topics, through Networks of Excellence (NoE) or AI lighthouses. And many other initiatives are involved: AI-on-demand platform, Digital Transformation Accelerator, European Digital Infrastructure Consortia (EDIC), Gaia-X, European Investment Fund, JRC AI Watch, EIT, DSBA, CEN/CENELEC, etc. We are just scratching the surface. In October 2024, the call for another 'animal in the zoo' has been launched, AI factories. Each of these actors, initiatives and programmes has an important role and the challenge is to grasp their functions, activities and focus so that stakeholders can find the support they need, while aligning to ensure more efficient operations.

[7] Adra: https://adr-association.eu/about-us

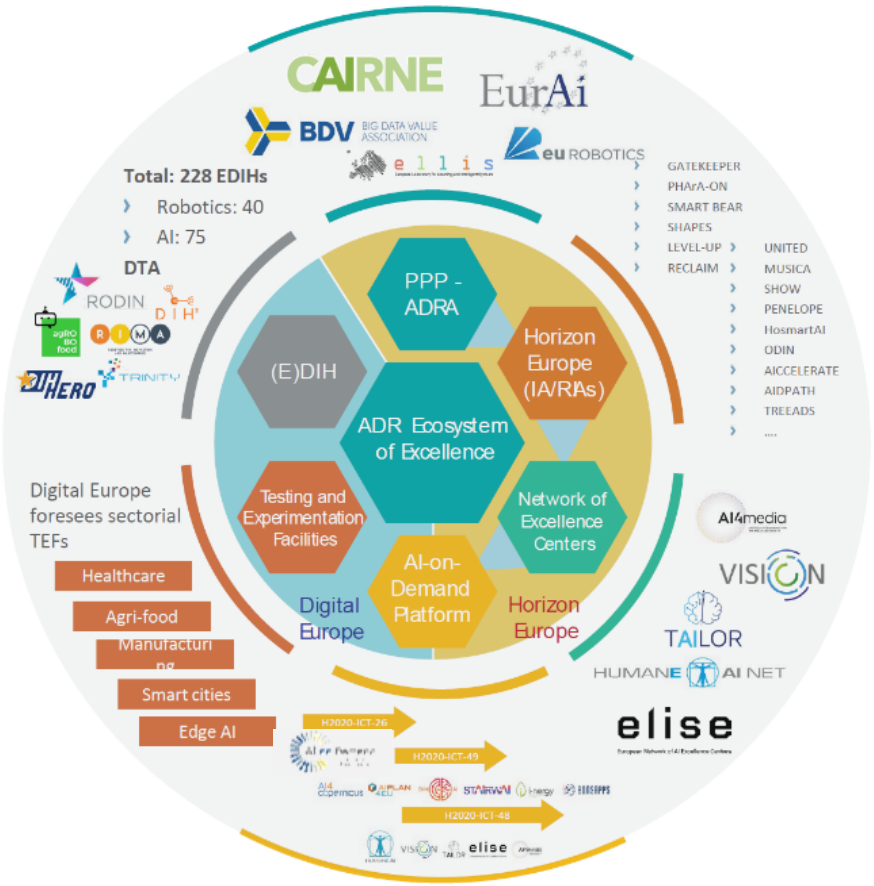

Figure 1.1: An overview of the ADR Ecosystem of Excellence by Adra-e (source: University of Twente)

Since the ADR ecosystem is large, complex, dynamic, and growing, it is prone to fragmentation, concurrency, and redundancy[8]. It requires effort to bring and keep stakeholders together to achieve common European goals of excellence. It requires effort that guides stakeholders to the right services, clarifies the roles and actors in the ecosystem, and enables coordination and alignment. This can be achieved with an overview of the ecosystem and related policy landscape, consisting of several elements:

- **A mapping of actors and their functions** – understanding who the actors in the ecosystem are, what they focus on, and what function they contribute to in order to enable landscape overview with clear roles and specializations as well enable analysis of strengths and weaknesses;
- **Embedding in complementary activities and services** – connecting the ecosystem mapping to additional services and translating this to useful information to increase the value;
- **Ecosystem integration/coordination** – understanding how the EU, national and regional ecosystems connect to enhance the coordination, collaboration and supporting strategic (policy) decision-making based on clear evidence;

[8] see DIH4AI (2023), "D8.10 DIH4AI Pan-Eu and International cooperation program", where an evaluation of the AI ecosystem has concluded that "*An efficient and effective coordinating and aligning actions across the system is challenging. The involvement of numerous coordinating actors alongside limited cross-layer connections are faced with barriers, affecting the efficient functioning of collaborative efforts within the EU innovation system.*"

- **Longer-term and user focus** – Success and sustainability hinges on delivering valuable, up-to-date information relevant for the user as well as confidence in the longer-term use and existence of the mapping to prevent over collaboration with data providers and stakeholders, continuous updates, and diversified funding strategies (e.g., public and private funding);
- **A joint effort** to enable scale and scope as well as longer-term relevance.

1.3 The European AI moonshot requires understanding priorities and gaps

While the number of calls for major investment is multiplying – the Draghi report currently the most recent one – the fragmentation of the investment makes the setting of priorities a challenge from a governance standpoint. The European Union's ambitious 'moonshot' mission to establish itself as a global leader in trustworthy artificial intelligence by 2030 necessitates a clear and comprehensive understanding of the existing AI ecosystem across the continent. An ecosystem mapping initiative is crucial for the successful implementation of this mission, as it provides a foundation for strategic decision-making, resource allocation, and collaborative efforts.

Identifying existing capabilities, and by contrast the gaps, is the top driver of a thorough ecosystem mapping exercise. This process reveals areas of strength and expertise, as well as gaps that need to be addressed to achieve the moonshot's objectives. By cataloging the capabilities of various organizations, including universities, research institutions, and private enterprises, policymakers and stakeholders can make informed decisions on where to focus investments and efforts.

By design, the AI moonshot mission requires for a pan-European effort, pooling talent, and resources to overcome technological dependencies on non-European entities. Cooperation is key. The ecosystem map will serve as a valuable tool, fostering collaboration among different stakeholders. It enables researchers, innovators, and industry players to identify potential partners with complementary expertise, thereby accelerating knowledge transfer and innovation.

Meanwhile, the European approach to AI also emphasizes trustworthiness, ethical considerations, and alignment with European values. An ecosystem mapping initiative will need to ensure that these principles are embedded across the AI landscape. By providing visibility into the focus areas of various organizations, it becomes possible to identify and promote research and innovation activities that align with the EU's vision for human-centric AI.

Finally, the decision-makers are an essential part of this ecosystem. Their proposed €100 billion investment over six years for the AI moonshot requires strategic allocation of resources. The mapping provides policymakers and funding bodies with a clear overview of the AI landscape, enabling them to make data-driven evidence-based decisions on resource distribution. With this support, they can monitor progress, maximize the impact of investments, and avoid duplication of efforts. As the AI landscape evolves rapidly, continuous ecosystem mapping will enable stakeholders to adapt strategies and reallocate resources while also addressing emerging challenges.

The implementation of a comprehensive ecosystem mapping initiative is a critical component of the European AI moonshot mission. It provides the necessary insights to guide strategic

decisions, foster collaboration, ensure alignment with European values, and optimize resource allocation. By leveraging the data gathered through ecosystem mapping, the EU can enhance its ability to achieve its ambitious goal of becoming a global leader in trustworthy AI by 2030, while simultaneously addressing societal challenges and promoting European competitiveness in the global ADR landscape.

