Draft proposal for a European Partnership under Horizon Europe
AI, Data and Robotics

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About this draft

In autumn 2019 the Commission services asked potential partners to further elaborate proposals for the candidate European Partnerships identified during the strategic planning of Horizon Europe. These proposals have been developed by potential partners based on common guidance and template, taking into account the initial concepts developed by the Commission and feedback received from Member States during early consultation[1]. The Commission Services have guided revisions during drafting to facilitate alignment with the overall EU political ambition and compliance with the criteria for Partnerships.

This document is a stable draft of the partnership proposal, released for the purpose of ensuring transparency of information on the current status of preparation (including on the process for developing the Strategic Research and Innovation Agenda). As such, it aims to contribute to further collaboration, synergies and alignment between partnership candidates, as well as more broadly with related R&I stakeholders in the EU, and beyond where relevant.

This informal document does not reflect the final views of the Commission, nor pre-empt the formal decision-making (comitology or legislative procedure) on the establishment of European Partnerships.

In the next steps of preparations, the Commission Services will further assess these proposals against the selection criteria for European Partnerships. The final decision on launching a Partnership will depend on progress in their preparation (incl. compliance with selection criteria) and the formal decisions on European Partnerships (linked with the adoption of Strategic Plan, work programmes, and legislative procedures, depending on the form). Key precondition is the existence of an agreed Strategic Research and Innovation Agenda / Roadmap. The launch of a Partnership is also conditional to partners signing up to final, commonly agreed objectives and committing the resources and investments needed from their side to achieve them.

The remaining issues will be addressed in the context of the development of the Strategic Research and Innovation Agendas/ Roadmaps, and as part of the overall policy (notably in the respective legal frameworks). In particular, it is important that all Partnerships further develop their framework of objectives. All Partnerships need to have a well-developed logical framework with concrete objectives and targets and with a set of Key Performance Indicators to monitor achievement of objectives and the resources that are invested.

Aspects related to implementation, programme design, monitoring and evaluation system will be streamlined and harmonised at a later stage across initiatives to ensure compliance with the implementation criteria, comparability across initiatives and to simplify the overall landscape.

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SRIDA update process will be complemented with outreach activities to engage targeted stakeholders. Details will be announced on the website www.ai-data-robotics-partnership.eu[2].

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[1] https://www.era-learn.eu/documents/final_report_ms_partnerships.pdf
[2] Web-site to be launched shortly, more information on SRIDA and Consultation process in section 2.2.16

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1 Summary

To deliver value to Europe from AI, data and robotics this Partnership will drive innovation, uptake and acceptance by building on the opportunities these technologies offer. It will support research, development and deployment, foster novel applications and stimulate public and private investment, to create economic, technological and societal value for business, citizens and the environment. It will build bridges between stakeholders that enable a human-centric and trustworthy European vision of AI to flourish.

2 Context, objectives, expected impacts

2.1 Context and problem definition

2.1.1 Context of the Partnership

The full benefit from using AI, Data and Robotics in all of production, in both small and large companies is still to be fully realised, the true impact of AI, Data and Robotics will be in our hospitals, on our farms, on our roads, in warehouses and at home; yes, in every sector of the economy. The capability to address these new markets is growing year on year as new applications emerge from the application of technical advances, as challenges are overcome, and the barriers to adoption are lowered.

This progress is global, the impact of these technologies is now being considered by every industrial nation and every corporation and yet there are significant challenges to uptake, challenges around skills, trustworthiness, societal impact and on jobs, wealth and the environment. Some believe it represents a threat, others believe it can be used to solve the greatest challenges we face, environmental sustainability, energy, food and water security, improved health and improved quality of life and productivity. Europe has a clear vision, to make AI, Data and Robotics human-centric, trustworthy and compatible with European Values and Rights. Here Europe can lead. To achieve this, we need to establish a focal point where AI, Data and Robotics can fuse together; a connection point for stakeholders where ideas, innovation and commercial reality meet to drive progress and uptake.

This Partnership is the European focal point for AI, Data and Robotics. Europe has all the expertise needed to progress rapidly in the deployment of these technologies, but it needs to direct energy towards cohering research, innovation and infrastructure so as to stimulate deployment and adoption, build up an effective innovation ecosystem and drive excellent research.

There is now a window of opportunity where Europe can shape its own concept of progress towards smarter machines and systems, one that matches and boosts its competitive strengths aligned with its values to deliver "*AI for Europe*".

This Partnership will federate and cohere the diverse communities that underpin European AI, Data and Robotics. It will stimulate private investment and orient public funding to address the key challenges. It will create collaborations that can deliver Europe's vision for a human centric and trustworthy use of AI, Data and Robotics.

Scope of the Partnership

The scope of the Partnership

a) defines the range of topics to be covered by the roadmap and implements it,

b) defines the range of actions undertaken by the Partnership

c) identifies the relevance to member organisations

The scope will include "*All of AI* [3] [4]", "*All of Data*[5]" and "*All of Robotics*[6]" within its remit.

The Partnership will provide structure to the European smart systems[7] community, to develop a strategic research, innovation and deployment agenda and federate efforts around this that are of primary importance for our society, environment and economy.

From the perspective of technical development, the Partnership will have a broad remit with respect to road mapping and engagement. It will address early-stage research through to application-specific technology development, thereby covering the whole of the research and innovation pathway from lab to application.

The scope of the Partnership will encompass all paradigms, techniques, methods and applications of AI, Data and Robotics both separately and in combination. It will develop the opportunities for joint and collective actions between these technologies more effectively than if each were isolated.

The Partnership will be open to industry, academia, public bodies and to organisations both small and large. In particular, SMEs, start-ups and entrepreneurs will be encouraged to join the Partnership. It will engage with a wide range of stakeholders, and it will connect with other related Partnerships and innovation organisations in Europe and outside.

2.1.2 Action is needed now

A partnership is needed to increase the impact of existing and on-going investments and initiatives, at different levels, and fully leverage current and future opportunities.

In terms of opportunities, Europe has a strong basis for progressing these technologies in terms of societal, environmental and business needs. There is clear evidence that each technical area has reached a level of maturity where wide-scale impact is possible. Uptake is happening, but there is a need to accelerate the pace with appropriate public and private investments. In addition, Europe has numerous markets where they can be effectively applied, but uptake needs to be promoted. Europe has a strong research base in each of the core areas, but defragmentation is required to effectively leverage the opportunities created by its research investment.

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[3] For the purposes of this document the definition of AI provided by the AI High Level Group will be assumed: "Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions.

As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems)." Source: A Definition of AI: Main Capabilities and Disciplines, Definition developed for the purpose of the AI HLEG's deliverable, 8th April 2019

[4] AI contains multiple competing paradigms that often appear at odds with each other; symbolic, non-symbolic, learning, model based, bio-inspired etc. This Partnership includes all of AI.

[5] http://www.bdva.eu/SRIA The Big Data Value Strategic Research and Innovation Agenda (BDV SRIA) sets out the scope of Data in Europe.

[6] https://www.eu-robotics.net/sparc/about/roadmap/index.html The SPARC Multi-Annual Roadmap sets out the scope of Robotics in Europe.

[7] Throughout this document the phrase "smart systems" will be used to denote technical systems that are built from AI, Data and Robotic elements in some combination. It is not the intention to define "smart" beyond its colloquial use.

This Partnership is instrumental in shaping Europe's digital future as referred in the recently published European Data Strategy[8] and AI Whitepaper[9], and shall play an important role in developing an attractive, secure and dynamic data economy, and making Europe a leading role model in the creation of a society empowered by Data and AI focused on excellence, trust and value. The current pandemic crisis has also shown the potential of digitalisation for the functioning of the European economies, as stated in the roadmap for recovery released by European Council.

The main objective of this Partnership is to join forces at all levels of the private and the public sectors together with the Commission. In creating this Partnership, the Commission expects to boost support in order to reach a combined public and private investment of €20 billion per year in the next decade.

Acting now to create this Partnership will build early-stage opportunities around current strengths; create cohesion around European focused themes and markets, around unified supply chains and around a regulatory environment that can stimulate both uptake, innovation and growth, and accelerate research. This will foster growth not only in each field but also in the interactions between them.

The pace of change is rapid, and the predicted market growth is extensive. Without a functioning innovation ecosystem that supports research and translation these rapid changes may lead to further fragmentation. No single organisation or existing association alone can achieve the required level of coherence across Europe necessary to maximise uptake and impact; this requires a collaborative Partnership.

A Partnership between all stakeholders can act to connect the communities, guide policy and strategy around investment, both public and private, and can stimulate a focused approach to research, innovation and deployment that connects and builds on European strengths.

2.1.3 Problems and challenges

A failure to properly invest in AI, Data and Robotics will significantly restrict European engagement in emerging global AI markets. As a consequence, we will see a negative impact on, in particular, B2B markets in which Europe is strong today. In addition, if Europe fails to implement a competitive, trustworthy approach to AI, Data and Robotics, smart systems from other parts of the world, not based on European values, are likely to penetrate European markets because there will be no alternative.

Therefore, the problems that the Partnership will address are the following:

Europe's research landscape is fragmented: Europe has a strong AI, Data and Robotics research capability and capacity in academia and research organisations. However, their activities are fragmented between different communities and remain siloed around AI, Data and Robotics, and within the Member States[10]. This makes it more difficult for European organisations to translate research into innovative smart solutions that can impact across regions and globally, as well as feed research with real-world questions. Fragmentation must be addressed; otherwise the results of research, innovation and deployment investments cannot be utilised with maximal efficiency due to redundant and overlapping activities.

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[8] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en

[9] https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

[10] European Artificial Intelligence. (AI) leadership, the path for an integrated vision". Policy Department for Economic, Scientific and Quality of Life Policies, Directorate-General for Internal Policies. Laura DELPONTE (CSIL) 2018

Lack of a functioning ecosystem for AI, Data and Robotics: Europe lacks a functioning Ecosystem covering AI, Data and Robotics that can establish the foundation for boosting value created by the innovative development and deployment of these technologies. No single player can achieve this alone; the sharing of assets, technology, skills and knowledge is crucial. In addition, for scaling the deployment of these technologies in real-world applications, a critical mass of engaged stakeholders is needed.

Although Europe has strong ecosystems around Data (BDVA) and Robotics (euRobotics) it needs to develop a single interconnected ecosystem that joins up across the technical areas and across Europe. An ecosystem that overarches European efforts in each of these areas needs to reflect the complexity and diversity of its constituents. It must encompass the three dimensions AI, Data, and Robotics and ensure that knowledge is cross-fertilised. In addition, this requires engagement from **all** stakeholders in order to be effective and requires alignment between them to ensure efficient collaboration.

High complexity in development and deployment： There are considerable complexity and cost in creating deployable systems in AI, Data and Robotics. In addition, critical requirements such as accuracy, robustness, repeatability and trustworthiness, have to be addressed. This requires dedicated research addressing deployment challenges and requirements across the technologies and around products and services that in turn, rely on complex and smart development and deployment systems.

Lack of Skills and Know-How: Many European organisations lack the skills to manage or deploy smart technical solutions[11] that can be built on these technologies. An increase in talent education is needed. However, a global competition for talent in these areas is underway. Regions with the most vibrant technology landscape are better positioned to attract skilled professionals and retain local talent. Talents are only attracted and retained in the case where conditions are compelling.

Lack of business opportunity understanding: Developing business impact using these smart technologies requires a full understanding of the market, the technology and its impact on business processes and models. Because this requires the integration of knowledge from multiple stakeholders,[12] it can result in low levels of uptake driven by uncertainty and a lack of knowledge. In addition, the novelty of these technologies means that emerging business potential may not be obvious from the outset, which in turn slows the return on investment.

Societal Trust in AI, Data and Robotics: There are many misconceptions and much misinformation about AI, Data and Robotics in societal debates, and the technology is not fully accepted by society in all application areas. On the one hand, this will slow uptake, especially where there is unfounded mistrust, but on the other, it may damage markets where its dangers are not fully understood, for example, the limitations of autonomy in road vehicles.

Lack of Infrastructure for AI, Data and Robotics: Both academics and innovators, SME's and start-ups, in particular, need good access to world-class innovation infrastructure including access to data and resources such as HPC and test

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[11] IDC's Western Europe AI/Cognitive Solutions Survey, June 2018

[12] Ranging from end user, application provider, user, data supplier, technology creator broker, innovator and entrepreneur, researcher and academic, regulator, standardisation body, investor and venture capitalist as well as citizen.

environments, etc. The lack of accessible and excellent infrastructure will slow market development and limit success.

Policy and Regulation Uncertainty: Policy and regulation of AI, Data and Robotics is still unclear in areas including liability, right to explain, data access and trustworthiness. Many organisations have concerns about compliance. The lack of clarity and the lack of a common European legal framework will slow company growth and the delivery of benefits.

Investment environment: In the international landscape significant private investments[13] in these technologies can be observed. To capture the full range of opportunities offered an appropriately high level of private investment for AI, Data and Robotics in Europe is needed. Engagement of major industries and investors around a common vision and roadmap is essential to reach the full impact of public investment.[14]

2.1.4 Drivers of the problem

Maturity of Technology: Recent technical advances have increased the demand for smart systems in every sector, and agile businesses are starting to react and develop new markets. However, the spread of uptake has been restricted to specific applications and sectors, and the full benefits of AI, Data and Robotics have yet to be deployed by all sectors and organisations. Therefore creating conditions that guide and foster the deployment and adoption of these technologies will be critical to their increased uptake.

A wider range of applications: With the recent technical advances in AI, Data and Robotics they can today be used for many different purposes ranging over all sectors. This has driven exploration of new markets and the search for knowledge and talent.

Systems complexity: AI, Data and Robotics are often applied where there is a high degree of system complexity, for example optimising the location of hundreds of thousands of stock items in a warehouse, or routing traffic in a city. In these applications we rely on these technologies to deliver safe and optimal performance, often in real-time. Achieving trustworthiness under complexity, taking into account the links with other technologies, is a significant challenge.

Misuse of smart technologies：In considering their value, one should not overlook that they can have negative implications on our human and digital rights if it is not managed in a responsible manner. This has driven both government and citizen awareness and stimulated debate and the formulation of ethical guidelines such as those produced by the AI High-Level Expert Group in Europe.

Human expectation: There are raised expectation around what these new smart technologies can do, where it will impact and the benefits it will bring. These raised expectations are often ahead of the state of the art and create an "expectation gap" that needs to be reduced.

Raised demand: There are more business opportunities around the use of AI, Data and Robotics than there are people with the knowledge to address them, or funding to support them. Companies struggle to recruit talent and opportunities are missed.

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[13] €17.9 billion by the U.S., €8.9 billion by China in 2016

High barriers to adoption: Utilising these technologies requires new resources, expertise and infrastructure, gaining their full advantage may require a change in business models or the development of new skills in the workforce. Unless there is a well-understood return on investment, these represent a high barrier to adoption.