1.4 Alignment and coordination through mapping

A mapping approach that tackles the complexity, dynamics and growth of the ecosystem can help give stakeholders in the ecosystem oversight and insights to take well-informed action. This has translated into a need to develop a central, continuously updated mapping of actors and indicatives that can support additional services such as matchmaking, benchmarking, and policy insights on strengths, overlaps and opportunities for alignment. To be more effective, the different layers of activities – on regional, national, and European level – must be connected and structured to ensure that information and connections flow through all layers. Furthermore, since different actors perform different functions in the ecosystem, knowing who is active on which topics and how that has been evolving provides clarity. Stocktaking can support making connections between actors. Finally, a mapping contributes to a longer-term perspective, continuing the existing initiatives and growing them.

While mapping approaches are often based on manual analysis work, a platform-based information repository can offer a self-sustaining alternative. Mapping approaches are often based on expert assessments, macro-indicators, manual labor. However, expert studies are time consuming and difficult to repeat regularly, subject to biases and information is quickly outdated. Macro-indicators (statistics) do not capture innovation trends and technologies well. This leads to challenges in regard to usefulness, effectiveness and shelf-life of mappings, as it compromises the possibility to extract real-time insights and ‘intelligence’ (e.g. for policymaking or partner search) and diminishing the value of the mapping over time. Platforms for data exchange can offer an alternative as proven by their increasingly important role in business-to-business services, and European industrial B2B platforms are often associated with European RD&I projects[6]. Inspired by the platform idea, additional external services can be connected to the mapping, offering a mutual benefit (e.g. policy insights and benchmarking need data from the matchmaking and at the same time can attract stakeholders to include their data). Depending on the purpose, the mapping can also be tailored to better serve these additional services – e.g. depicting connections, research outputs, or activities of the mapped stakeholders.

To ensure higher impact in achieving an ecosystem of excellence, Europe needs a way to systematically provide better understanding and connections in the ADR ecosystem. A combined effort to develop a platform-based ecosystem mapping is the best way to provide information services that maximize the effectiveness of the European ADR ecosystem. Joining efforts is a prerequisite, because for a platform that sustains itself, a critical mass of users and data providers is required.

The goal of this white paper is to outline a joint approach to ecosystem mapping and is mainly aimed at policy makers and ADR community leaders. In this white paper, we further elaborate the strategy to establish the ecosystem mapping and what it entails in section 2; In section 3 we suggest how to proceed in the future in terms of governance and stakeholders, and which steps have already been taken. Finally, in section 4, our conclusions are drawn.

2 Envisioning a Mapping for the ADR Ecosystem

We strongly believe a mapping is a key element to overcome fragmentation of the European ADR ecosystem. As a European community platform, it is *for* the European ADR community, empowering a responsible ADR-powered society, compatible with European values and regulations, *by* the European ADR community, and *of* the European ADR community.

For people in the ADR community, the mapping provides reliable and insightful information services. It is frequently being used by people in the European ADR community to navigate the ecosystem, publish, monitor, benchmark, find matches. Needs from the community are elicited and specified into requirements for the continuous improvement of the mapping.

Furthermore, the ecosystem mapping is managed and maintained by stakeholders in the ADR community, in an inclusive and sustainable way. The research and technology topics, metrics, data sources, inclusion and exclusion criteria are therefore supported by the community, either directly or through representatives.

Finally, as a key component in the European ADR community, the mapping also benefits from the expertise of this community. The mapping is a testbed for state-of-the-art techniques for automation, learning, data collection, data analysis, and data visualization. As an open-source project, the mapping is continuously improved by dedicated developers and interested volunteers from the ADR community.

The remainder of this section further elaborates on the key components of the approach: how it provides value to the community (2.1), the role of joined coordination (2.2), embedding in a larger platform (2.3), the distinction between innovation system layers and functions (2.4), and the proposed ecosystem mapping approach (2.5).

2.1 Community value

Given the already developed breadth and some existing connections in the ADR ecosystem, a map can further contribute by offering the following to policymakers, universities (incl. universities of applied science), research and technology organizations, SMEs, large corporations, and intermediaries:

- A **shared language** of the community: a categorization of ADR research and technology topics and application areas that are developed and maintained *by* the ADR community *for* the ADR community and reflect European values;
- **Community building and engagement**: mapping of the ADR ecosystem can help to align and engage stakeholders, acting as a communication tool. It provides a shared understanding of roles, enabling better coordination and fostering trust within the ecosystem.

- **Coordinated information** provisioning of the ADR research and innovation ecosystem, resulting in efficient data collection and reduction of duplication of work, as well as new abilities to identify intersections between application areas and technological domains;
- A **focused channel** offering visibility in the ecosystem, a forum for discussion as well as representation towards policymakers (collective voice).

Delivering this added value however hinges on the ability to both attract enough data providers and users by offering valuable services. To remain up-to-date, relevant, and used, the ecosystem mapping needs to provide sufficient value along the whole chain – from mapped organizations (data provider), the organization supporting the mapping, as well as those promoting its use (distribution channels).[9]

Secondly, the mapping and any related services need to be user-centric. Users could be vastly different stakeholders – companies, universities, research and innovation organizations, policy makers, etc., etc. – each with different needs and potential benefits of the mapping. Further, in an ecosystem mapping by the ecosystem, the users and the data providers may in times overlap. It is therefore crucial to develop good understanding of the different user-personas and offer tailored representation.

For companies, R&I actors and intermediaries, for instance, the mapping can offer clarity of relationships at the EU level, national and regional levels, providing stakeholders outside the community with a starting point and those more familiar with the ecosystem with opportunities to find unexpected partnerships or access to the 'intelligence' generated from the mapping. For policymakers, on the other hand, the mapping can act as a strategic policy input, informing about strengths and leadership hotspots, gaps, etc. Reciprocally, for the mapped organizations - the data providers - the value often lies in increased visibility and fostering collaborations, access to information and access to valuable services to the community.[10] Further, well organized information provisioning can result in efficient data collection and reduction of duplication of work. For the organization coordinating the mapping, the benefits often lie in a combination of enhanced reputation, networking opportunities and opportunities for leadership. Any mapping is however useless if the ecosystem is unaware of it. Distribution channels connecting the users to the information are therefore key. The benefit for them often lies in the ability to provide additional (awareness) value to their existing network and staying informed.

Lastly, to ensure continuity and viability of the activities, therefore justifying the effort, operational strategy is needed to ensure sustained funding, starting with user-centric approach, embedding operations in broader activities, lean organization, and continuous engagement.[11] This requires a joined effort.

2.2 Joined coordination

To fulfil this vision for a mapping of the ADR ecosystem, involvement, and active participation, underpinned by effective coordination, is needed. Only then can the mapping be effectively embedded within broader innovation ecosystem. The first step to this is to involve as many stakeholders and initiatives as possible, promote open and active participation and adapt and

[9] RODIN D1.4 (2023)
[10] See RODIN D1.4 and DIHNET Academy (2024) primer series on Repository-based community platforms
[11] RODIN D1.4 (2023)

tailor the information presented to the ecosystem (the user!) needs.[12] By conducting a joined mapping, a more coherent and representative (in scale and scope) result can be expected, with the network effect driving expansion and better coverage. Involvement in the whole process may also increase the awareness of and commitment to the mapping.