2.1.5 AI Impact in numbers

Numbers related to the problems

- *Limited industrial Investments*: European industrial investments in 2016 were low in comparison to industrial investments in the United States and China. For instance, external investors have been investing between 1.2 and 2 billion Euro in Asian companies and 6.4 billion in North American companies, whereas external[15] investments in European countries were only between 900 million and 1.3 billion Euro. For internal corporate investments, the numbers are similar, 2.5 to 3.3 billion Euro internal investments in Europe are less than a quarter compared to United States (12.2 to 18.8 billion Euro) and less than half compared to Asia (6.5 to 9.8 billion Euro). [16]

- *Limited Uptake of AI technologies*: Europe is facing the challenge of limited adoption of AI technologies by companies and the public sector[17]. It is reasonable to assume that there is a strong correlation between the uptake of AI, Data and Robotics technologies and the uptake of digital technologies in general. In particular, in comparison to the United States, on average Europe is lagging in using digital technologies. The adoption of data-related technologies, such as Internet-of-Things (IoT), the use of Big Data and the development of Big Data infrastructures are still niche areas in European countries, according to a recent McKinsey study[18]: On average, European countries are only capturing 12% of their digital potential, whereas the United States is capturing more than 65% of its digital potential. With the limited degree of digitalisation in Europe due to less digitalised processes, less industrial data is produced that can, therefore, be made available.[19]

Numbers related to the strategic opportunities

In terms of global impact, PwC[20] estimates that AI[21] could contribute 14.3 trillion Euro to the global economy by 2030, representing an increase of 14% on today's global GDP. 55% of this increase is accounted to productivity gains and 58% to demand-side impacts. From this amount, 1.6 trillion Euro are attributed to Northern Europe with a total impact of 9.9 % of GDP and 0.6 trillion Euro to Southern Europe with a total impact of 11.5% of GDP.

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[15] External investments from external investors in comparison to internal corporate investments.

[16] The Age of Artificial Intelligence – Towards a European Strategy for Human-Centric Machines. EPSC Strategic Notes, Issues 29, March 2018.

[17] European Political Strategy Centre. The Age of Artificial Intelligence. Towards a European Strategy for Human-centric machines, EPSC strategic Notes, Issue 29, March 2018

[18] McKinsey Global Institute, Tackling Europe's Gap in Digital and AI, February 2019

[19] from "The Vision for Artificial Intelligence in Europe", AI4EU Deliverable, accessible at https://www.ai4eu.eu/discussion/40

[20] PricewaterhouseCoopers (PwC), 'Sizing the prize – What's the real value of AI for your business and how can you capitalise?', June 2017.

[21] PwC defines the term AI in a very inclusive manner. It consists of a number of areas, including Large-scale Machine Learning, Deep Learning, NLP, Collaborative Systems, Computer Vision, Algorithmic Game Theory or Soft Robotics, but not limited to those areas. Thus, Data and Robotics can be seen as covered.

In terms of impact on the overall economy, Accenture[22] anticipates that AI[23] has the potential to double the economic growth rates by 2035. In their analysis, they highlight that AI is *a new factor of production*, rather than a means to enhance productivity. The above numbers underline the high impact as well as opportunities for the global and European economy and society.

Gartner[24] highlights the trend of AI[25] creating more jobs than it eliminates, for instance, in the period from 2020 to 2025 AI-related job creation is expected to be positive on balance and reach two million net new jobs. A similar impact is expected from AI-based augmentations of jobs and tasks. By 2022, twenty percent of workers that are engaged in mostly non-routine tasks will benefit from incorporating AI into their work processes. In terms of business value, this will allow the generation of 2.6 trillion Euro as well as the recovery of 6.2 billion hours of worker productivity.

Numbers related to AI Investments:

According to IDC[26] the global investment in AI & Data is increasing and will reach worldwide 33.1 billion Euro in 2019 from which 6.5 billion Euro, 19%, will be made in Europe. This is an increase of 33% worldwide and respectively 40% in Europe over the amount spent in 2018. By 2023, this amount is projected to more than double to 86.6 billion Euro worldwide, whereas the European share of industrial investments for this market is estimated at 18.8 billion Euro.

From 2020 to 2023 (4 year time-frame), it is expected that European Investment in AI & Data sum up to 54 billion Euro, which leads to an investment of 13 billion Euro per year on average.

Higher spending numbers are available for the robotics market: According to IDC[27] worldwide spending in robotics and drones will be worth 101.8 billion Euro in 2019 from which about 12.6 billion Euro are spent in Europe. It is expected that European spending will go up to 17.6 billion Euro in 2023 and 21 billion Euro in 2025.

The European investments in robotics and drones in the years from 2020 to 2023 will accumulate to 63.2 billion Euro and spending of 15 billion Euro per year on average.

Based on the above numbers, European investments for AI, Data and Robotics will sum-up to 117.2 billion Euro from 2020-2023 with a yearly investment of 29.3 billion Euro on average. Investments in European AI start-ups are indicating similar increases. From 2015 to 2019 investment in AI start-ups grew by nearly a factor of 4 from 1.25 billion to 4.88 billion Euro, in big data start-ups by a factor of 2.5 from 1

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[22] Accenture, 'Why Artificial Intelligence is the Future of Growth', June 2016. The analysis covers 12 developed economies (Unites States, Finland, United Kingdom, Sweden, Netherlands, Germany, Austria, France, Japan, Belgium, Spain and Italy) with 10 of them being European.

[23] When talking about AI Accenture refers to the combination of multiple technologies covering three high-level capabilities Sense, Comprehend and Act. Based on this definition, the AI also incorporates Data and Robotics.

[24] https://www.gartner.com/en/newsroom/press-releases/2017-12-13-gartner-says-by-2020-artificial-intelligence-will-create-more-jobs-than-it-eliminates

[25] In accordance to Gartner applies AI applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions, and take actions (see https://www.gartner.com/en/information-technology/glossary/artificial-intelligence). From this definition, overlaps with Data and Robotics can be assumed.

[26] For this analysis of the AI and Data sector we using data from the Worldwide Semiannual Artificial Intelligence Systems Spending Guide 2018.

[27] For this analysis we are using data from the Worldwide Semiannual Robotics and Drone spending Guide 2018 H2. By putting a filter on the IDC data from the worldwide semi-annual Robotics and Drones spending guide 2018H2 allowing us to select all technologies relevant to this Partnership

billion to 2.5 billion Euro and in robotics by a factor of 8.7 from 160 million Euro to 1.4 billion Euro.[28]

2.1.6   Previous and related Framework Programme intervention

Both of the Horizon 2020 partnerships, BDVA and SPARC cPPPs, achieved high impact by enhancing cohesion and engagement within the wider data and robotics ecosystems and communities. This new Partnership, as described in this application, builds on the work of these current partnerships and on the investment in the broader European AI community crystallised in the formation and existence of EurAI, CLAIRE and ELLIS.

BDVA

The Big Data Value (BDV) cPPP and related funded projects cover Big Data technology, including AI methods, data and AI platforms and applications, data incubators, Big Data DIHs, new data-driven business models, data ecosystem building support, data skills, regulatory and IPR requirements as well as societal aspects.
As part of the H2020 Work Programme 2016-2020 actions have been developed in alignment with the BDV SRIA objectives and implementation mechanisms, such as i-Spaces, lighthouse projects, technical projects and cooperation/coordination activities.

The activities covered over six major sectors[29]) with close to market large-scale implementations and 15 additional sectors in the other actions.

The funded projects could achieve significant e*nvironmental impact. For instance,* 20% contributed to the reduction of energy and 30% contribution to the reduction of CO_2 . Some projects could reach efficiency improvements[30] between 25% and 51% in energy reduction and up to 29% and to 23% of emission reductions in general (including PM and NO_x).

The BDVA Monitoring Report[31] reports about BDV PPP's achievements and impacts in detail. For instance, Macro-economic KPIs linked to the BDV PPP such as the *EU share of the total revenues*, the number of Data companies and its associated *revenues*, and the *number of Data Professionals*, have shown a very positive trend in the last few years:

- *EU share of the total revenues* in 2013 baseline was 27,7%. This share increased slightly to 27.9% in 2018, which is remarkable because the international indicators grew very fast in this period, but the EU kept pace with them.
- The *number of Data Companies i*ncreased to 283 100 by 2018, compared to 271 700 in 2017.
- The *revenues of Data Companies* in the European Union reached 77 B€ in 2018 compared to 69 B€ in the year before, with a growth of 12%.
- The *baseline for Data Professionals* in the European Union in 2013 amounts to 5,77 million. The number of Data Professionals increased to a total of 7,2.

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[28] Numbers are taking from the recent Atomico Report 2019 The State of European Tech
(https://2019.stateofeuropeantech.com/chapter/about/)

[29] Bio-Economy, Transport, Mobility and Logistics, Healthcare, Smart Manufacturing, Energy and Finances

[30] for selected monitoring items

[31] http://www.bdva.eu/MonitoringReport2018

million by 2018, resulting in a total absolute growth of 1,453 million professionals since 2013.

A large percentage of the BDV PPP projects and BDVA members reported contributions linked to these KPIs accelerating the adoption of new technologies, developing innovative technologies and new tools to make European companies more competitive, and making data processing easier and cheaper for companies; also by creating and supporting new EU data-driven companies, offering direct support and getting funding for data start-ups, creating new opportunities through privacy-preserving analytics solutions and supporting education and training. In addition, the report shows that a wide range of SMEs and start-ups in Europe benefit from the BDV cPPP, considering size, age and geographical distribution.

Strong liaisons with European and worldwide Standardisation bodies have been set up by the association as a way to coordinate and channel European R&I input (cPPP) into global standards for AI and Big Data. This includes e.g. current official liaison with the ISO/JTC1/SC42, discussions with IEEE, and MoUs with CEN/CENELC and ETSI.

Furthermore, BDVA has established efficient cooperation with the major European horizontal initiatives, such as EITDigital, AIOTI, EuroHPC, euRobotics, NESSI and ECSO, as well as vertical initiatives, such as EFFRA.

By officially joining the EuroHPC Joint Undertaking as a private member, BDVA showed strong commitment to contribute to the alignment of HPC, Big Data and AI strategies and roadmaps in Europe.

BDVA is organising yearly two events European Big Data Value Forum (EBDVF) and the Big Data Value Meet-up to gather and engage all stakeholder of data-driven AI research and innovation community.

euRobotics aisbl and SPARC

The main achievements of the SPARC[32] cPPP, covering all aspects of robotics technology and applications, can be summarised as follows:

1) The alignment of industrial and academic research in robotics in the funded actions based on the development of a common terminology and approach to robotics. Joint academic and industry development of the Multi-Annual Roadmap[33] detailing all aspects of robotics technology and applications used as the basis for work programme co-development.

2) Established the largest European focused Robotics event attracting some 900 participants or more each year. The European Robotics Forum is the key event for all robotics related organisations in Europe and is built around workshops, exhibitions and demonstrators combined with plenary sessions to focus and engage the community in discussion around key topics.

3) Established the five Digital Innovation Hub Networks in Robotics focused on the four main priority application areas of Healthcare, Agri-Food, Infrastructure inspection and maintenance and Agile Production[34].

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[32] SPARC is the cPPP between euRobotics aisbl and the European Commission

[33] https://www.eu-robotics.net/sparc/about/roadmap/index.html

[34] https://rodin-robotics.eu is the overarching CSA that coordinates the DIH in robotics.

4) Pioneered the operation and value of cascade actions to support SMEs by lowering access barriers through funded actions such as ECHORD++[35].

5) Established the European Robotics Week that takes place in November each year and coordinates robotics open-labs and events to engage citizens and build awareness of robotics and its impact. Some 1300 events in 41 countries were held in 2019 reaching some 1.2 million accounts on social media.[36]

AI Research

AI research in Europe has a long and successful history. It was the home to George Boole, father of symbolic reasoning, and Alan Turing, father of the Turing Test. Pockets of AI research existed from as early as 1963.[37] Larger-scale European-wide participation dates back at least to the creation of the ECAI[38] archival conference in 1974 organised by the European Artificial Intelligence Association (EurAI)[39], an association of 29 of Europe's national AI associations, which in sum counts more than 4500 members. CLAIRE[40], the "Confederation of Laboratories of Artificial Intelligence Research in Europe" has more than 3000 individual members and a network of 320 laboratories, institutes and institutions employing more than 19,000 people. ELLIS[41], the "European Lab for Learning and Intelligent Systems", brings together machine learning research excellence in Europe. Bibliometric data[42] show that Europe ranks first worldwide in terms of published AI research papers in AI (Europe: 170,800; China: 135,000, US: 106,600). Many of today's most used AI methods and tools are rooted in the formal work done in European universities and research institutes: for example, Deep Learning originated from the work of Ivakhnenko (Kyiv) and Schmidhuber (Lugano); the semantic web was initiated by Berners-Lee (Oxford), and Prolog was developed by Colmerauer[43] (Marseille) and Kowalski (Edinburgh). Europe leads the world in areas such as Constraint Programming, SAT solving, or AI Planning. Many winners of the IJCAI Research Excellence Award have been European.

For 20 years, Europe has been actively supporting R&D on AI and its applications. Remarkable successes in creating strong unified European research communities with clear links with industry were obtained through the "Networks of Excellence" instruments of FP6-FP7 (renamed "Coordinated Actions" in H2020), and the related FET projects. The most successful have been the successive PASCAL networks[44], that contributed to boosting research in Machine Learning long before it became clear it would boost AI and beyond. Among others, one could also cite Evonet, FOCAS, and other similar initiatives like PERADA, IPROMs, etc. More recently, the AI-on-demand platform is working towards similar, although more operational, goals. These strategic investments have led Europe to gain top position in the world in AI at large, and put Europe in a unique position to deliver world leading solutions in areas like machine

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[35] http://echord.eu

[36] https://www.eu-robotics.net/robotics_week/

[37] http://www.inf.ed.ac.uk/about/AIhistory.html

[38] European Conference on Artificial Intelligence, https://www.eurai.org/activities/ECAI_conference

[39] Previously named ECCAI.

[40] https://claire-ai.org/

[41] https://ellis.eu/

[42] Data from 1998 to 2017, source: Elsevier AI Report 2018, Scopus.

[43] Colmerauer, A.; Roussel, P. (1993). The birth of Prolog. ACM SIGPLAN Notices. 28(3):37.

[44] https://www.k4all.org/project/pascal2/

learning, knowledge representation and automated reasoning, natural language processing, and machine vision, as well as in areas like "Physical Intelligence", with applications to intelligent robotic systems,[45] like embedded AI systems and cognitive systems[46]. AI systems will play a decisive role against the economic, environmental and human challenges we face ahead, and could grant Europe the competitive edge that will prove its value in the near future.[47] Unfortunately, although Europe is currently producing twice as many PhDs in AI than the US, and is still leading in terms of the number of scientific publications in the field, these economic promises have been slowly vanishing in recent years, as the commercial giants from the US and China have attracted European researchers and promising European start-up companies (e.g., the Apple Siri system was originally built by a small company in France). Action is needed to counterbalance such trends.

The European Commission has already begun to strengthen the AI research ecosystem in Europe through a series of calls that are specifically focussed on AI, including ICT-26, ICT-48, and ICT-49, to name a few. ICT-26 has funded the AI-on-demand platform which is a key piece of the infrastructure needed for European AI. ICT-48 will fund four large networks of excellent research centres and one coordination support action. These will bring together much of Europe's excellence in AI, and will form a starting point for building this further. ICT-49 is meant to improve and extend the AI-on-demand platform and its sustainability while also reaching new sectors. In addition, AI is being funded in societal challenges and applications along the overall H2020 work program, like health, energy, mobility, manufacturing, HPC and edge computing.