Coordination is needed to provide a driving force as well as to increase efficiency and prevent duplication of efforts. Effective coordination also enables dynamic updates, ensuring the map evolves with the ecosystem and remains scalable, making it more actionable and relevant for all involved parties. To support the ecosystem mapping, an up-to-date and intuitive platform infrastructure with an integrated business model is needed to guide the stakeholders. Crucial elements for the platform infrastructure are data accuracy and data autonomy. Data about organizations should be editable, while reviews may be needed to ensure data quality. To facilitate this, data space elements are useful to organize and validate commercial data transactions securely, in a standardized manner.

2.3 Embedding in a community platform

Ecosystem mapping is only one of the tools that enables the development of the broader ADR ecosystem. To ensure a longer-term impact and effect of the mapping, it needs to be embedded in the broader ADR ecosystem activities,[13] adding valuable information and insights and possibly additional services. The mapping should not therefore be seen as a stand-alone activity but as a first step enabling of the community to access people, services, assets. This requires a joined and coordinated effort beyond the mapping itself as well as a longer-term perspective to provide stability and direction of the mapping. Further, there are multiple valuable mapping initiatives already, necessitating a closer look in the positioning and purpose of the ADR ecosystem mapping. Connecting the ecosystem mapping to the broader EU ADR initiatives is thus crucial. In this section we further describe existing mapping initiatives (2.3.1), platform services (2.3.2) and how the mapping should be embedded in existing platforms (2.3.3).

2.3.1 European mapping initiatives

While many mapping efforts have been initiated over the past years, alignment is necessary to create a broader overview. Many organizations and projects have performed mapping or cartography activities to understand the ecosystem, but there has not yet been a long-lasting effort at a European scale. Each effort has their own goal, scale, and target group. The JRC AI Watch, focused on policy, provides insights on implementing the coordinated plan on AI of the 27 Member states along 22 indicators. There are also multiple repositories and marketplaces offering information on adoption services and support – e.g. the EDIH Catalogue offers a mapping of over 200 EDIHs supporting AI, data and robotics adoption; multiple service, partner, training catalogues are also developed to support EU networks (e.g. on robotics: DIH2, Agrobofood, Trinity, RIMA; on AI: DIGIWARE and DIH4AI to name a few). Prompted by the need to better understand the research ecosystem and where ‘excellence’ resides and on what topics, the VISION project, in consultation with the European Commission and conducted together with the Networks of Excellence (NoE)[14], conducted a mapping of the EU R&I ecosystem. To connect the prices together, ADRA-e aims to provide a high-level overview, supporting the understanding the complexity at the EU level, analyze links between

[12] RODIN D1.4

[13] M. Butter, et al (2024), ‘Repository-based Community Platforms’, DIHNET Academy Primer Series

[14] The nine Networks of Excellence are: AI4Media, dAIEDGE, ELISE, ELIAS, ELSA, ENFIELD, euROBIN, HumanE-AI-Net, TAILOR

projects, organizations, and companies, while the AI-on-Demand (AIoD) platform offers access to various (research project) assets and AI resources. Examples are abundant. Yet, it is still challenging to find a comprehensive overview of the R&I strengths and how these relate to market. An ADR mapping therefore is justified but needs to be positioned and connected to existing initiatives to leverage each other's information (which would differ, depending on user needs).

2.3.2 Services in addition to ecosystem mapping

To increase the value of the mapping, previous analysis of repositories,[15] indicates that the information function needs to be connected to additional services that increase the value as well as accessibility of the information. Various additional services can be included depending on the purpose of the initiative and customer needs (fig. 2.1).

Given this vision for the ADR ecosystem mapping, an ecosystem analysis function, matchmaking and insights on gaps and strengths should be explored. Additional services use the mapping data and in return contribute to activate the community but also provide value to multiple activities, thus increasing impact. For instance, a matchmaking functionality might use the expertise areas identified in the mapping while also requesting the users to review their profile if suggested matches are not relevant or RD&T road mapping activities might provide useful insights for future expertise areas to be included in the mapping while also gathering insight of current state of the ecosystem.

Figure 2.1: Repository-based community platforms (source: DIHNET Academy primer series 2024)

2.3.3 Embedding the ADR ecosystem mapping

Simply listing actors is of limited use and performed at different level by other organizations, and the mapping must be positioned to add maximum value (fig. 2.2). The key gaps that the ADR mapping fill are to:

- Offer an integration of all three domains (AI, data and Robotics), bridging silos;
- Provide a view on 'excellence' specialization on topics & domains, and supporting capacities to support more effective matchmaking (following experience from BOWI on collaboration assessment);
- Provide an overview of scale and capacity;
- Connect actors efficiently with alignment mechanisms across different layers—regional, national, and EU-wide;
- Provide an ecosystem orchestration view with innovation role for the stakeholders.

[15] RODIN D1.4 (2023)

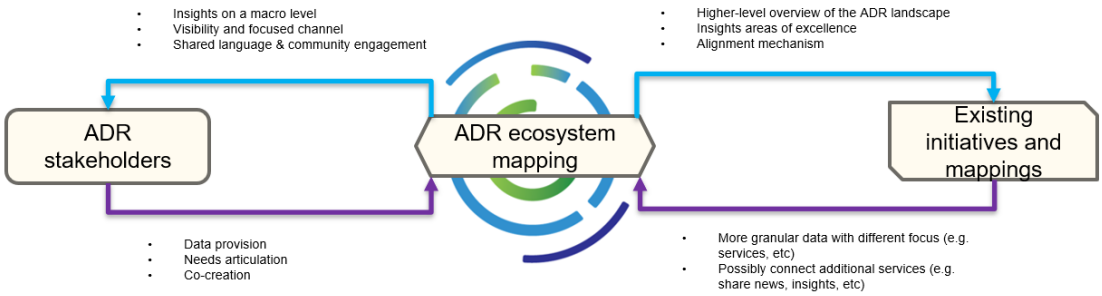

Figure 2.2: Positioning the ADR ecosystem mapping added value towards other initiatives (source: Author's own)

In line with the objectives of creating a coordinated, comprehensive EU-wide map of the AI, data, and robotics ecosystem, partnering with organizations like ADRA and the European on Demand Platform (AIoD) is logical and critical. Both ADRA and AIoD play key roles in shaping ADR strategies and policies in Europe, aim to and could find benefits of the mapping and could provide the organizational backbone needed to support the mapping effort. By forming connections with these key organizations, the mapping initiative would align with broader EU strategic goals and ensure continuous support from both policy and industry perspectives. This would also help maintain momentum in the effort.

2.4 Groupings of the European ADR ecosystem

To better understand what the European ADR ecosystem is, we present two different perspectives on how it can be grouped. First, a distinction between layers based on geographical scope (2.4.1), and second, a distinction of system functions that influence the overall effectiveness of the innovation ecosystem (2.4.2).

2.4.1 Innovation ecosystem layers

Three different layers can be distinguished in the ADR innovation ecosystem: European, national, and regional. Each of them aims to support the innovation activities but has slightly different priorities with respective organizations acting across these layers: e.g. while the aim of European layer is to coordinate and align activities, national level aims to ensure a competitive innovation base, aligned with the interests in the Member State, and the regional actors focus on supporting and leveraging on place-based capacities. Moreover, the exact prioritization and organization at the national and regional level varies between Member States.

Key organizations from the ADR ecosystem operate at each of the layers (see figure 2.3) and some across layers (e.g. RTOs may have a dual regional and national focus and often are leading or participating in framework instruments). Previous research however indicates that while it is imperative to establish cross-layer connections to ensure aligned direction and building on strengths and capacities of others, especially in high capital-intensive innovations

like ADR, this alignment and coordination remains challenging, impacting the efficiency of the 'single market'.[16]

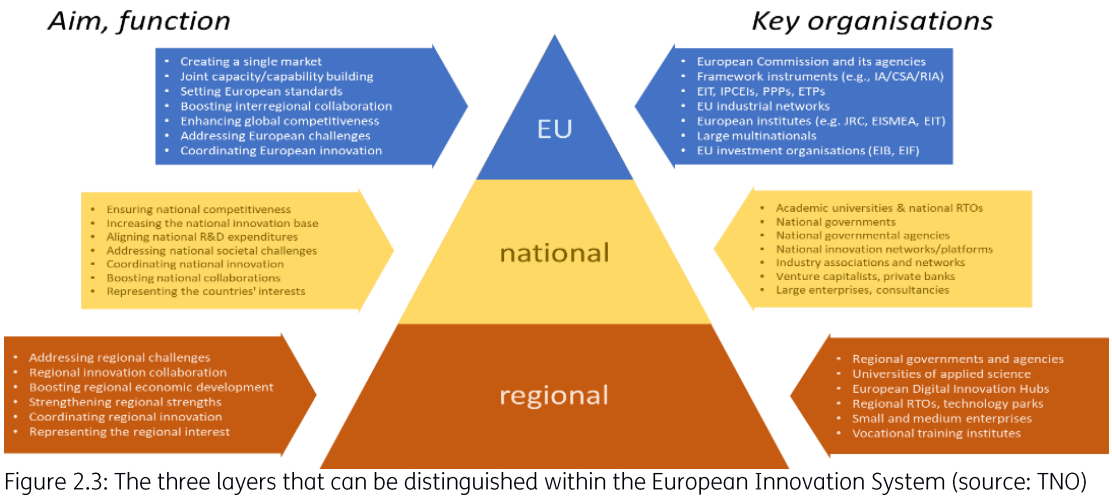

Figure 2.3: The three layers that can be distinguished within the European Innovation System (source: TNO)

2.4.2 Innovation ecosystem functions

Because of the massive scale of the ecosystem and the vast number of actors operating at different layers, it is easier to understand the ADR ecosystem at the higher level of 'system functions'. To better understand how they interact to contribute to the creation, diffusion, and commercialization of innovation, it is important that their function[17] – key activities to support innovation - is better understood. As an organization may perform multiple functions (e.g. universities support the RD&I base as well as provide skills and training), this allows for a better overview of how the ecosystem functions and what functions might need to be strengthened or where overlaps are occurring.

Several functions essential for the good functioning of the ecosystem can be distinguished ranging from coordination and alignment to contributing to the RD&I foundation (by conducting research, setting up infrastructures, framework conditions, etc.) (see figure 2.4). The complexity of the ADR ecosystem and the involvement of multiple actors within specific subfunctions and at the different layers of the innovation system,[18] suggest that an explicit mapping of the primary functions of organizations might also provider clearer overview of mandates, ultimately supporting coordination and alignment. In that respect, the ecosystem partners might also find possibilities to better position themselves.

[16] DIH4AI, D8.10
[17] Hekkert et al, "Functions of innovation systems: A new approach for analysing technological change Functions of innovation systems: A new approach for analysing technological change - ScienceDirect
[18] DIH4AI, D8.10

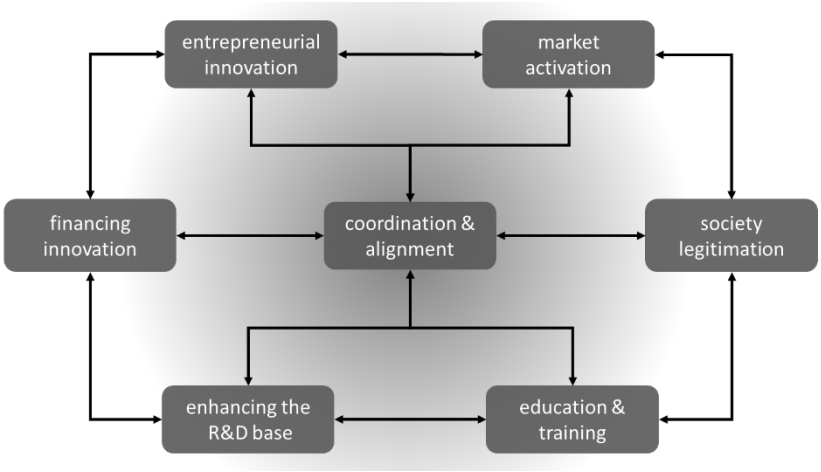

Figure 2.4: Overview of the functions that can be distinguished in an innovation system (TNO, based on research in DIH4AI project.)

2.5 Ecosystem mapping approach

In any approach to ecosystem mapping, several steps must be given careful thought. This section outlines our suggestions for this approach. First, an ecosystem mapping must provide a current and clear topics structure and a relevant and measurable definition of metrics (2.5.1). Next, data is collected from reliable sources (2.5.2), and visualized in a useful and insightful way for its users (2.5.3). We further examine the relevance of user-centricity (2.5.4), as it influences the way in which the ecosystem mapping should be deployed (2.5.5). Finally we need to consider the funding (2.5.6) and governance (2.5.7).

2.5.1 Categorization of topics and metrics

To ensure that the collected and visualized data is relevant and insightful to different stakeholders, it is crucial to define and agree on a shared language, while allowing it to evolve. Adopting an agreed upon ontology, categories for the data, topic descriptions, etc., ensures that the collected data can be analyzed and presented with relevant analysis and detail. The structured data can then be connected and presented to match the purpose of the mapping and deliver insights (see 2.5.3).

Secondly, balance between codification, free data gathering, and evolution of the codification needs to be struck. Some topics die out while others emerge, and it is possible that our focus shifts from one metric to another. This is particularly relevant around innovations and technological developments, where the speed of change is so fast and disruptive that mechanisms for continuous re-assessment of category fit should be built in the process.

While many ontologies and classifications for AI, data, robotics (and computer science in general) exist, these all have a different focus. Scientific associations such as the Association for the Advancement of Artificial Intelligence (AAAI) and conferences such as International Joint Conferences of Artificial Intelligence (IJCAI) have several classifications of research topics[19], the JRC has produced a taxonomy of AI aimed at better defining AI for their policy-

[19] Each AAAI-conference has their own list of topics, but a repository of AAAI-related topics is also maintained on aitopics.org

oriented monitoring activity and uses, among others, the AAAI and IJCAI classifications[20], the Computer Science Ontology is a taxonomy of research areas in computer science research[21].

To structure ADR topics and areas, an ontology lends itself better to this task than a typology or taxonomy, as topics are formulated more based on agreement rather than empirical observation. For instance, some outputs fit multiple categories, such as a paper or project on '*deep learning*-based *computer vision* and *robotics* in *healthcare'*. An ontology is a "formal, explicit specification of a shared conceptualization" between multiple stakeholders and describes entities and relationships. In the case of ADR research and innovation relates to topics of activities (e.g. research topics, technological areas) and focal areas (e.g. domains, application areas) that are relevant to the ADR community[22]. Meanwhile, typology and taxonomy are approaches to classification. A typology is a conceptual separation of a set of items (objects, people, situations, …) based on a certain number of combinations of groups of variables (age, weight, historical period, …)[23]. In contrast, a taxonomy refers to a classification based on empirically observable and measurable characteristics, often structured in hierarchical clusters, such as in biology[24]. Since an ontology is a shared language based on classification, *this is the most suitable for ADR research and technology topics, application areas, metrics.*

A shared language, however, needs to be constructed together. To produce a common ecosystem mapping, stakeholders are required to effectively agree on an ontology and update procedure. It is crucial that these three elements are agreed upon: 1) definition of research and technology topics and application areas, and their relationships; 2) metrics and the criteria to which they are subjected (e.g. what contributes to research or industrial excellence), and; 3) procedures for updating the ontology and metrics. Updating is important, because, like regular language, our conceptual languages also change over time–new concepts are introduced, some concepts fall out of fashion. When all three of these elements are established, we can speak of a shared language for the ADR community.