2.1.7 Addressing market failures and bottlenecks

The systemic bottlenecks in R&D&I strongly relate the challenges set out in Section 2.1.3 that the research landscape is fragmented and siloed and it is therefore hard to assess value and accelerate uptake, there is a talent drain to competitor regions such as the US and Asia because the European AI, Data and Robotics innovation eco-system is not strong enough or well resourced enough to provide the best opportunity for research and innovation to flourish at full speed. In addition the investment landscape in Europe has a reputation for being too slow with a limited appetite for risk. Infrastructure support for AI, Data and Robotics, in terms of computational resource and testing infrastructure at scale, is also an issue given the need to prove systems at scale. Europe has to unlock its potential by investing to cohere and resource its R&D&I infrastructure.

In terms of market failures opinions are divided as to the direction that Europe should drive AI, Data and Robotics to correct them. There is no doubt that increasing uptake will drive up productivity, but the direction Europe takes with regard to the consumer based AI and Data corporations in the US and the robotics manufacturing of China needs to be carefully balanced with the inherent strengths of Europe in B2B and public service use of AI, Data and Robotics. Europe has proved that it can take the initiative in developing consumer protections, for example with GDPR, and it plans to extend

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[45] Reinhard Lafrenz. Robotics needs AI and AI needs robotics. The Parliament Magazine 479: 47, 2018.

[46] Metta, Giorgio, et al. "The iCub humanoid robot: An open-systems platform for research in cognitive development." Neural Networks 23(8-9): 1125-1134, 2010

[47] "The Vision for Artificial Intelligence in Europe", AI4EU Deliverable, https://www.ai4eu.eu/discussion/40

this to AI, Data and Robotics in order to create a European "safe haven" for AI[48] to counter market failures in the protection of citizens.

However, if Europe is to *address the significant shortfall in the uptake of smart technologies within its industrial and service base* it must act intelligently and innovatively to both create awareness and uplift skills. In particular it must act to level the regulatory landscape across Europe and utilise modern skill development technologies to rapidly spread knowledge into the existing workforce. For this to be effective, a collaborative approach is needed that can engage the resources of the EC in combination with those of Member States that combine the private and public sector to address the potential for market failure in the adoption of AI, Data and Robotics.

2.1.8 Serving public and private interest

The Partnership will have impacts at multiple levels that will serve the public interest. For instance, AI, Data and Robotics can be used to improve government operations and public services. Although most public institutions are aware of the impact of smart technologies, their adoption lags behind. The reason for the adoption delay in the public domain is caused by the same problems observed in other sectors, i.e. first, the required data is often difficult to access or find, second the public sector officials lack appropriate knowledge and expertise to scope application scenarios and justify investments and third, ethical considerations bring additional complexity[49]. Thus, to foster its dissemination and exploitation in both, private and public sector, information flows between stakeholders needs to be improved. This will lead to more rapid adoption of AI, Data and Robotics across all industries thereby improving and creating jobs. In addition, more rapid uptake of these technologies will enhance both products and services and lead to citizen benefits and create benefit around the Sustainable Development Goals and European Missions as well as addressing citizen acceptance, by promoting understanding of AI, Data and Robotics to citizens.

2.1.9 Building on experience of prior R&I partnerships

The two Horizon 2020 Partnerships that this new Partnership is built on have gained extensive experience, built effective engagement mechanisms and, through the promotion of the roadmap derived work programmes, created collaborations and technical advances that have delivered significant impact. This new Partnership is forged from these strengths[50], for example on the i-Spaces developed within BDVA and on the Digital Innovation Hubs developed through SPARC. The new association will now work to integrate the extended remit of the Partnership by focusing on the impact of the existing portfolios while focusing on the objectives defined in Section 0.

2.1.10 Key R&I Challenges

Each of the three technology areas, AI, Data and Robotics, present enduring long-term challenges that will be the focus of technical ambition in the Framework Programme. They also present significant application and deployment challenges that are coupled to the challenge of creating a fully functioning innovation ecosystem in Europe. It is critical to also consider the range of challenges that exist along the R&I

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[48] https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

[49] https://www.weforum.org/projects/unlocking-public-sector-artificial-intelligence

[50] Evidence of success in each of these areas can be found in the Annual Monitoring Reports and other on-line resources from the two associations: http://www.bdva.eu/MonitoringReport2018 and https://www.eu-robotics.net/sparc/10-success-stories/index.html

pathway from lab to application so that early stage research, application driven research and deployment are fully taken into account.

AI R&I Challenges

Decades of research in AI have produced technologies that are providing strong benefit to industry, government, and society. Machines can perform better and faster than humans many tasks that were not thought possible a few years ago. In the process, the field has expanded from an initial focus on algorithms, reasoning and theories and into a context of continuous data collection, interactivity, and massive amounts of knowledge about a constantly changing world.

This Partnership will focus its work on various aspects of AI. However, achieving the potential of AI technologies poses many further research and innovation challenges, across a broad spectrum of areas. AI challenges span all areas of computer science, as well as cognitive science, psychology, biology, mathematics, public policy, ethics, education, and communication, to name just a few. In addition to scientific challenges on the method and theory levels, there are also particular challenges when applied in different application areas.

The most prominent recent successes of AI were obtained through immense progress in Machine Learning encountering technological and organizational access to data. The size of the success can be seen from Google's recent list of science sources (lead by Nature and Science as expected) where 5 entries out of the top 100 sources in are now machine learning conferences or conferences on direct applications in computer vision. At the same time we see a tremendous impact in application areas which have been transformed by machine learning: medical image analysis, natural language processing, audio and all other forms of signal processing. Reinforcement learning, robust learning, new architectures, limitations of the number of data needed in the learning, machine learning hard- and software, the use of unlabelled data are all current topics of research with great acceleration. No longer the old adage of garbage in, garbage out is valid per se if compensated by sufficiently many data points. The quest for small data learning, continuous learning and transfer learning will remain on the agenda together with the quest for efficient architectural design and hyperparameter optimisation. A key to establishing the next level of intelligent systems is finding good ways to combine machine learning and machine reasoning (generally, this means combining symbolic and sub-symbolic approaches). We can imagine the importance of this by reflecting on what it means if a person could only learn, but not reason, or vice versa. Incorporating symbolic knowledge (rules, ontologies, etc.) into deep learning remains a challenge today.

But beyond ML-specific challenges, an overarching area that needs research and innovation is how to design AI systems (and not only learning systems) that are trustworthy and human-centric as defined by the European Union's High-Level Expert Group on AI, and reinforced in the White Paper on AI. Trustworthiness is crucial for humans to trust AI systems, and therefore for the deployment of AI-systems. Furthermore, trustworthiness can be both a challenge and an opportunity for the EU to get back in the game and is a cornerstone in the EU strategy.

Trustworthiness encompasses explainability, fairness, and robustness. One way toward explainable AI is yet another type of hybridisation with symbolic methods.

Another approach relies on causal reasoning. Though often implicit and common sense driven for humans,[51] causal models require specific algorithms to be learnt from data and observations. Similarly, fairness needs further research work: no universal formal definition of fairness exists, and ad hoc algorithms and test procedures are needed to automatically identify biases in data, learned models, and decision support systems. Robustness is another critical property of trustworthy AI systems, be it robustness against noisy data and environment or against adversarial attacks. In any case, in most contexts, we are still a long way from certified and verified AI systems, and hybridisations with either numerical approaches to robust optimisation, or formal methods in Computer Science, seem a promising way to go.

Further examples of the need for a broad approach to AI in the years ahead include the need for novel developments in how users interact with advanced AI systems, and the further development of AI for robotics, including the development of situational AI, spatial reasoning and, again, causality. Significant research is needed in particular to best understand and design collaborative problem solving, where humans and machines can take advantage of each other's very different strengths. Meaningful interaction comprises techniques for productive collaboration in mixed teams of humans and machines, combining diverse communication modalities (verbal, visual, emotional).

Data R&I Challenges

Success in data-driven AI application relies on the combination of a wide range of technical research and innovation challenges ensuring the access and processing of data in high quality and in an efficient manner. First, to overcome barriers to data sharing for AI, frameworks for data governance need to be established to enable all parties to share their data assets within a trusted framework to create new data value chains. Common frameworks, methods, tools, and platforms for data sharing are required to enable the development of trusted technologies, products and services that cater for stakeholders across the diversity of the European Union, while respecting individual rights. Second, when working with large datasets in flexible environments, data analytics methods need to be advanced to enable flexible adaption while running efficiently. The scaling and federation of AI systems, ensuring that simple AI-models can seamlessly be composed and combined into large scale federated systems. This includes scenarios based on distributed data storage locations, for data-in-motion and data-in-rest while satisfying the privacy, robustness and performance requirements from the user side. Third, improving the data assets by addressing data pre-processing challenges for the various data types (including unstructured data such as image, text, video, audio, etc. and real-time data). This includes methods for annotation of unstructured data sources, unbiased and representative input data, methods for handling volumes of real-time data with high velocity, etc. Generating of enriched and high-quality input data for analytic applications. This includes any methods in advanced analytics and learning techniques to derive insights, patterns, events, data anomalies detection, sentiment and emotion analytics, etc. from heterogeneous data sources, advanced learning techniques. Fourth, to derive value from data and domain knowledge, methods from both symbolic AI and statistical AI need to be combined to give the maximum potential and usability of data-driven AI-based applications. This

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[51] And common sense is one important component today missing on the way to General Artificial Intelligence, together with consciousness.

combination for making use of knowledge graphs and statistical AI techniques supports AI solutions with regard to (i) data quality issues, (ii) integrated and continuous knowledge and use of training data, (iii) explainable AI (no black-box solutions) and, finally, (iv) the mutual fertilisation of semantic technologies and AI techniques towards self-optimising machines. Fifth, with the increasing number of intelligent devices at the edge, more and more data will be processed and analysed in distributed locations. With computing capabilities in the cloud and at the edge being increasingly intertwined, scalable and reliable approaches for distributed data analytics (edge analytics) need to be developed. Sixth, continued support for research, innovation and deployment of Privacy-Preserving Technologies is needed. This includes the scalability and uptake of GDPR-compliancy in processing and sharing of data sources, ensuring data privacy and data security standards along the data lifecycle which also applies to distributed data and real-time data. Seventh, with AI's disruptive potential, there are significant ethical implications on the use of data-driven AI & autonomous machines, and their applications for decision-support. To ensure trustworthy and explainable data-driven AI in industrial or critical settings further research is needed. Finally, the European Data Space will be a key enabler for data-driven AI by enabling the creating of data value chains using a mix of personal, non-personal, proprietary, closed and open research data.

Robotics R&I Challenges

Robotics faces multiple technical challenges because robotics is the integration of mechanical, sensing, electronics, software, AI and design systems to create functional entities that have to work unaided in complex environments, or work in close proximity with people to enhance their work. Safety, reliability, dependability and trustworthiness are therefore essential technical goals. Robotics also depends on positional accuracy, from the micro-meter scale to the planetary scale. It challenges energy storage and the efficiency of actuation to build robots that can operate for weeks and months without recharging or breaking down. There are challenges in the interpretation of complex dynamic environments, such as a disaster zone, or an elderly care home, where decisions about how to interact with both people and objects have potentially damaging consequences. Robots must integrate knowledge gathered from the immediate environment with that held remotely or supplied by human operators and then use this to make effective decisions that deliver useful functions that can be scaled to provide economic, societal or environmental benefit, for example by the early detection of fatigue in wind turbine blades, or the faster assembly of complex energy efficient buildings. Robotics also depends on numerous horizontal technologies from photonics to smart data networks as well as battery technology and novel materials to create new forms of actuation and control that drive up dexterity and motion control to faster than human performance levels in complex tasks. Finally, Robotics depends on advances in configuration and design tools, tools that make robotics faster and easier to design, configure and deploy. Tools that can smoothly integrate interoperable components into effective systems as well as command and control tools that enable the coordination of multiple independent autonomous actors focused on a collective task. Robotics is inherently a multi-disciplinary challenge that integrates a wide range of technologies, human factors and operational complexity into a single autonomous entity.

2.2 Common vision, objectives and expected impacts

2.2.1 General objectives

1. **Secure European's sovereignty over AI, Data and Robotics technologies and knowhow** (position and control perspective dimension)

   It is critical that Europe retains sovereignty over both the skills and assets it has built and developed. It is important that this European sovereignty is supported in all its aspects; the need to retain a talent base, the need to benefit from public investment, the need to ensure that its AI, Data and Robotics infrastructure advantages its citizens and businesses. The **Partnership will** work towards ensuring Europe can protect its public investments by highlighting where protections are needed, by ensuring non-dependence from other international players and by ensuring that public investment is matched by private commitment to a European focused approach to the development and deployment of AI, Data and Robotics.

2. **Establish European leadership in AI, Data and Robotics technologies with high socio-economic impact** (technology and innovation dimension)

   The current data explosion, combined with recent advances in analytical capabilities, computing power and advanced robotics, pave the way for AI, Data and Robotics technologies to provide economic, environmental and societal value. The **Partnership will** strengthen scientific capabilities as well as master essential technologies in human-centred and trustworthy AI, Data and Robotics by connecting and engaging all relevant stakeholders to ensure faster uptake of AI, Data and Robotics in all sectors and regions in Europe.

3. **Reinforce a strong and global competitive position of Europe in AI, Data and Robotics** (market dimension)

   AI, Data and Robotics present an opportunity to improve the operation of European public and private sectors and a challenge to translate Europe's core strength into a global market advantage. The **Partnership will** focus on strengthening the transfer of research into the market, developing and extending Europe's skill base and raising AI, Data and Robotics deployment.

2.2.2 Specific objectives:

To achieve the general objectives, seven specific objectives have been identified. The seven objectives correspond to the problems and challenges, as well as the problem drivers discussed in Sections 2.1.3 and 2.1.4. In addition, the relationship between general and specific objectives is displayed in Figure 1 Objective Tree of the Partnership.
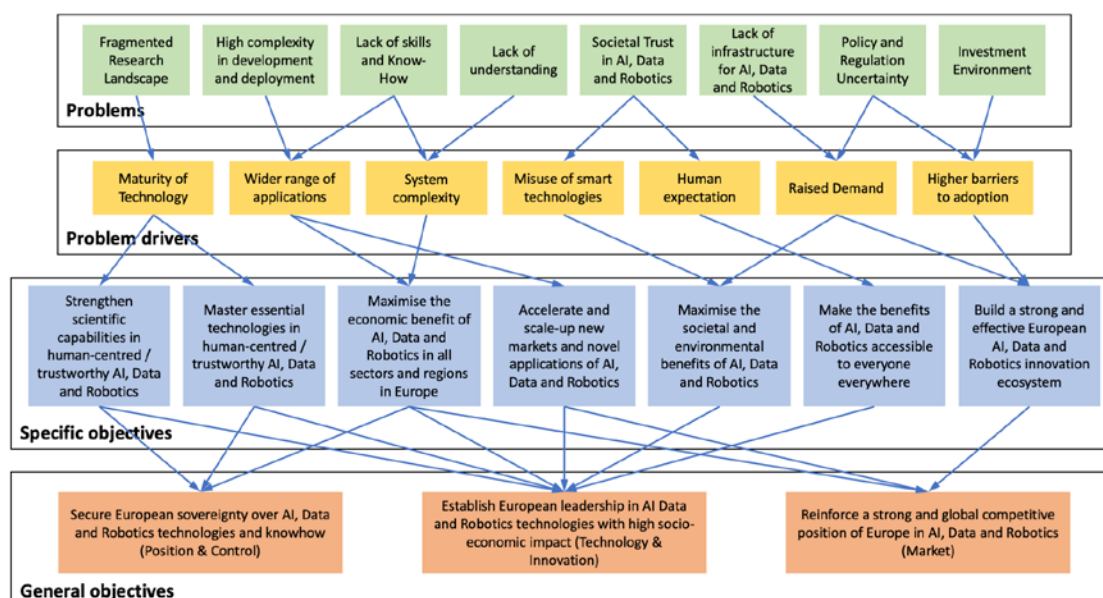
Figure 1 Objective Tree of the Partnership

Scientific objectives

Three major scientific objectives have been identified

- **Strengthen scientific capabilities in human-centred / trustworthy AI, Data and Robotics**

    The market for AI, Data and Robotics will not develop and will remain limited if its technologies cannot be trusted. Greater opportunities exist if AI, Data and Robotics can be made safe, robust and trustworthy. **The Partnership will** work to develop the opportunity for these technologies, to enhance deployment by identifying appropriate and efficient means to deliver trustable systems that do not restrict the benefits that result from AI, Data and Robotics.

- **Master essential technologies in human-centred / trustworthy AI, Data and Robotics**

    Europe enshrines particular fundamental values and rights in its constitution. These must be enhanced and respected when AI, Data and Robotics are used by businesses, citizens and governments. Law and regulation need to account for their use and for the added complexity it brings to the interpretation of human-centric legislation and to decision making. **The Partnership will** support the uptake of these technologies by ensuring innovators and researcher understand how to make them usable and trustworthy, within legal and regulatory frameworks and by building best practice guidance. The Partnership will also support the development of methodologies and infrastructure that advance these goals.

- **Build a strong and effective European AI, Data and Robotics innovation ecosystem**

    The uptake of AI, Data and Robotics will be maximised when there is a well-founded and functioning innovation ecosystem that can spread knowledge and expertise efficiently between sectors and across regions. **The Partnership will**

develop such an ecosystem by working with its members, stakeholders and the Commission to identify synergies between academia, industry and entrepreneurship. It will promote research excellence in AI, Data and Robotics technologies and encourage researchers to work across disciplines and in close interaction with user communities. The Partnership will also support the development of critical infrastructure needed to accelerate excellent research and innovation.

Economic / technological objectives

Four economic /technological objectives have been identified

- **Master essential technologies in human-centred / trustworthy AI, Data and Robotics**

   To achieve technological and economic impacts, **the Partnership will** address the opportunity to develop a specifically European character for AI, Data and Robotics while supporting new business and novel markets and in working to highlight the need for regulation and for the underlying legal frameworks in Europe to match technical and market developments. By strengthening the European AI, Data and Robotics, Europe reduces dependency on external sources of technology.

- **Maximise the economic benefit of AI, Data and Robotics in all sectors and regions in Europe**

   While AI is often portrayed as a disruptive technology, it is as much a technology that enhances and strengthens existing supply chains, value networks and organisations. Through the Partnership's broad set of members, and its connection to other partnerships and associated networks it plans to mobilise and actively identify and disseminate best practice around the deployment of AI, Data and Robotics, thereby enhancing the economic benefit and opportunity that this delivers to Europe.

- **Accelerate and scale-up new markets and novel applications of AI, Data and Robotics**

   There are tremendous opportunities for transformation through the use of smart technologies, for example many of the benefits of digitalisation depend on functioning smart systems to manage analysis, complexity and decision making. **The Partnership will** act to enhance and promote new markets and the scale-up of companies, the development of novel applications both in existing markets and new markets. The Partnership will also act to ensure that the infrastructure, including regulatory framework, necessary for scale-up, is identified and supported.

Societal objectives (including environmental and societal objectives)

Three general objectives address the environmental and social aspects, including challenges such as climate change and energy efficiency.

- **Maximise the societal and environmental benefits of AI, Data and Robotics**

   That the use of AI, Data and Robotics must be responsible and acceptable to citizens and that its use must take account of the environmental impact of these technologies. **The Partnership will** provide a forum to explore how trustworthy smart systems can be delivered in practice within each sector and how this can be done within market constraints. It will similarly explore how AI, Data and Robotics can be used to deliver critical environmental gains and how to maximise its use in optimizing resource efficiency, therefore minimising waste.

- **Make the benefits of AI, Data and Robotics accessible to everyone everywhere**

  Maximising the benefit of AI in Europe will only come about if it can be used in all regions and by all citizens on an equal basis. This will not be easy to achieve while there are different regulatory practices across Europe, and while the distribution of expertise is uneven between regions. **The Partnership will** work to ensure that the benefits of AI, Data and Robotics are accessible, and it will specifically engage with regions where these technologies are poorly deployed.

- **Strengthen scientific capabilities in human-centred / trustworthy AI, Data and Robotics**

  For generating social and environmental value out of AI, Data and Robotics, the technologies need to be safe, robust and trustworthy. **The Partnership will** promote and characterise the implementation of safe, trustworthy design and deployment that bring value to society and the environment.

- **Master essential technologies in human-centred / trustworthy AI, Data and Robotics**

  As mentioned before, the usage of Europe AI, Data and Robotics technologies needs to be in line with European values, principles and values. **The Partnership will** develop a specifically European character for AI, Data and Robotics that will maximise the uptake of AI, Data and Robotics applications that address societal and environmental challenges.

2.2.3 Intervention Logic

Expected scientific impacts

The partnership is aiming towards four key scientific impacts as illustrated in Figure 2 and further described below.
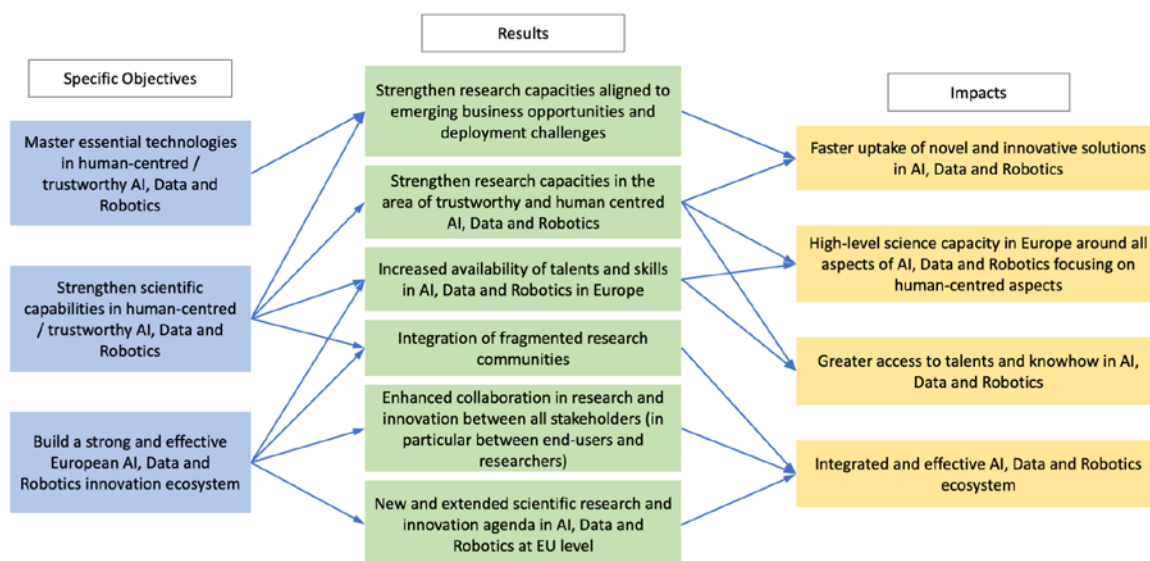

Figure 2 Pathway leading to scientific impact

It is expected that the three objectives will strengthen the European research capacities around all aspects of AI, Data and Robotics and will help to accelerate the uptake of novel and innovative solutions in AI, Data and Robotics.

In this context, the availability of a well-functioning innovation ecosystem will play a central role to enable collaboration between the different stakeholders. For instance, it will help to integrate the fragmented research communities as well as to connect end-users with researchers.

By establishing a focal point for the development and implementation of a common European strategy in AI, Data and Robotics, academic excellence and innovation can be aligned to the needs of both industry and citizens as well as investments and efforts across Europe can be federated

We expect that all scientific impacts can be realised within the time framework of the Partnership.

Expected economic / technological impacts

The Partnership will work towards achieving economic and technological impacts as visualised in Figure 3 and detailed below.
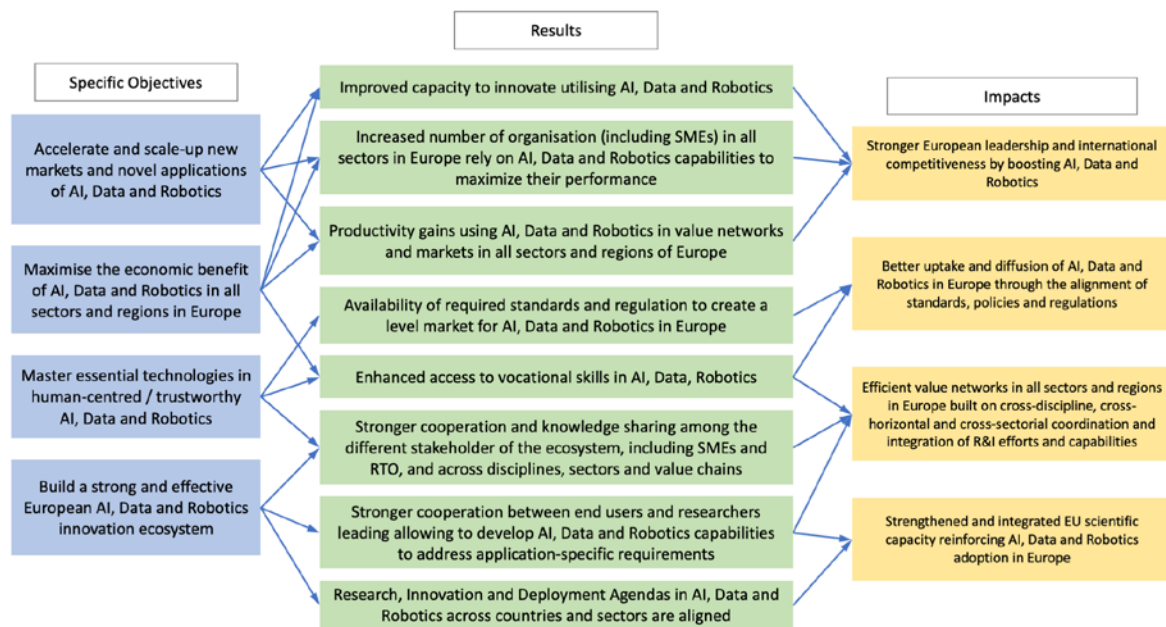
Figure 3 Pathway leading to economic / technological impacts

The four objectives will help to build efficient value networks in all sectors and regions of Europe by supporting collaboration across disciplines, across sectors and with the adjacent horizontal technology communities, such as HPC, IoT, Security, Cloud etc.

Central for the market adoption of AI, Data and Robotics technologies will be the availability of standards, policy and regulations that are aligned to the needs of users and industry.

Again, the cooperation between the different stakeholder groups will be a central aspect to generate impact, in particular, between end-users of all sectors and researchers of all disciplines.

It is expected that the improved capacity to bring AI, Data and Robotics innovation to the market and the increased number and organisations (including SMEs and start-ups) and value networks that are using AI Data and Robotics, will help to increase the overall performance and productivity of organisations in Europe.

As already described in Section 2.1.5, PwC, Accenture and Gartner anticipating that AI, Data and Robotics will have impact on the growth of GDP, economy and jobs. To ensure that this is happening in Europe, the Partnership will boost European industrial competitiveness by strengthening the EU capacity in adopting AI, Data and Robotics Those impacts will materialise within the timeframe of the Partnership and beyond.

The financial investment data from IDC (*Figure 4*) indicate that economic impacts can be expected across all sectors. Given the high number of sectors, a wide range and variety of applications is expected. High economic impacts are expected when existing processes will be optimised, in the area of circular economy and through the realisation of new business opportunities.
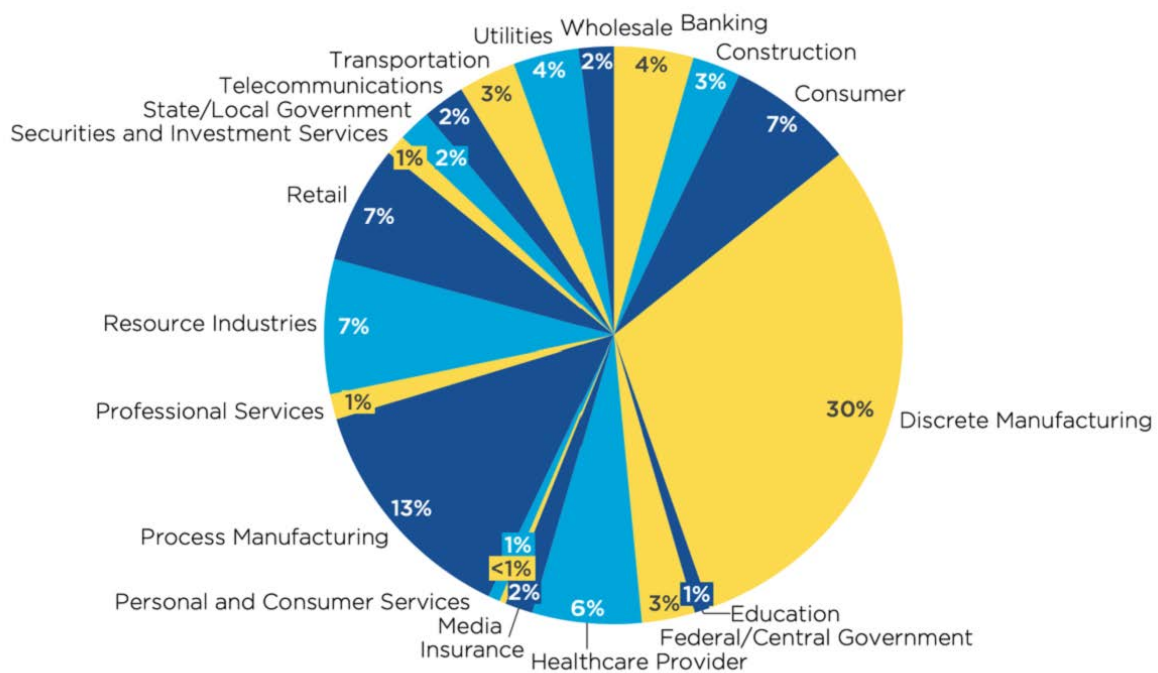
Figure 4 Expected distribution of financial investments in Artificial Intelligence systems, Robotics and Drones in Western Europe in 2019[52]

Any details related to the expected technology progress impact related to the three areas AI, Data and Robotics will be reported in the upcoming SRIDA. The work on the updated SRIDA version will be kick-started in May 2020 to collect and consolidate content from the three communities in the upcoming months.