2.5.2 Data collection and provision

To describe the innovation ecosystem mapping, data is the crucial element that populates the ecosystem mapping. The data collection has several elements: 1) the data sources need to be established, 2) the provision and 3) update organized and validated.

[20] Samoili, S., López Cobo, M., Gómez, E., De Prato, G., Martínez-Plumed, F., and Delipetrev, B. (2020), "AI Watch. Defining Artificial Intelligence. Towards an operational definition and taxonomy of artificial intelligence", EUR 30117 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-17045-7, doi:10.2760/382730, JRC118163 and Samoili, S., Lopez Cobo, M., Delipetrev, B., Martinez-Plumed, F., Gomez Gutierrez, E. and De Prato, G. (2021), "AI Watch. Defining Artificial Intelligence 2.0", EUR 30873 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-42648-6, doi:10.2760/019901, JRC126426, p7.

[21] Salatino, A. A., Thanapalasingam, T.,Mannocci, A., Birukou, A., Osborne, F. & Motta, E. (2020), "The computer science ontology: A comprehensive automatically generated taxonomy of research areas". Data Intelligence 2(2020), 379-416. doi: 10.1162/dint_a_00055, p.12.

[22] Gruber, T. R. (1993). A translation approach to portable ontology specifications. *Knowledge acquisition*, 5(2), 199-220.

[23] Capecchi, V. (1968). On the definition of typology and classification in sociology. *Quality & Quantity*, *2*.

[24] Smith, K. B. (2002). Typologies, taxonomies, and the benefits of policy classification. *Policy studies journal*, *30*(3), 379-395.

Many data sources are available, each with different uses, quality, unit of analysis, sparsity. We distinguish between four relevant categories of data that can be used to provide an overview of the ecosystem (fig 2.5).

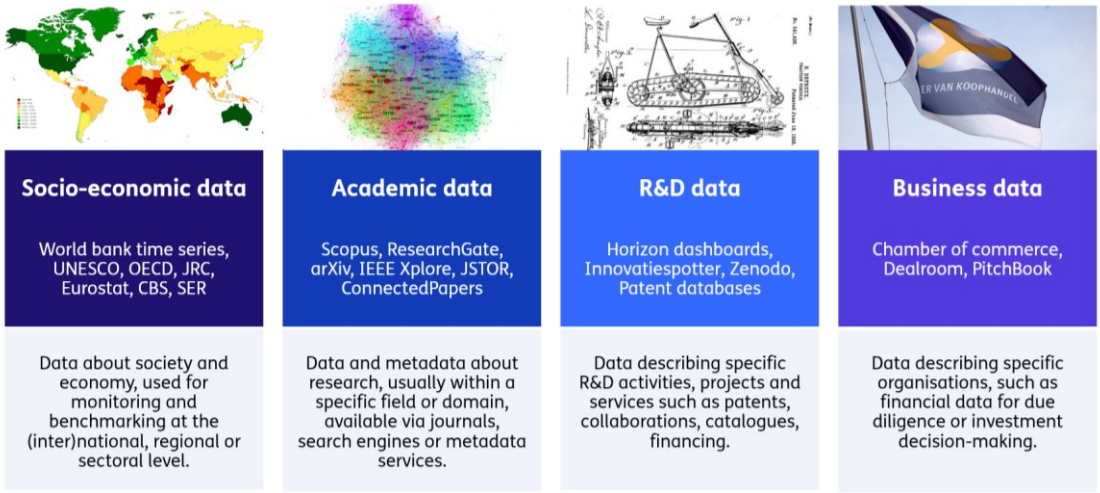

Figure 2.5: Types of relevant RD&I data sources (source: Author's own)

Socio-economic data, data about social and economic aspects, often at aggregated levels (national, regional or sectoral), used for benchmarking countries (e.g. World bank indicator time series, UNESCO, OECD, JRC, Eurostat, CBS, surveys). Under very specific and restricted conditions, data is available for analysis at lower levels of aggregation (e.g. household).

Academic data can provide information on (applied) research that occurs in (or is applicable to) a certain domain. Qualitative indicators may be extracted, such as research topics, summaries, overview of relevant recent papers, collaborations. Quantitative indicators may be based on number of papers, number of researchers, as well as network analysis (clustering, centeredness, shortest path, etc.). Potential data sources are research databases, search engines and metadata services (e.g. Scopus, ResearchGate, arXiv, IEEE Xplore, JSTOR, DBLP, AMiner, ConnectedPapers)[25].

R&D data provides information on specific R&D efforts: Patents, collaborations, funding (e.g. Horizon Europe dashboards, Innovatiespotter, Zenodo). Variations at the national level. In the Netherlands, data on the use of tax credits for research and development (WBSO) is collected by the government but is classified and only reported at high levels (e.g. total budget spent, total number of applicants in a year).

Business data: Information about organizations. Mainly financial information for due diligence or investment decision-making (e.g. Chamber of commerce, Dealroom, PitchBook), but also the number of employees, the sector, their types of products and services offered. Organizational profiles consist of data which describes (sub)organizations. This can help with filtering, searching, classifying organizations for any type of activity. Examples are: Much of this data is submitted by employees or relations and due to the potential subjectivity of self-reported data, as much as possible should be extracted from verifiable data or properly constrained by the form or survey.

[25] https://guides.lib.berkeley.edu/information-studies/apis
https://en.wikipedia.org/wiki/List_of_academic_databases_and_search_engines

More context-specific data could be added to an organizational profile, e.g. via data that people submit on behalf of their own (sub)organization. This data can help with filtering, searching, classifying organizations. Due to the potential subjectivity of self-reported data, as much as possible should be extracted from verifiable data or properly constrained by the form or survey.

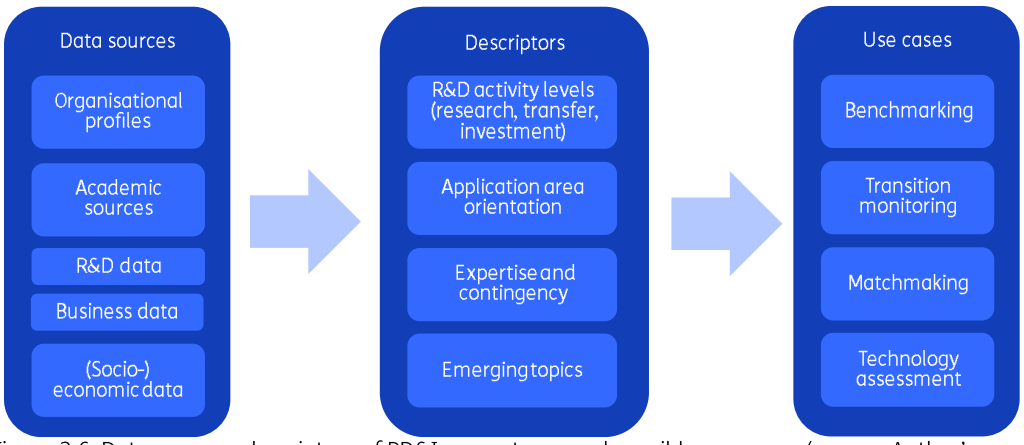

Figure 2.6: Data sources, descriptors of RD&I ecosystems and possible use cases (source: Author's own)

Secondly, a key element of the data collection is organizing it in systemic and structured manner. This requires development of agreed upon categories that should correspond to the user needs (when presented and analyzed).