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[52] Source: Combined data from IDC Worldwide Semi-annual Artificial Intelligence Systems & Robotics and Drones Spending Guide -2018 H2)

Expected societal / environmental impacts

Societal impact can be achieved when scientific and economic / technological capacities are used to address societal challenges as illustrated in Figure 5
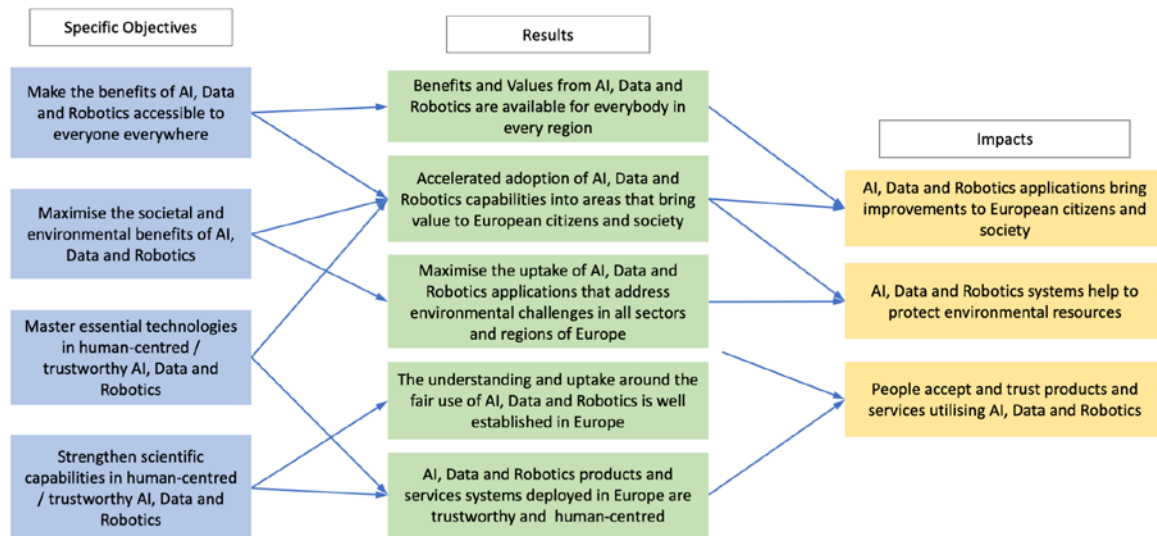
Figure 5 Pathway leading to societal impacts

The scientific and technological capacity in AI, Data and Robotics establishes the basis to bring value to European citizens and society as well as to protect environmental resources.

Central to this goal is that AI, Data and Robotics technologies are deployed in human-centred manner, and people are willing to accept and trust new applications.

The Partnership will work to raise awareness of AI, Data and Robotics and the opportunities and benefits, economic, societal and environment.

All AI, Data and Robotics technologies can be applied to impact on all missions and clusters in Horizon Europe.

For instance, **societal impacts** can be achieved

- in the area of *pandemic emergency response, e.g. for fighting Covid-19*[53]: Smart systems that enable trusted and transparent contact tracing can directly translate into lower death rates. Trustworthiness is critical to the acceptance of contact and tracing methodologies using smart systems. An overview of how AI, Data and Robotics can help in the battle against the Covid-19 pandemic (including access to different resources) can be found under http://www.bdva.eu/Covid19 and https://www.eu-robotics.net/eurobotics/newsroom/press/robots-against-covid-19.html?changelang=1

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[53] Further examples of how AI, Data and Robotics can be used to fight Covid-19 can be found under www.bdva.eu/Covid19, https://towardsdatascience.com/artificial-intelligence-against-covid-19-an-early-review-92a8360edaba , Nguyen, T. T. (2020). Artificial intelligence in the battle against coronavirus (COVID-19): a survey and future research directions. Preprint, DOI: 10.13140/RG.2.2.36491.23846 and Pham, Quoc-Viet & C. Nguyen, Dinh & Huynh-The, Thien & Hwang, won-Joo & Pathirana, Pubudu. (2020). Artificial Intelligence (AI) and Big Data for Coronavirus (COVID-19) Pandemic: A Survey on the State-of-the-Arts.

- in the area of *healthcare and cancer*: AI-powered digital technologies will lead the way in transforming the healthcare sector including the transition to new care models and, notably, value-based healthcare as well as new diagnostic methods and treatments, in particular in the area of chronic diseases such as cancer.

- in the area of *smart cities and mobility*: Existing transport infrastructure will be enhanced by intelligent systems aligning personal travel journeys with the flow of traffic, weather conditions, etc.

In addition, AI, Data and Robotics technologies pave the way to materialise **environmental impact**. The Partnership will join forces to maximise its contribution to the *European Green Deal*[54]. A wide range of opportunities exit, for instance

- in the *manufacturing and production* area: AI, Data and Robotics system can help to deliver productivity gains through more efficient resource, energy and material use, through better design and manufacturing processes and inside products and services through improving operational efficiency through more and refined contextual knowledge.

- for the *circular economy*: AI, Data and Robotics technologies can be used to enhance and accelerate the development of new products, components and materials fit for a circular economy, to operate circular business model as well as optimise circular infrastructure.[55]

- for optimising *IT systems*: Advances in AI algorithms aiming for optimised HPC computing ensure that AI systems consume less energy. In addition, research in AI will help to reduce carbon footprints required for training deep learning and NLP models.

A recent study from PwC and Microsoft[56] highlights that using AI or **environmental applications** has the potential to boost global GDP by 3.1% to 4.4 % and will help to lower the worldwide greenhouse gas emissions by 4% in 2030. Furthermore, smart systems can provide a valuable contribution to sustainability at large, addressing challenges such as (with an arbitrary choice of concrete examples): climate change monitoring and understanding[57], natural resources[58] and ecosystem[59] management, reduction of the carbon footprint of industrial[60] and human[61] processes, energy efficiency[62] and management, mobility management[63], and infrastructure planning[64]. In these contexts, the scale and complexity of the problems to be solved pose new challenges to current AI techniques that need to be scaled, made global, made more efficient, incorporated into hybrid AI systems and integrated with knowledge coming

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[54] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[55] https://www.mckinsey.com/business-functions/sustainability/our-insights/artificial-intelligence-and-the-circular-economy-ai-as-a-tool-to-accelerate-the-transition

[56] Microsoft and PwC: How A can enable a Sustainable Future: https://www.pwc.co.uk/sustainability-climate-change/assets/pdf/how-ai-can-enable-a-sustainable-future.pdf

[57] Better extreme events forecast by the US National Oceanic and Atmospheric Administration

[58] Prediction of renewable energy production

[59] Wildlife conservation and restauration

[60] German Otto distributor optimizes its supply chain by smart prediction of future demand

[61] Make the food supply chain sustainable

[62] 20% energy saving in St Vincent hospital

[63] Truck traffic monitoring

[64] Monitoring urban growth vs high flood risks

from human experts. In addition, security issues arising from terrorism-related issues, natural disasters, and epidemics[65], can be also addressed and better managed through smart systems.

2.2.4 Operational objectives

Figure 6 illustrates the operational objectives and the types of activities that can be implemented. The operational objectives will set out prioritisations covering the balance along the R&I pathway and the allocation of themes to the core instruments within the framework programmes, primarily Horizon Europe and Digital Europe.
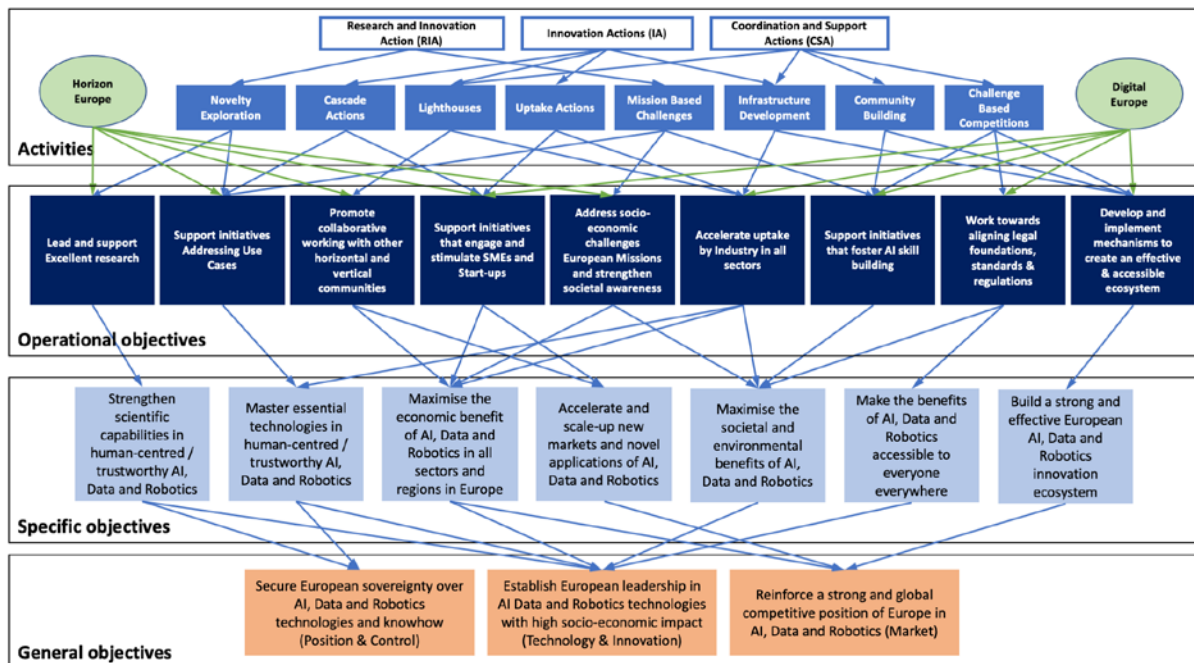
Figure 6 Operational objectives of the Partnership

The following list presents a more detailed description of the operational objectives.

1. **Accelerate uptake of industry in all sectors** Activities that build connections to vertical markets, explore scalable use cases and deliver demonstrators and larger-scale pilots that deliver risk reduction and stimulate awareness of technical capability applied to real-world scenarios. In the context of AI, Data and Robotics:

    a. Address both the horizontal (Technology supply) and vertical (Sector uptake) markets with engagement strategies; in the case that corresponding partnerships exist this will be done in collaboration

    b. Raise awareness and promote actions to improve the sectorial understanding around the return on investment for AI, Data and Robotics.

    c. Assess and collaborate to disseminate the opportunities around improving competitiveness and productivity.

    d. Identify and address key industrial and commercial challenges.

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[65] For soil moisture prediction

e. Promote and engage the involvement of end users in the process and development of innovative solutions and approaches.

f. Support actions to develop Digital Innovation Hubs, Large Scale Pilots and demonstrators

g. Identify industrial and commercial needs with respect to skills and support infrastructure.

2. **Lead and support excellent research raising the state-of-the-art around AI, Data and Robotics:** Activities that enhance the individual technology areas AI, Data and Robotics across the full scope of the Partnership and combinations of them. There is a need to develop technically deep actions that can drive step changes in technical capability. These need to be aligned to deployment challenges across the sectors so that they have appropriate context. However, the impact is likely to be long term. In the context of promoting excellent research:

    a. Identify and promote key strengths within the European research community and identify threats and opportunities including critical gaps in capability and strategic infrastructure.

    b. Seek to connect and enhance the collaboration between industry and research communities to foster mutual understanding and problem communication.

    c. Support actions that aid the translation of research into innovation and the market.

3. **Support initiatives addressing Use Cases in AI, Data and Robotics:** Activities that join together the AI, Data, and Robotics communities in developing combined technical advances that align with European challenges and strategic objectives. Such actions need to address issues around, integration, interoperability, data access and sharing, safety, trustworthiness and reliability across all the technical domains when working in combination.

    a. Support actions that create collaborative opportunities to connect the AI, Data and Robotics communities to address Use Cases across all sectors

    b. Promote actions that address key European challenges

    c. Promote and support the development of trustworthy, fair and dependable AI, Data and Robotics products and services

    d. Promote responsible research and innovation with appropriate dissemination and guidelines that support European fundamental rights and values and a human centric approach to AI, Data and Robotics.

4. **Promote collaborative working with other horizontal and vertical communities and Partnerships:** Joint activities together with other Partnerships both horizontal and vertical. AI, Data and Robotics impact within other Partnerships and there will be common areas between this Partnership and others that can be encapsulated in joint actions within the work programme.

    a. Work with other European associations to bring external expertise into the Partnership to enhance its strategic and technical competence especially in areas outside of the technical domains.

5. **Develop and implement mechanisms to create an effective & accessible ecosystem (incl. innovation infrastructure):** A key objective of the Partnership is to develop a well-founded AI, Data and Robotics ecosystem across Europe. This will require a mixture of activities ranging from small scale wide reach actions that can stimulate and cohere communities to infrastructure actions that develop resources and facilities that support the research, innovation and translation of AI, Data and Robotics.

    a. Support and promote the development of a strong innovation eco-system in Europe.

    b. Identify and prioritise the need for and support the development of critical infrastructure to support the Operational Objectives.

    c. Seek to create and align connections with national and regional investments in eco-systems and infrastructure.

    d. Develop links to key policy makers and develop strategy for a European AI, Data and Robotics eco-system and infrastructure investment and operation.

    e. Ensure that the eco-system is aligned with the skills and competence needed by Europe in AI, Data and Robotics.

    f. Work to develop inclusion and diversity within the AI, Data and Robotics eco-system

    g. Identify, assess and promote actions that develop appropriate regional engagement around all aspects of AI, Data and Robotics.

    h. Support and promote actions that deliver technology brokerage, technology exchange and connectivity within the eco-system.

6. **Support initiatives that engage and stimulate SMEs and Start-ups:** The objective of these activities is twofold. On the one hand, it will stimulate the creation of new companies/start-ups and will support SMEs and start-ups providing solutions and integrating technology to become more competitive. On the other hand, it will support SMEs in many different sectors (users of the technology) in their digital transformation. These actions will rely on the DIHs in AI, Data and Robotics, and European testing facilities building bridges in between HE and DEP.

    a. Identify and support mechanisms that promote the engagement of SMEs and start-ups in the innovation eco-system and that support the translation of research into innovation.

    b. Act to support connectivity between SMEs/Start-ups and end users including the development of collaborative actions and partnership instruments.

    c. Work to identify and promote private investment in SMEs/Start-ups and access to finance including raising awareness of investors to key opportunities and value creation in Europe.

    d. Work to establish links to incubators and innovation generators both nationally and at European scale.

7. **Work towards aligning legal frameworks, standards & regulation:** The objective is to create a level market in Europe shaped around common worldwide standards and regulations and around common approaches to the certification and validation of AI-based products and services. This will enable a smooth translation of innovation into the market.

   a. Identify and analyse the European market for AI, Data and Robotics in terms of standards and regulatory systems.

   b. Engage with legal and regulatory experts to understand and assess the impact on the deployment of AI, Data and Robotics products and services

   c. Identify and support actions to enshrine trustworthiness and processes to support "by design" approaches.

   d. Identify, prioritise and support actions that develop inter-operability and modularity of AI, Data and Robotic systems.

8. **Support initiatives that foster AI Skill building:** The objective is to take a broad perspective in understanding the skill challenge facing Europe. Based on an understanding of the demand and supply of AI skills in Europe, the partnership will take actions that support a strong educational AI, Data and Robotics skills pipeline at all educational levels.

   a. Engage with and assist organisations, including other Partnerships, able to assess the skill needs of research and industry and the impact of AI, Data and Robotics on society.

   b. Work with educational providers to collaborate on a strategic approach to skills enhancement.

   c. Identify and prioritise actions to retain and attract talent, especially those relating to the operation and resourcing of the eco-system.