Lastly, to maintain value, procedures for ensuring data quality accuracy are essential. For this, not only is a sound methodology and good initial mapping needed but the data provision and revision needs to be organized on a continuous, recurring manner to ensure relevance. Automated tools to retrieve texts and update data among several databases are becoming more easily available but still require continuous coordination and engagement with the data providers (to at least ensure scraped data is correct or to provide raw data where data is missing). Securing their cooperation requires that they recognize the added value of their participation (see previous section) and are supported with appropriate infrastructure to ensure maximum ease of use.

2.5.3 Data analysis and visualization

One of the crucial elements in any mapping is to translate the data into actual insights that can be easily accessed by the users. The visualization would therefore very much be driven by the purpose and user persona in mind – e.g. it is important for them to find a stakeholder based on geographical or topic basis. Visualization provides context, insights and simplifies the data, which contributes to overall better understanding.[26] This requires specific functionalities but even more importantly, regular contact with users to ensure that the insights generated are useful. Several basic functionalities are powerful and provide value to a large group of users as proven by experience in the VISION mapping of the research focus of partners in several networks of excellence:

Shared language

[26] See FasterCapital (n.a), "The Importance Of Visualizing Complex Data", available here.

- Provides a list of ADR research topics & application areas, with navigation and search abilities to find suitable categories for a user's information need
- Ability to search organizations by AI research topic or application area

Detailed reporting on organizations
- Ability to position the expertise of a (sub)organization in terms of research focus and application areas
- Provide contextual information on a (sub)organization for branding, including contact details and URL

High-level overview
- Geographical map of European ADR R&D excellence, including filtering and search functionalities
- Geographical map of spread and expertise in terms of research topic and application area, including filtering and search functionalities
- High-level overview of Lab-to-market spread per research topic or application area. Lab-to-market spread refers to the extent to which fundamental research, education, applied research, consulting, product development occurs around a specific research topic or application area.
- High-level overview of research topics intersected with application areas to show strengths and weaknesses in terms of coverage.
- Ability to report on AI research (sub)topics to showcase the granularity of research focus topics.

2.5.4 User-centricity

User-centricity is vital for ensuring that the mapping delivers value, by catering to the specific demands of various users. Different users — such as SMEs, research institutions, and tech providers — have distinct needs, which requires a deep understanding of their goals and challenges. To effectively address these demands, the mapping and the related analysis and possible services should consider elements such as user segmentation, understanding the specific needs of each group, and user journeys, mapping how users interact with the platform from awareness to retention. To make a platform or service more user-centric, it is crucial to evaluate users. Assessing their innovation level — such as innovation readiness, awareness of the innovations and topics — can help tailor features and resources to align with their capabilities. Additionally, feedback mechanisms and continuous engagement are essential to adapting the platform's offerings over time, ensuring it evolves with user needs and delivers targeted, actionable insights.

We distinguish among the following user personas for the ecosystem mapping: researchers, policymakers, intermediaries, companies. For these, the users are mostly familiar with the topic of ADR but the level of detail of knowledge differs – the relation between topics is therefore important to clarify. The needs and use cases for each group have been explored as part of the VISION project via several community engagement moments and will be further evaluated in the framework of the broader ADR topics.

2.5.5 Deployment and usage

The deployment involves strategically implementing the mapping's infrastructure, features, and services to effectively facilitate access to innovation resources and foster collaboration among diverse stakeholders within the ecosystem. The following elements are highlighted:

- **An enabling infrastructure** (platform, website, etc.): to enable dynamic (as opposed to static) mapping and updates, a reliable technical foundation that securely collects and transforms data into valuable information, is needed. The mapping by itself might not be too demanding in terms of infrastructure but the translation of the data into insights, visualizations and connections to other services need to be considered to ensure visibility and a smooth customer journey. Possibilities for connectors, APIs, etc. should be incorporated in the design.
- **Access to the infrastructure**, including possibilities to edit the data, should also be considered. While distributed editing feature might enable more up-to-date information, editing rights, overall quality check, reports of errors could all be features that need to be considered. Related to that, any feedback from users, data providers or intermediaries acting as dissemination partners should be enabled to ensure continuous fit with needs;
- Following **how, how often, and for what purposes the database is used** can also inform further developments and enable better alignment with the distribution and dissemination channels.
- **Dissemination channels** that can connect the users, the data providers, and the mapping. These could be usual suspects such as social media, newsletters, but also utilizing the partner networks and resources, as well as broader advertising.

These elements translate to the need to enable connecting the mapping to a well-known platform, easy to use infrastructure and a dedicated process to upload and edit the information. APIs to connect to other infrastructures (with additional services) and automated tools and rules for access, user analysis, etc. could also be utilized.

2.5.6 Funding and sustainability considerations

Funding is critical for the sustainability and continuity of any mapping – at the very least the coordination and update of information cost effort that needs to be covered. Given the broad scope of a mapping and its function to address information asymmetries (ensuring that all stakeholders can find and understand the ecosystem), public investments often support such mapping but mostly covering the setup phase.

To ensure long-term viability, mappings and their supporting platforms must adopt a **diversified financial model** that includes a diverse range of revenue streams, e.g. from user fees and public-private partnerships. By connecting the mapping to additional services—such as consulting, training, and networking opportunities—the platform can create added value, making these services more attractive and justifying the inclusion of user-based revenue streams. This approach not only enhances the utility but also secures continuous updates and improvements, driving sustained engagement and impact within the ecosystem.

2.5.7 Governance and coordination

Governance is essential for ensuring that the mapping is organized efficiently, maintain data quality, foster trust, and facilitate collaboration with data providers, distributors/dissemination channels and other service offerings, driving long-term sustainability and success. Effective governance of Repository-based Community Platforms (RbCPs) requires a strong focus on cooperation and coordination across all stakeholders to ensure the platform remains relevant, trusted, and sustainable. User-centric governance ensures that users have control over their data and experience, while automated processes guarantee compliance and data quality. Beyond that, cooperation between data providers, service users, and intermediaries is vital for keeping the platform updated and aligned with

evolving needs. **A governance model** that encourages stakeholder involvement in co-design and feedback loops ensures continuous improvement.

For broader impact, coordination with regional, national, and international innovation networks strengthens the platform's role within the ecosystem, helping bridge gaps between localized efforts and larger, coordinated initiatives. This requires transparent decision-making and collaboration between public and private entities to create synergies, especially in funding and service development. By fostering strong partnerships and ensuring active communication channels, governance can drive long-term value creation, enhance trust, and ensure that the mapping contributes effectively to a more connected and efficient innovation ecosystem.

In conclusion, the establishment of a collaborative ADR ecosystem mapping is essential for fostering an impactful and coordinated European ADR landscape. A robust, sustainable mapping adds significant value to all stakeholders involved by promoting a joined, coordinated effort that aligns diverse interests and resources within the ecosystem. By embedding ecosystem mapping in a community platform, one can drive activation and engagement, connecting various relevant European R&I mapping initiatives and enhancing collaborative opportunities. Understanding the intricate layers of the European ADR ecosystem and defining clear functions should also be considered to provide a comprehensive view of roles and contributions, facilitating informed decision-making. Furthermore, employing a robust approach that prioritizes user-centricity, effective data collection, analysis, and visualization ensures the delivery of actionable insights. The collaborative ADR ecosystem mapping could become an enabler beyond just as a tool, but as a vital framework that will support connections, insights, and better alignment in the ADR ecosystem.