9. **Address socio-economic challenges, European Missions and strengthen societal awareness:** The partnership will take action to increase awareness of AI, Data and Robotics within both public and private organisations and with citizens. It will work to ensure that its actions contribute to European Missions especially concerning the environment and the response to the COVID-19 crisis and will address socio-economic challenges.

   a. Develop actions and strategies that align with key European Missions and the recovery from the COVID-19 crisis.

   b. Work to prioritise the use of AI, Data and Robotics in addressing socio-economic challenges

   c. Act to support actions that promote and develop environmental responsibility and where AI, Data and Robotics can impact on the Green Deal

   d. Engage with organisations to assess and promote the fair use of AI, Data and Robotics and to assess the risks to citizens of AI-based products and services.

	European Ecosystem	Skills, Acceptance & Society	Innovation & Market Enabler	Guiding Standards & Regulation	Promoting Research
1) Accelerate uptake of industry in all sectors			■		
2) Lead and support excellent research raising the state-of-the-art around AI, Data and Robotics:					■
3) Support initiatives addressing Use Cases in AI, Data and Robotics			■		■
4) Promote collaborative working with other horizontal and vertical communities and partnerships	■				■
5) Develop and implement mechanisms to create an effective & accessible ecosystem (incl. innovation infrastructure	■	■			
6) Support initiatives that engage and stimulate SMEs and Start-ups			■		
7) Work towards aligning legal frameworks, standards & regulation				■	
8) Support initiatives that foster AI Skill building:		■			
9) Address socio-economic challenges, European Missions and strengthen societal awareness		■			

Table 1 Mapping between Investment areas and Operational Objectives

2.2.5 KPIs

A wide range of indicators have been identified to measure the short, medium and long-term progress of the Partnership[66] towards its operational objectives. In the table below we summarise a tentative estimate of the expected impacts in the five investment areas and different operational objectives over the timeframe of the Partnership. During the first year of operation the Partnership will establish a baseline for each of the Partnership KPIs and will set targets against the medium and long term. At the same time it will also examine the macro-economic forecasts for AI, Data and Robotics and will create and update its forecasts.

KPIs	Operational Objective	Measured Impact	Short (year 1+)	Medium (year 3+)	Long (year 5+)
European Ecosystem					
Detailed KPIs should be aligned with following Operational Objectives	*4) Promote collaborative working with other horizontal and vertical communities and partnerships*	Engagement with other relevant initiatives at European level and worldwide needed to maximise the impact of the partnerships (other partnerships, verticals, DIHs, TEFs, Communities of Start-ups, Regional, National initiatives, Non-European organisations, Standardisation Bodies, Investors etc) will be measured as follows: The number of new formal collaborations established. The number of verticals engaged in collaborations. The number of other partnerships (tackling AI, Data or Robotics) engaged with impact. Alignment in SRI(D)As with other partnerships (measured as common topics common topics in WPs,.) The number of existing worldwide initiatives collaborating with the Partnership (Standards, OCDE, UN,..) Impact assessment of the number and nature of activities performed through the collaborations.	Number of projects and actions engagement with other relevant initiatives at European level and worldwide needed to maximise impact of the PPP (other PPPs, verticals, DIHs, TEFs, Communities of Start-ups, Regional, National initiatives, Non-European organisations, Standardisation Bodies, Investors, etc.)	Increase number of projects and actions in engagements by 25% Number of verticals engaged in collaborations Impact assessment of the number and nature of the activities performed through the collaborations	Increase number of projects and actions in engagements by additional 25% Number of verticals engaged in collaborations should cover 60% of verticals categories (top level) from the International Standard Industrial Classification (ISIC)

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[66] This also includes all funded projects and activities assigned to the Partnership.

	4) Promote collaborative working with other horizontal and vertical communities and partnerships	Number of projects and actions to align academia/research with industry Number of established Industry-Academia collaboration	Number of projects and actions to align academia with industry and researchers with end users	Increase by 25%	Increase by additional 50%
	5) Develop and implement mechanisms to create an effective & accessible ecosystem (incl. innovation infrastructure	Number of regions (NUTS-2) involved in projects and actions % of European regions engaged in collaborations with impact	Cover approx. 20% of European regions	Cover approx. 30% of European regions	Cover approx. 40% of European regions
	5) Develop and implement mechanisms to create an effective & accessible ecosystem (incl. innovation infrastructure	Number of actions and projects involving research teams from different AI, Data and Robotics disciplines	At least 25% of the actions and projects including AI, Data and Robotics disciplines	At least 40% of the actions and projects including AI, Data and Robotics disciplines	Above 50% of the actions and projects including AI, Data and Robotics disciplines
Skills, Acceptance & Society					
Detailed KPIs should be aligned with following Operational Objectives	8) Support initiatives that foster AI Skill building	Number of projects and specific actions to increase the capacity of AI, Data and Robotics training to support all educational levels and to increase the supply of talent.	All training courses should be listed	Increase by 15% the amount of training courses	Increase by add. 10% the amount of training courses
	8) Support initiatives that foster AI Skill building	Number of projects and actions contributing to the creation of new job-profiles Number of new job-profiles arising from the Partnership	Monitor, identify and report new job profiles		
	9) Address socio-economic challenges, European Missions and strengthen societal awareness	Number of projects and actions to engage citizens in AI, Data and Robotics, participants and European outreach. Number of citizens that have been reached by projects and actions Qualitative indicator of public acceptance	At least 5% of the actions and projects to engage citizens	At least 15% of the actions and projects to engage citizens	At least 25% of the actions and projects to engage citizens

		derived from European-wide surveys			
	9) Address socio-economic challenges, European Missions and strengthen societal awareness	Number of actions and projects targeting societal impact. Number of innovations with societal impact. Number of large-scale experiments supporting the transformation of economic sectors or/and with relevant impact in society Number of actions and projects targeting environmental impact and showing engagement with the European Green Deal Number of innovations with environmental impact.	List and define: - A) actions and projects targeting societal impact - B) number of innovations with societal impact - C) Number of large-scale experiments supporting the transformation of economic sectors or/and with relevant impact in society - D) Number of actions and projects targeting environmental impact and showing engagement with the European Green Deal - E) Number of innovations with environmental impact. - F) Number of innovations helping to fight covid-19 and address missions	Increase by A +10% B +10% C +10% D +15% E +15% F +10%	Increase by additional A +10% B +10% C +10% D +30% E +30% F +10%
Innovation & Market Enabler					
Detailed KPIs should be aligned with following Operational Objectives	*1) Accelerate uptake of industry in all sectors*	Number of projects and sectors with experimentation in close to market environments (high TRLs and experimented in real-life environments) that foster scaling up	At least 10% of projects with close to market experiments	Approx. 25% of projects with close to market experiments	Approx. 40% of projects with close to market experiments
	1) Accelerate uptake of industry in all sectors	The calculated level of European private leverage investments	We report the leverage factor in any case, see for instance our summary of the related IDC Reports in Section 2.1.5		

	1) Accelerate uptake of industry in all sectors	Report the evolution of macro-economic indicators (market share of the European Union in global AI, Big Data and Robotics Market, number of companies, revenues and professionals) related to the Partnership	Report actual status	Report actual status	Report actual status
	6) Support initiatives that engage and stimulate SMEs and Start-ups	Number of projects and actions to engage SMEs, entrepreneurs, start-ups. Number of Member States where SMEs/Start-ups originate	Report actual status	Increase by 15%	Increase by add. 15%
Guiding Standards & Regulation					
Detailed KPIs should be aligned with following Operational Objectives	*7) Work towards aligning legal frameworks, standards & regulation*	Number of projects and actions setting up a path to influence and support standardisation	Approx. 5% of the projects should provide input to international standardization	Approx. 15% of the projects should provide input to international standardization	Approx. 25% of the projects should provide input to international standardization
	7) Work towards aligning legal frameworks, standards & regulation	Number of projects and actions setting up a path to influence and support regulation and certification	Approx. 5% of the projects should provide input to regulation and certification	Approx. 15% of the projects should provide input to regulation and certification	Approx. 25% of the projects should provide input to regulation and certification
Promoting Research					
Detailed KPIs should be aligned with following Operational Objectives	*2) Lead and support excellent research raising the state-of-the-art*	Number of projects with one or more publications Number of peer reviewed publications produced by the Partnership Share of publications produced by the Partnership in journals within the upper 25% based on Filed-weighted Citation index	50% of projects with one or more publications	50% of projects with one or more publications Target is to have approx.10% of project members should have a H-Level above average of the field of expertise	50% of projects with one or more publications Target is to have approx. 10% of project members should have a H-Level above average in the field of expertise
	3) Support initiatives addressing Use Cases in AI, Data and Robotics	Number of peer reviewed papers with co-authoring from industry and RTOs Number and share of peer reviewed publications from projects that are core contributions to scientific field with co-	20% of the co-authored papers should be peer reviewed	30% of the co-authored papers should be peer reviewed	40% of the co-authored papers should be peer reviewed

		authoring from industry and RTOs.			
	3) Support initiatives addressing Use Cases in AI, Data and Robotics	Number and type of organizations participating in activities organized by the Partnerships Number of member states and regions represented in activities organized by the Partnerships Number of sectors represented in activities organized by the Partnerships	Number and type of organizations: 300 (½ Industry ½ Academia, approx. 25% SME)	Increase in 20%	Increase in additional 20%

2.2.6 Vision, ambition and expected impact in numbers

"The Vision of the Partnership is to **boost** European competitiveness, societal wellbeing and environmental aspects to lead the world in researching, developing and deploying value-driven trustworthy **AI, Data and Robotics** based on fundamental European rights, principles and values."

Global Perspective on AI, Data and Robotics

AI, Data and Robotics are at a critical phase in their deployment, a relatively small number of use cases have been implemented at scale, and it is too early to fully measure its effectiveness against the expectation of its impact. There has been enough uptake to raise concerns and yet not sufficient to provide long term predictions. Investment levels are still skewed by hype and early experimentation in all sectors so a steady baseline of investment and return is yet to emerge.

In this noise every nation is attempting to assess the impact of AI, Data and Robotics on its own economy and society while at the same time reflect on how its business and industry can gain the benefit from their application. Those nations with a strong research base in AI, Data and Robotics are looking to achieve global growth, by building AI based companies that can drive new global markets, each one seeking out its unique position in those areas.

European Perspective on AI, Data and Robotics

Europe has also reacted. Its advanced economy and developed markets both business-to-business and business-to-consumer, are fertile ground for the uptake of AI, Data and Robotics. The European Commission has set out its priorities based on the AI High-Level Expert Group and its own assessments of the economic, environmental and societal impact of AI. Market studies show significant investment (Section 2.1.5) and major businesses are exploring the impact and investing in deployment. The Commission has set a path towards achieving an impact for AI, Data and Robotics that respects fundamental European values, that is acceptable to citizens, and that is trustworthy. It has set out to develop "AI made in Europe" as a brand that can be associated with trustworthy and dependable AI, Data and Robotics.

The EC whitepaper on AI[67] which was released on 19th February 2020 highlights the importance of a public private partnership in AI, Data and Robotics to secure fully engagement of the private sector in setting strategic directions as well as to ensure co-investments.

2.2.7 Reaching the raised ambition

The main difference between this Partnership and the preceding cPPPs (BDVA and euRobotics) arises from the broader nature of this Partnership. Through integrating a wide range of stakeholders into the activities of the Partnership a raised ambition can be realised by extending the reach of the Partnership and by creating actions that reach beyond the current membership of the associations.

The inclusion of major European businesses in the Partnership will add strength and value to its actions. The widening of the stakeholder base will allow the Partnership to shape its actions within a wider context, for example, considering citizen acceptance, legal frameworks and socio-economic factors in greater depth. The development of active connections to the broader European innovation ecosystem will create new opportunity to collaborate and to scale and translate research to market. While helping the AI, Data and Robotics communities to work together will deliver alignment and mutual understanding that will accelerate research and innovation to gain a material advantage for Europe in AI, Data and Robotics.

2.2.8 Collaborative Opportunities

The **Partnership will deepen** the links that are already established between existing cPPP partnerships as they transform into Horizon Europe **and will strengthen its links to vertical partnerships.** It will explore and develop strategic collaboration with the EITs and Union programmes that support innovation funding so that synergies can be developed.

Linked Partnerships and initiatives (Horizontal)

The Partnership, in its role as a horizontal technology partnership, forms part of a wider ecosystem of partnerships that cover all aspects of the technology application landscape in Europe. Many of these partnerships will rely on AI, Data and Robotics as a critical enabler to their own endeavours. Both horizontal (technology) and vertical (application) partnerships intersect around AI, Data and Robotics and the impact on each of these partnerships will drive the need for connectivity between this Partnership and each of them.

The following are the main associations and horizontal partnerships where there is an intersection around AI, Data and Robotics:

- **Cybersecurity with ECSO**: Active engagement with Cyber Security is a critical enabler for AI, Data and Robotics so that organisations can reliably safeguard critical infrastructure, protect sensitive information and assure business continuity. The deployment of AI, Data, and Robotics applications is not possible without a high level of trust, and an effective Cyber Security regime underpins the development of that trust. In addition AI, Data and Robotics can be used to improve cybersecurity.

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[67] https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

- **Smart** Networks **and Services with 5G IA:** Smart communications will be required to provide high speed and low latency networks to be delivered by 5G infrastructure, at the same time AI will be a key enabler for cost-effective communication networks.

- **Electronics,** Components**, and Systems with AENEAS, ARTEMIS-IA, EPoSS, and ECSEL JU:** The combination of NanoElectronics, Smart Systems Integration and Embedded Intelligence together with AI, Data and Robotics is central to continued digitalisation that will help industries to maintain their competitive edge. In addition, AI, Data and Robotics applications have a need for the dedicated hardware and embedded systems that these associations map to.

- **High-Performance Computing with** ETP4HPC **and EuroHPC JU:** *High-Performance Computing* (HPC) capabilities are needed by specific AI, Data and in some cases Robotics applications (e.g. healthcare) where faster decision-making is crucial and extremely complex data sets are involved, while AI capabilities improve the development and deployment of HPC solutions.

- **Internet of Things with** AIOTI**:** The alignment with *Internet-of-Things* technologies is needed to foster the seamless integration of IoT with AI, Data, and Robotics technology. The integration of multiple data sources, both static and mobile and the connectivity between them is critical to many aspects of AI, Data and Robotics**.**

- **Machine Vision with The European Machine Vision Association***: Machine Vision* with The European Machine Vision Association: Vision components can be seen as a major source to generate data and knowledge about the environment and are a basis for decision making and control in many application areas. Therefore, alignment with the European Machine Vision Association (EMVA) is of mutual benefit.

- **Software and Systems with NESSI:** The creation of a new class of self-learning, self-optimising and self-adapting systems will create the need for novels ways of software and system development. Software engineering will need to be "re-engineering" concerning software design and architecture, data lifecycles, quality assurance, and deployment on dedicated hardware.

The Partnership will create points of interaction with each of the above associations and seek to develop formal links. It is also proposed that an overarching roadmap is developed that can link the underlying roadmaps from each horizontal technology area. There is a need to align terminology and to develop common understandings between the areas so that there is an opportunity to develop joint actions that are able to break down barriers between the technical areas. This type of collaborative action is uniquely possible in the European innovation ecosystem and needs to be explored to its limits.