3 Roadmap for European ADR Ecosystem Mapping

After having presented a vision in section 2, we outline a roadmap that leads to the implementation of that vision. Its main components are the Adra Joint Topic Group EMIR (3.1), the reuse of prior efforts (3.2), an organizational governance (3.3), and an implementation roadmap (3.4).

3.1 The Adra EMIR joint topic group as focal point

The AI-Data-Robotics association (Adra) provides the best forum to discuss and build a unified mapping of European AI, data and robotics R&D, while ensuring the sustainability of prior efforts and joining forces among current efforts. Adra is a European public-private partnership, founded by five European organizations (BDVA, CAIRNE, ELLIS, EurAI and euRobotics). As European focal point, Adra aims to drive innovation, acceptance and uptake of AI, data and robotics technologies. The benefit of facilitating the development via Adra is that we do not end up with several concurrent mappings.

The Joint Topic Group of Adra named **'Ecosystem Mapping and Information Repository'** (EMIR) will help achieve an aligned view on the ecosystem mapping. Adra JTGs are working groups around a topic of common interest, such as standardization or generative AI. They provide cross-community exchange of viewpoints and expertise and allow to build a network of stakeholders around a topic. In 2024, the Adra board of directors has approved a mandate for EMIR, with the mission to "maximize the effectiveness of the AI, Data and Robotics (ADR) community by supporting the development and maintenance of an ecosystem mapping and information services that are of value to the ADR research & innovation community"[27].

EMIR is inspired by the VISION project, Adra-e and AI-on-Demand platform while noting that similar efforts in the larger ADR domain have been undertaken by RODIN, DIHNET.EU, DIH4AI, etc. EMIR responds to a strong demand for a single and sustainable follow-up of these mapping activities, expressed by stakeholders such as the EC. The new Adra JTG was founded by TNO, University of Twente and University College Cork, organizations which have been instrumental in these initiatives. The EMIR JTG is intended as an open forum for the further development of an ecosystem mapping beyond the prototype developed by VISION, as any organization can join the JTG and get involved.

EMIR has several functions to support the community:

1. An inclusive, diverse, and open forum to support the governance of the ecosystem mapping, for decision-making on research & innovation topics;

[27] https://adr-association.eu/topic-groups/ecosystem-mapping-information-repository

2. A growing coalition of stakeholders willing to contribute to the development of the services;
3. A recognized reference activity for policy makers and the ADR community
4. A representation of the ADR ecosystem, including policy/decision makers, that can provide requirements for the development and maintenance of the services and judge the value of potential services;
5. Oversight of the implementation of the mapping.

3.2 Building on prior effort

Prior effort to create a joint mapping of the ADR research & innovation (R&I) ecosystem occurred in 2023, under the lead of the VISION coordination and support action[28]. This mapping (fig. 3.1) is a VISION initiative, led by TNO, in consultation with the European Commission and conducted together with the Networks of Excellence (NoE)[29]. NoEs are European network projects with universities, research & technology organisations, businesses, and governmental organisations, aiming to promote research and innovation around specific themes such as trustworthy or green AI. The mapping was developed in frequent engagement with the wider AI community and regular meetings with EC and NoE representatives.

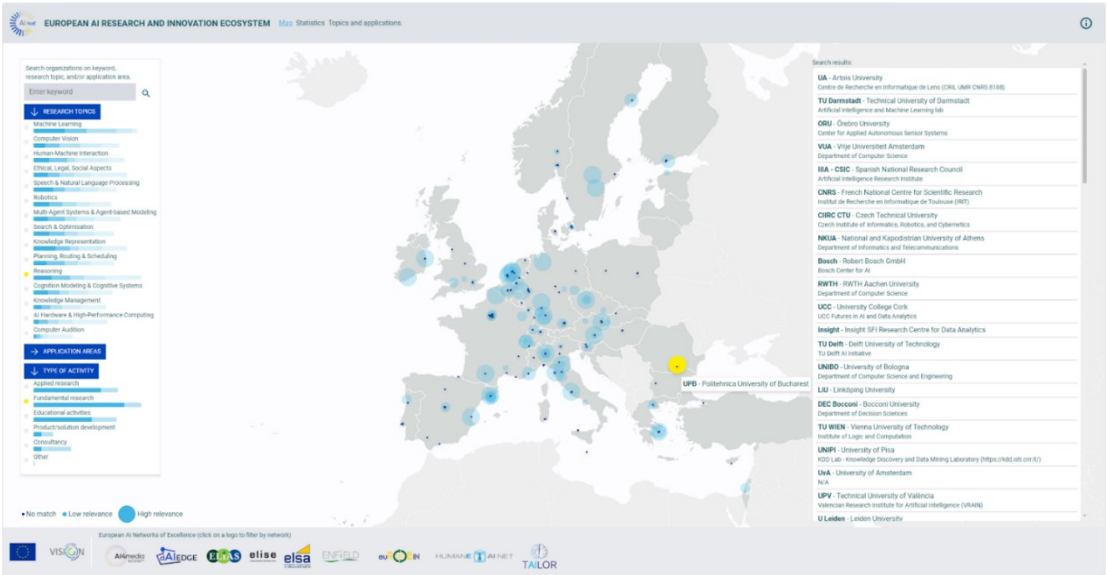

Figure 3.1: The mapping of the European AI research & innovation ecosystem by VISION (Source: TNO)

The mapping represents all the 339 organizations within the AI NoEs, consisting mainly of universities and research & technology organizations, spread across Europe and associated countries. This data was collected via EUSurvey at a response rate of 80,5% (N = 231).

The fully developed prototype (eu-ai-ecosystem.tnods.nl) is integrated with the AI-on-demand platform (AIoD) to ensure continuity beyond the VISION project lifetime, for instance

[28] VISION project on CORDIS (European Commission): https://cordis.europa.eu/project/id/952070

[29] The nine Networks of Excellence are: AI4Media, dAIEDGE, ELISE, ELIAS, ELSA, ENFIELD, euROBIN, HumanE-AI-Net, TAILOR

through the JTG EMIR. Finally, development and access are arranged with AIoD, which includes handover of hosting to a durable alternative.

The categorization of research topics was derived based on community feedback and through a democratic process that ensured all NoEs were able to voice their views and ensure that the categorization reflected their notion of AI research and application as well. The categorization therefore derived by synthesizing the topics list of an academic AI conference (AAAI-23), the 12 research areas and 12 application areas of CAIRNE, and community-driven topics of the NoEs which were provided by the working committee through several review rounds. Changes at the top level were made only if it is justified (e.g. a more representative title). Preferably no more high-level categories, to keep it comprehensive. The high-level topics are alphabetically sorted, not implying any primacy. At the subtopics level, the NoEs were able to add as many topics as desired.
The result of this process is a structured list of AI research topics and application areas that is rooted in scientific communities but adapted to European values and shared by the NoEs (fig. 3.2)[30].

Research topics	
AI Hardware & High-Performance Computing	4
Computer Vision & Audition	36
Ethical, Legal, Social Aspects	34
Human- Machine Interaction & Cognition	32
Knowledge Representation & Management	17
Machine Learning	60
Multi-Agent Systems & Agent-Based Modelling	10
Planning, Routing & Scheduling	15
Reasoning	31
Robotics	19
Search & Optimisation	26
Speech & Natural Language Processing	27

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Application areas	
Agriculture & fisheries	9
Economy & financial markets/services	9
Environment, energy & sustainability	18
Health & wellbeing	12
ICT infrastructure	4
Industry	11
Learning & education	10
Media, communication, web & entertainment	16
Mobility & transportation	18
Public sector & citizen services	6
Safety & Security	8
Scientific research, design & engineering	6

Figure 3.2: High-level overview of the research topics and application areas categorization, including the number of subtopics (Source: Author's own)

While we aim to build on the insights and data gathered from the VISION ecosystem mapping, the ADRA topic groups aims to address the broader ADR community and potentially the aim of the mapping. Therefore, the following steps are still envisioned:

- Open the discussion to the broader community;
- Identify additional user personas and their underlaying need;
- Design an approach to regularly revisit the topics and application domains to ensure inclusivity of the data and robotics topics;
- Extend the mapping to stakeholders beyond the NoEs.

In parallel, work is also under way to integrate the mapping with AIoD and to design the business case for the mapping and organize the governance and decision-making process.

3.3 Adra EMIR governance

To create an ecosystem mapping that truly reflects the European innovation community, efforts must be made to also ensure that the information is correct, open, independent,

[30] The full list can be found in the online ecosystem mapping tool: eu-ai-ecosystem.tnods.nl/topicsOverview

inclusive, and that it supports the development of a community and the democratic principles. This implies that the mapping needs to be built as an open-source community and infrastructure, allowing for different stakeholders to not only include their information but also actively contribute to (discussions related to) setting up the initiative. These principles need to be embedded in the development and governance of the mapping. The envisioned governance includes a user-centric approach with an Adra joint topic group on Ecosystem Mapping & Information Repository (JTG EMIR), which is open to all Adra members, acting in advisory function and supporting co-development and user-need identification. The decision making can then be organized by appointed steering board, supported by committed execution team and lead that can organize the co-development activities and link with relevant stakeholders. The integration of the ecosystem mapping with the AI-on-demand platform is managed by the JTG EMIR chair and/or another appointee (such as technical leads). The suggested organizational governance for the JTG EMIR is shown in figure 3.3.

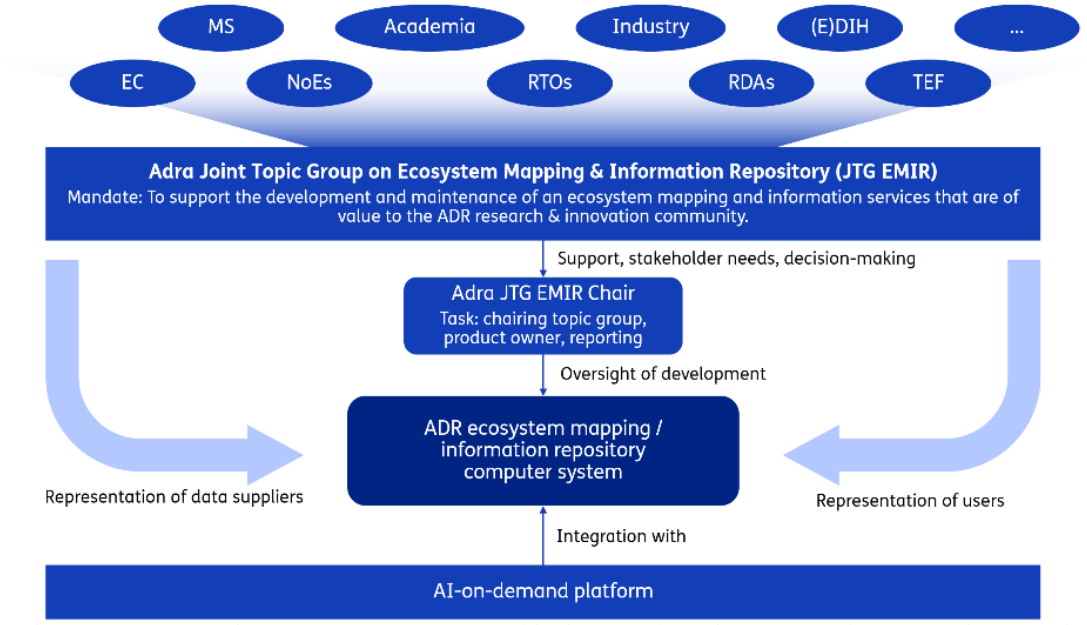

Figure 3.3: Suggested governance structure to guide the mapping - the JTG EMIR (source: Author's own)

3.4 Implementation roadmap

The Adra JTG EMIR provides a platform for the most important activities of community engagement and community building. This requires a user-centric, participatory approach that gives the users a sense of ownership. Respecting this, the implementation roadmap describes the activities to establish an organizational governance and a minimum viable product (MVP). Several tasks are required including the refinement of the use case and value added, engaging with the community to expand current categorization to include data and robotics. We distinguish between short-, mid- and long-term tasks.

In the short-term (0-6 months), a governance model is established that can lead the development of a minimum viable product (MVP) of the ADR EMIR.

1. Further establish the organizational *governance* for Adra Joint Topic group EMIR, including mandate, new organization roles and responsibilities, decision-making procedures, ownership and licensing
2. Extend the *categorization of research topics and application areas* for a wider scope of research, innovation and applications in the ADR community

3. Extend the *scope of the mapping* to organizations in the AI, Data & Robotics community, but that were not included in the initial mapping
4. Establish *architectural principles* for EMIR (e.g. open source, machine-readability, transparency)

In the medium-term (6-18 months), further validation of the business model and funding sources is required, while the MVP is further developed. This also asks for a establishing a clear business case for the mapping to address the value and sustainability of the approach.

5. Establish a *business case* for the mapping
6. Formulate *requirements* for the MVP and AI-on-demand metadata
7. Organize *funding*, and commission the development and maintenance of the MVP

In the long-term (18-36 months), the focus is operation, maintenance, and continuous development of services, indicators, data, topics classification, visualizations, and insights. Iterative development processes ensure the continuous improvement based on user experiences.

4 Conclusion

Europe needs an aligned and well-coordinated ADR ecosystem, and a solid and continuous mapping is an essential element of that. With the rapidly developing ADR field and the strategic position of data, robotics and AI not only to support economic growth but also enable every-day activities, support solutions towards societal challenges ranging from health to demographics and environment, Europe cannot afford a fragmented effort. Yet, despite various attempts, it is still challenging to get a clear overview of actors, topics, and services developed in Europe. A joined effort is therefore needed to map the ecosystem. This however needs to be coordinated and aligned, so the mapping is not emerging in isolation but integrated into other activities that support the ecosystem.

With this paper, we set out a vision and a roadmap for a mapping as the key element of a European community platform, which is *for* the European ADR community, empowering a responsible ADR-powered society, compatible with European values and regulations, *by* the European ADR community, and *of* the European ADR community.

To enable future actions, we outline some main elements of the ecosystem mapping – ensuring that the mapping delivers added value and connects to other activities, that the layers and functions in the ecosystem are considered and importantly that the mapping approach takes a comprehensive view – from data collection to ensuring data provision, user centric approach, fit-for-purpose insights as well as longer term practicalities such as funding, sustainability and proper governance. Based on these elements, we suggest a way forward, including an implementation plan that can guide future activities.

We intend this white paper to be a conversation starter, by identifying the need and inviting stakeholders to join the effort and contribute to the mapping and its organization. Only then can we benefit from mapping to ensure European innovativeness, competitiveness, and sovereignty.

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