The current version of the SRIDA[68] documents the initial discussions between the new Partnership and horizontal partnerships and associations identifying areas of collaboration aiming to leverage synergies as well as to understand /define how to best complement each other.

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[68] http://www.bdva.eu/sites/default/files/AI%20PPP%20SRIDA-Second%20Consultation%20Release-September%202019%20-%20Online%20version.pdf

Linked Partnerships (Vertical)

The sectorial reach of the Partnership is very broad and there are crossovers with all of the vertical Partnerships proposed in Horizon Europe. In manufacturing, health, energy, food and mobility there are very strong cross-links to this Partnership although these are not the only sectors where AI, Data and Robotics has an impact. In establishing links to vertical markets, the Partnership will also take into account public sector engagement and the need to examine the impact on supply chains and service industries that are often cross-sectorial (for example the financial sector, or environmental sector).

This presents a complex array of sectorial interactions that the Partnership will need to engage with. These many to many interactions require a broad approach to build awareness and then a more detailed approach to individual interactions when the scope and need have been identified. First steps must be to establish workable links and to identify the scope of interaction that can develop mutual benefit.

Other Funded Actions and the Innovation Ecosystem

A vital part of the European AI, Data and Robotics Ecosystem are the projects funded through the European Commission Framework programmes. These public investments stimulate interaction and exchange within the Ecosystem boosting the adoption of AI, Data and Robotics and the development of excellence. Their success is based on generating market impact that both stimulates private investment and generates new market opportunities. It is not sufficient for these investments to solely deliver greater academic connectivity and exchange. They must deliver real economic impact and novel technology that creates step changes in AI, Data as well as Robotics marketplaces. Funded actions must also focus on cross-fertilising opportunity between multiple vertical sectors and in the horizontal infrastructure, service and component markets.

These funded action fall into broad categories that are differentiated by the impact they generate. More details related to the different categories of funded action is covered in the Appendix 4.1

Linked Union Programmes

The core areas of AI, Data and Robotics permeate through multiple EU programmes, either directly within the ambition of a particular programme, or because the programme provides resource or infrastructure that impacts on AI, Data and Robotics. The extent that the Partnership can interact with these programmes depends on the influence it can have, or on the importance of the programme to the Partnership.

There are potentially strong connections to be made to the EIC[69] and to the JRC[70] that can provide input to the Partnership and those that engage with it around the development of fundamental research and around innovation. The EIT[71] networks around key areas such as Digital and Health also have a strong resonance with the Partnership and connections are already in place through the existing associations. As presented in Section 2.4.1 there is a critical function of the Partnership around

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[69] Enhanced European Innovation Council; https://ec.europa.eu/research/eic/index.cfm

[70] Joint Research Centre; https://ec.europa.eu/jrc/en

[71] European Institute of Innovation and Technology; https://eit.europa.eu/

providing connections to finance that, at one level, would involve the EIB[72] and ESIF[73] funds.

The most closely linked programme to the Partnership will be the Digital Europe Programme (DEP) with Euro 2.5 Billion allocated to AI, Data and Robotics in three separate areas of action. Here the Partnership can make a direct impact through its actions and stakeholders to work to achieve the goals of the Digital Europe Programme. The Partnership will seek to engage with the Commission to assist in setting the orientation of the DEP, to assist with brokerage and in working with the Commission to disseminate outcomes and showcase success from the DEP. The Partnership will work to engage its community and the wider AI, Data and Robotics community in DEP and integrate funded actions in the DEP with other actions within the remit of the Partnership.

2.2.9 Necessary investments

The AI, Data and Robotics market is diverse and growing. The value of that market can be estimated based on historical trends (as set out in Section 2.1.5).

In accordance to IDC numbers, one can expect that European investments for AI, Data and Robotics in the years 2020 to 2023 will sum-up to 117.2 billion Euro which matches to a yearly investment of 29.3 billion Euro. To ensure that private investment can leverage high economic, societal and environmental impact, additional and complementary public funding is needed to stimulate ecosystem building and market uptake.

The relationship between public stimulation and private investment is complex and cannot be reduced to a single cause and effect rational. In AI, Data and Robotics this is compounded by the cross-sectorial nature of AI, Data and Robotics technologies, the different technical maturity levels of the three different areas and by the difficulties inherent in deploying disruptive technology into existing markets. Where AI, Data and Robotics impact to provide a new factor of production, the ability to predict leverage becomes blurred by novelty.

2.2.10 Rationale for public investment

Public funding is needed to reduce risk. To step in where market failure is likely to occur, to stimulate new markets where the technology maturity level is low but the potential is high, to ensure the development of an European approach towards trustworthy AI, and to stimulate co-investment where pre-competitive opportunities exist to generate scale through joint action.

Key to identifying appropriate levels of public investment is to prioritise the forms of investment that have the greatest impact in a given time frame. In measuring the impact it is preferable to select short to medium term indicators of impact rather attempt to measure investment leverage directly.

The second shaping factor to any spread of public investment in European AI, Data and Robotics is the identification of the specific USP for AI in Europe. There is some

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[72] European Investment Bank; https://www.eib.org/en/index.htm

[73] European structural and investment funds; https://ec.europa.eu/info/funding-tenders/funding-opportunities/funding-programmes/overview-funding-programmes/european-structural-and-investment-funds_en

degree of danger in assuming that investment must match that of the US or China in the expectation that this will achieve the same levels of growth. Instead it is important to consider the differences in the various global AI, Data and Robotics markets. In particular it is likely that the European B2B market may take longer to equivalent gains but in contrast it is likely have greater long-term impact than the more mercurial B2C market.

2.2.11 Public Investment

Private investment in AI, Data and Robotics will follow successful demonstrations of core technologies in each area, it will follow the establishment of a clear regulatory environment and it will follow the understanding and acceptance of AI as a useful means of achieving growth and value. However, at the same time investment impact will be reduced by a narrow skill base and by loss of talent and poor AI infrastructure.

It is therefore critical that public investment is balanced to achieve a spread of impact over short, medium and long time scales. In the long term, investment will scale to match the perceived market value of the research output generated by public funding. In the short term public investment needs to be structured so that it accelerates market uptake by reducing risk and barriers.

2.2.12 Investment sources

There are many different sources of investment that operate over different timescales. Within the context of the investment triggered by the Partnership there is a time lag between initial investment and subsequent investment.

Investments in Research

There are a number of direct sources of funding for research:

 a) Commission framework programmes

 b) Member state R&I programmes

 c) Research foundations

 d) Industrial and business investment in research

These represent long term funding sources that do not expect to see a significant direct leverage effect in the immediate term. Although some collaboration with industrial research will generate private investment, this will typically be at a low leverage factor less than one. Typically the major leveraged investments will follow these investments in research at 5-15 years after the results are known and most likely after sequential public investments.

Investments in innovation and translation

The direct sources of funding for innovation and translation are:

 a) Commission framework programmes (including SME based programmes and the Digital Europe Programme)

 b) Member State innovation support funds, including sovereign funds and challenge-based funds.

 c) National bodies, for example specific public procurement such as transport or healthcare and the general public procurement of innovation.

d) Industrial and business investment in innovation

e) Venture capital and investment funds (private and public).

f) Digital Europe Programme through its investments in AI, and further investments in AI Digital Innovation Hubs and networks.

These represent short to medium term investments that take multiple forms, from direct grant to loans and equity.

Investment in skills

While the development of skills is primarily the responsibility of member states and of companies. The Partnership has a role in the setting of objectives for skills development, at all levels, and in monitoring the state of skills development, examining future need and current provision. It also has a role in outlining curricula and in fostering career paths and professional development and certification.

Investments in infrastructure

The final source of funding comes from infrastructure funding

a) Commission based infrastructure funding for example the Structural Fund or EIB investment.

b) National infrastructure funding for example around testing infrastructures, national computing resource and network infrastructure.

c) Digital Europe Programme investments to address safe access to large volumes of data and in testing and experimentation facilities for products and services.

d) Skills based funding for example national PhD programmes.

e) The establishment of national competence centres through special funding.

These investments occur over the long term and may represent a significant investment in buildings, facilities and equipment. In the majority of cases, these require concerted engagement and commitment from member states.

2.2.13 Investment predictions

Public investments need to be aligned to concrete objectives. Sections 2.2.1 to 2.2.4 describes the Partnership's general, specific and operational objectives including intervention logic.   While the general objectives set the key areas of strategic development while the specific objectives state what the Partnership expects to achieve within the context of each of these general objectives.

For structuring, bundling and prioritisation of the wide range of envisioned activities that will be accomplished within the context of the operational objectives, the Partnership will rely on five investment areas[74]. Each of the investment areas address a crucial aspect / foundation for the success of the partnership:

- **Investment area 1: The European AI, Data and Robotics Ecosystem** The Partnership will impact on the ecosystem by *providing strong European leadership for AI, Data and Robotics that* ensures Europe has a clear global voice that is

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[74] The five investment areas (initially named working areas) are described in detail the second consultancy release of the Strategic Research, Innovation and Deployment Agenda for an AI PPP (See http://www.bdva.eu/sites/default/files/AI%20PPP%20SRIDA-Second%20Consultation%20Release-September%202019%20-%20Online%20version.pdf)

rooted in its widespread deployment of these technologies in sectors and regions across Europe. This will allow Europe to *develop a global position* in AI, Data and Robotics that aligns with fundamental European values and delivers technology, products and services that maintain this goal by seeking to *align academic excellence* and innovation to the needs of *industry, citizens and the environment*. This will develop a healthy and *sustainable European AI, Data and Robotics ecosystem*.

- **Investment area 2: Skills, Acceptance and Society** The Partnership will work to ensure that AI, Data and Robotics skills are widespread throughout Europe. These actions will increase the capacity of *AI, Data and Robotics education and vocational training* to support a *strong skills pipeline in AI, Data and Robotics* at all educational levels to increase the supply of talent. It will ensure that the successful adoption and deployment of these technologies is not limited by a lack of skills in the workforce. The partnership will work to grow and *retain key talent in* Europe. The Partnership will also propagate best practice on collaborative change and *increase the awareness of AI, Data and Robotics* within both public and private organisations and with citizens. The Partnership will engage to support the implementation of AI, Data and Robotics applications addressing societal and environmental challenges.

- **Investment area 3: Innovation and Market enablers** The Partnership will stimulate industrial investment and private funding for AI, Data and Robotics in Europe and impact on the success of innovators translating research to market. It will contribute to creating a connected and rich innovation ecosystem for AI, Data and Robotics across Europe, contributing to success by providing innovators with access to data and key innovation resources.

- **Investment area 4: Guiding Standards and Regulation** The Partnership will seek to create a level market in Europe shaped around common worldwide standards and regulation and around common approaches to the certification and validation of AI, Data and Robotics based products and services. This will enable the smooth translation of innovation into the market by enabling innovators to more rapidly deploy products and services across and beyond Europe, giving an edge to European industry over other overseas companies less concerned with European regulation. It will also enhance trust in these technologies by creating understandable guarantees for operation and behaviour.

- **Investment area 5: Promoting Research** The Partnership will lead to improved cohesion of the innovation ecosystem, including academia-industry collaborations. With Europe' strong positions in both science and industry, this will create a global leadership position in AI, Data and Robotics for Europe built on a foundation of academic excellence based on industrial relevance. It will improve the rate of technology transfer and adoption of AI, Data and Robotics from the lab to real-world deployments. In addition, the Partnership will encourage the development of blue-sky research, by maintaining tight links with other dedicated European or national institutions and instruments.

Ecosystem Stimulation

Public investment is needed to stimulate the ecosystem. No single business or national body can achieve the scale and range of impact that Partnership, based on

European public funding, can achieve. This is one of the main reasons for the existence of the Partnership.

Investment areas:

Community Building: Delivering large scale events and roadmap development

Challenge based Competitions: Community coherence building

Infrastructure Development: Providing platforms, shared resource, Centres of Excellence, Digital Innovation Hubs.

Triggering: Ecosystem development triggers short term investments in:

   a) Business in-kind investments in time and resource to support the ecosystem from both small and large companies and research organisations.

   b) Investment by associations in hosting and running community resources and events.

Medium to long term investments in the other Impact areas flow from, and are enabled by, a functioning ecosystem. These long-term investments are in the form of technology transfer to deliver new products and services, investment in new value chains and markets through the adoption of new technology, and gains in market penetration achieved by reduced time to market. In addition, new markets will be enabled by the greater flow of information caused by AI, Data and Robotics.

Skills and Acceptance

Public investment is needed to foster alignment and European wide recognition of skill levels and attainment. While member states carry responsibility for primary, secondary and tertiary education and post graduate training, businesses most often continue this into the workplace and through workplace training. In addition AI, Data and Robotics are expected to trigger the need for re-training and mid-career opportunities for skill enhancement[75]. A European approach to skill development can create transformation at national level and set out transferable skills that enable a European wide labour market in AI, Data and Robotics.

Investment areas:

Community Building: Engagement with citizens and consumer stakeholders

Challenge based Competitions: Promote early career skill development

Mission Based Challenges: Increase visibility and awareness

Challenge Based Competitions: Promotion of early career talent and public awareness

Triggering: Short and medium term investment by Member States and Business in training and re-training. Expected longer term investment in research skill development and in raising the awareness of AI, Data and Robotics in the workplace. Trade based associations, including Trade Unions, may also invest in training and awareness at a general level. As AI, Data and Robotics uptake increases longer term investments by Members Sates may be needed as the nature of work reacts to AI, Data and Robotics impact and the skill balance shifts in key employment areas.

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[75] "AI: The Future of Work? Work of the Future!" Michel Servoz, European Commission (2019)

Innovation and market enablers

Public investment is needed to support the translation of AI, Data and Robotics from the research lab to the market. This happens through the combined actions of multiple instruments and processes. The funding sources are highly varied, and the innovation tools used to maximise impact vary depending on the maturity of the technology, the maturity of the market and the involvement of the stakeholders. AI, Data and Robotics poses unique challenges in validation and certification, in its potential to disrupt established markets and to be integrated within existing products and services. Agile technology and service based SMEs are a critical element in delivering deployment of AI, Data and Robotics technologies as is the engagement of large scale vertical end users including public procurement. Funding is needed in innovation scale-up, in providing testing infrastructure and innovation support and in developing demonstrators such as large scale pilots operating within regulatory sandboxes. Public funding reduces risk and acts as a seed to greater private investment needed to carry ideas to market once they have been sufficiently proved.

Investment areas:

Uptake Actions: Stimulation of market opportunity and development of infrastructure

Lighthouses: Stimulation of major vertical markets, development of large scale demonstrators and pilots. Extended real-world use case development and validation of technology in application areas.

Cascade Actions: Support for SMEs and start-ups through Digital Innovation Hubs, Centres of Excellence and dedicated technology and market based action.

Novelty Exploration: Application driven technology development and exploration of novel solutions and applications. Pull through from fundamental research.

Community Building: To connect with other horizontal and vertical communities

Infrastructure development: To ensure fast access the AI, Data and Robotics assets

Triggering: Early stage public funding will eventually trigger later stage private funding. This is particularly important at the demonstration and pilot stages where the required funding is beyond research investment levels but too risky for business to invest. Closer to market public funding will target areas of market failure either in seeding coherence, to develop integrated systems, or build AI, Data and Robotics around new standards or regulatory regimes to prove the robustness of technology. Public funding will also trigger venture capital and private investment in start-ups and SMEs that own key technologies by proving out that technology thereby reducing investment risk.

Guiding Standards and Regulation

Public investment is needed to support revised regulatory frameworks in sectors where AI, Data and Robotics deployment changes the nature of decision making from human to machine in ways that invalidate existing regulation. This might occur in the context of partly or completely replacing human based decision making, or in the context of human-centric scrutiny of outcomes; for example in automated transport, or in financial transactions. There is also a need to invest publicly to ensure that

fundamental rights are protected and to create level markets across Europe. With regard to standards no single business can direct AI, Data and Robotics standardisation and a pre-competitive approach is needed to ensure interoperability and a level market in Europe and globally. Public investment is critical to achieving harmonised standards and regulation that enable innovation and deployment across sectors with diverse deployment of AI, Data and Robotics. Public investment in standards and regulation can help to ensure a level and well regulated market that enables rather than hinders innovation.

Investment areas:

Lighthouses: Testing of regulatory and business models, standards and systems in real and realistic operating environments. Testing economic viability and societal impact and legal status.

Challenge Based Competitions: Demonstrating systems against key challenges

Community building: to align regulation and research

Uptake Actions: Regulatory sandboxes, CSA to support standardisations

Triggering: Clear and well-balanced regulation will trigger investment in developing new markets because it removes risk from the development and deployment processes. Interoperability standards promote a multi-supplier market and promote competition, they also enable the encapsulation of IP and protect technical innovation. Consumer based standards and regulation also stimulate market uptake by promoting trust in products. The goal is to ensure that certification and standardisation is in compliance with regulation, and not to engage in regulation development.

Promoting Research

Public investment is needed to ensure that Europe finds its USP (Unique Selling Point) in AI, Data and Robotics by focusing its efforts to develop research communities around that focus. It must set its own path and ambition in a way that fits its cultural, market, skill and technical specialisations. The maintenance of a strong front end to the innovation pipeline is critical to long term future success because of the expertise it generates and the skilled workforce it creates. Novel AI research will give Europe an advantage. However there will never be sufficient funding to develop every idea. It is essential that careful prioritisation is carried out so that ideas with relevance to business, society and economic promise are funded first, while leaving space for blue-sky disruptive ideas to be developed.

Investment areas:

Novelty Exploration: Building research strength, extending and step changing the state of the art, identifying and addressing key challenges and novel approaches.

Community Building: Cohering and aligning research excellence, identifying supporting and growing specialisations, retaining and securing talent, joint road mapping. Connecting research to industry and vice-versa.

Mission Based Challenges: Identifying, exploring and enhancing impact on key missions and societal challenges. Connecting and translating research into public good.

Cascade Actions: Supporting early stage research translation and alignment of research to industry. Promoting connectivity and brokerage.

Triggering: Public funding at a European level will trigger Member State funding to either support or complement it. Member State collaboration will also trigger aligned investment. European funding will promote a European value driven approach to research and will seed innovation uptake and the creation of spin-outs and technology transfer opportunities. Investment in research infrastructure is also critical to success.

The table below illustrates how the investments in the five areas set out above connect to the specific objectives set out in the intervention logic.

2.2.14 Operational objectives impact on transformation

While some of the levers of control to achieve wholescale European wide transformation through AI are outside the grasp of the Partnership, there is still an expectation that significant progress can be made through the effective use of public funding combined with leveraged private funding. Targeting clear paths of development that adhere to a European vision for AI, Data and Robotics while at the same time keeping an eye on the economic, environmental and business opportunities will be the main role of the Partnership. Using the information, it gathers through its extensive contacts to direct funding and to prioritise against multiple competing factors will require extensive consultation. This cannot be achieved by single private actors. Only a Partnership between public and private sectors that engages both research and industrial stakeholders can achieve the level of collective knowledge needed to leverage investments and have an impact at scale. Section 2.2.13 details the Investment areas and sets this out in more detail.

2.2.15 Exit Strategy

The success of the Partnership will lie in the structures, connections and activities that it establishes that survive after the formal part of the Partnership has ended. It is possible to identify key criteria for success that reflect the expectations about what the new Partnership can deliver:

- New value networks / chains will have been established that are triggering greater demand and creating new markets.

- Horizontal stakeholders are working effectively together and building synergies that create a technical framework to deploy AI, Data and Robotics broadly across sectors.

- Research communities are addressing industry needs, they are de-siloed and de-fragmented.

- Europe will have identified its key USP in AI, Data and Robotics reflected in its growing global market share.

- Trustworthiness will have become the new European Brand for AI, Data and Robotics

- Citizens will feel more informed about the capabilities and trustworthiness of AI, Data and Robotics

- The foundations for industrial AI, Data and Robotics standards are established and continue to be applied and developed with increased cross-sector relevance.

- There are aspects of a level market for AI, Data and Robotics in place across all member states.

- AI, Data and Robotics talent stays in Europe because of the opportunity to do excellent work.

- There has been a measurably raised of awareness of AI, Data and Robotics

- Europe has a well-developed and expanding innovation infrastructure for AI, Data and Robotics that addresses the needs of its USP.

The Partnership will have developed new collaborative structures that will create cohesion between different stakeholder groups. It will have enhanced the associations engaging with the Partnership and the interactions between them, it will have

established the development of a strong AI, Data and Robotics infrastructure and will have noticeably impacted on skills. The work of the Partnership will continue beyond public funding based on its value to members and to the associations that are connected to it.

2.2.16 SRIDA and Consultation Process

BDVA, the Big Data Value Association and euRobotics, the European Robotics Association, published on September 18th 2019, an updated version of the Strategic Research, Innovation and Deployment Agenda (SRIDA) for a European AI, Data and Robotics Partnership[76].

The updated AI PPP SRIDA was presented to the European Commission on September 16th by the Presidents of BDVA and euRobotics, Thomas Hahn and Dr. Bernd Liepert, as part of a meeting that BDVA and euRobotics had with Roberto Viola, Director General in the European Commission, DG CNECT, and Lucilla Sioli, Director Directorate A, DG CNECT. The meeting was a follow up of the June 6th event in Brussels (joining forces to boost AI adoption in Europe).

The first consultation release of the SRIDA document was based on a comprehensive public consultation process with more than six workshops with more than 400 participants from BDVA, euRobotics as well as PPP projects. For the second consultation release a series of bilateral meetings with representatives from the horizontal partnerships and initiatives as well as the with representatives AI research communities EurAI, ELLIS, CLAIRE and HumaneAI have been accomplished. Figure 7 provides an overview of the overall SRIDA development process including its timeline.
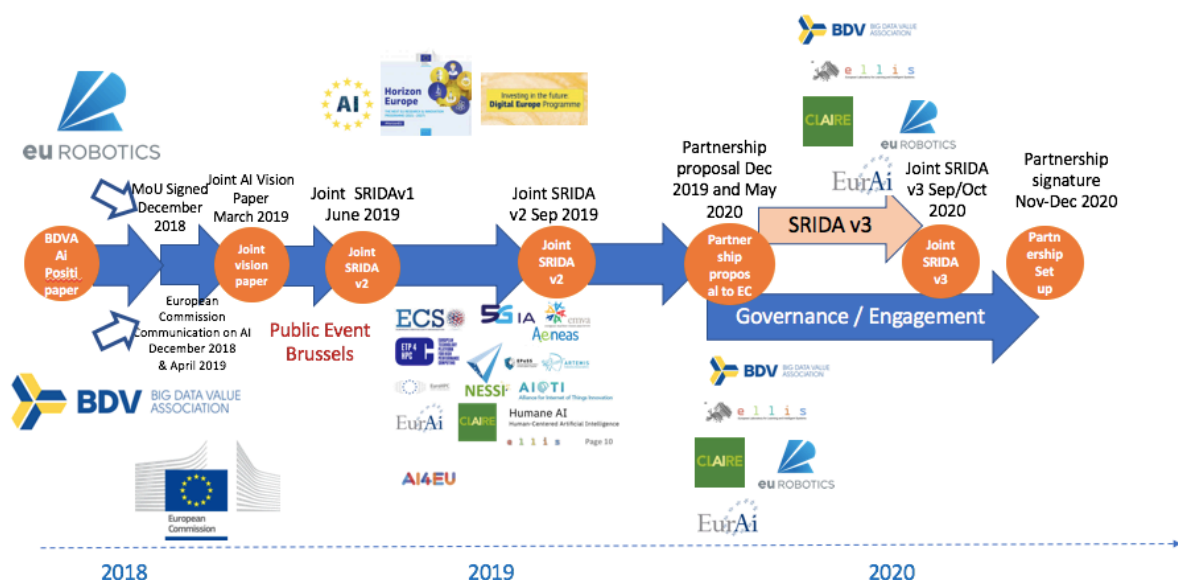

Figure 7 Overview of the overall SRIDA Development Process and Timeline

The second consultation release of the SRIDA will be the basis to produce the first official version of the Partnership SRIDA via a third consultation cycle that will take

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place in between June and September 2020. Figure 6 provides an overview of the steps and workstreams of the SRIDA update process within this timeframe.

During the SRIDA update process several outreach activities will be organised targeting i) user industries and stakeholders (including industrial AI) in many different sectors (outreached mainly through industry associations and other multipliers); ii) other partnerships and strategic European initiatives (both technology oriented and verticals); iii) Member States, in collaboration and coordination with the European Commission (e.g. with the support of the AI coordination group); and iv) other relevant stakeholders such as start-ups, trade associations, investors, etc.

The specific activities (such as workshops, webinars, information sessions, etc.) organised with these targeted stakeholders will be announced on the website www.ai-data-robotics-partnership.eu. The AI, Data and Robotics Partnership will pro-actively inform all these players[77]. Through this website an engagement channel will be open for those interested in following activities, receiving regular information updates or/and to take an active role in the Partnership (e.g. joining the Partnership).
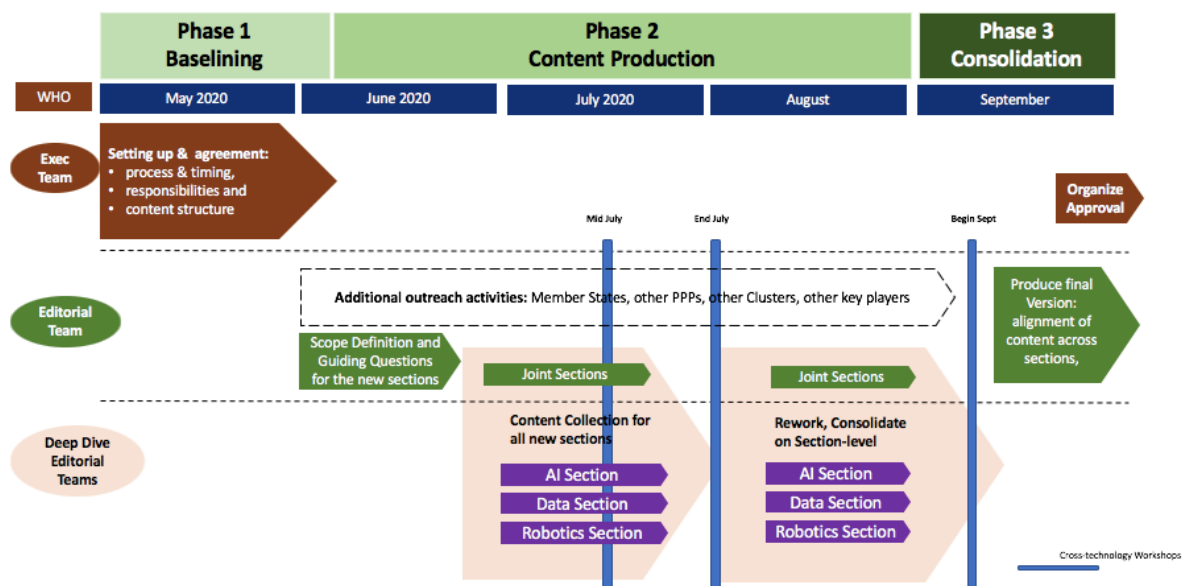
Figure 8 Steps and workstreams of SRIDA Update Process

2.3 Necessity for a European Partnership

The collaborations built with stakeholders, made possible by the Partnership, go beyond that needed to address the calls and funded actions developed through the Partnership. The Partnership creates wider cooperation between researchers, and innovators in industry and the service sectors and engages with external stakeholders around the broader impact of AI, Data and Robotics in the economy, societally and environmentally.

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[77] At the time of submitting this proposal document over 90 industry associations (including European and National) and over 60 European Strategic initiatives (including all the partnership candidates) have been identified.

For these reasons the impact of the Partnership is more significant and effective than can be achieved by open calls alone because of its ability to draw in knowledge and experience from this broad community of stakeholders to shape strategy, knowledge sharing and the orientation of calls. These interactions will identify need, drive opportunity and guide participation through brokerage. In doing so, it creates an eco-system, built on connectivity, that is able to direct impact and align funding.

The Partnership addresses all of the key operational objectives of Horizon Europe[78] through its proposed actions, its connectivity, and its promotion of collaboration between vertical and horizontal communities. It will engage with SMEs and start-ups, promote responsible research and innovation, and address normative issues. The Partnership will reinforce the links between research and innovation and between European and national or regional actions, it will strengthen basic research and seek international cooperation.

Scientific Impacts: By stimulating excellent research and by creating connections between research outcomes and industrial needs the Partnership will ensure greater and more rapid uptake and alignment of research by industry. By improving the connectivity in the eco-system and by working to improve the AI, Data and Robotics infrastructure in Europe the Partnership can create a European R&I environment capable of both attracting and retaining talent. A clear focus on prioritising human-centric AI and trustworthy AI will, in addition, create a unique AI culture in Europe and attract both investment and talent inwards to Europe.

Economic and Technical Impacts: By connecting and engaging with industry and commerce in all sectors a gearing effect can be generated with regard to the wide spread deployment and uptake of AI, Data and Robotics. The Partnership will orchestrate the development of a European approach to competitiveness and work to lower regulation and market barriers while promoting the development of fair and trustworthy products and services. The Partnership will work to improve access to finance especially for SMEs and start-ups by fostering innovation potential and business development. It will similarly address strategic skills for AI, Data and Robotics and highlight strengths and weaknesses in the supply and value chains that Europe needs to deploy these technologies at scale.

Societal Impacts: By focusing on a human cantered approach to AI, by promoting good practice and outreach to citizens the Partnership can raise levels of acceptance both by citizens and by industry such that AI, Data and Robotics work to bring improvements to society and to the economy as a whole. By aligning actions with the key European missions, including the environmental challenge and post Covid-19 challenge, the Partnership will ensure that the impact of AI brings progress against mission targets.

2.3.1 Achieving Directionality

A key benefit of the Partnership is achieving the alignment of objectives between the European Union and the European private sector so that the actions of public and private side are synergetic and self-reinforcing. The Partnership will work so that policy objectives are achieved through a connected approach built through its eco-system.

The EU policy objectives concerning the development of a globally competitive European AI, Data and Robotics industry that delivers sovereignty and trustworthiness

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[78] https://ec.europa.eu/research/pdf/horizon-europe/ec_rtd_orientations_towards_the_strategic_planning.pdf

built around a uniquely European common strategy can only be achieved if there is a common understanding of the benefit of these technologies. The Partnership, through its actions, creates the focal point to connect, identify and align this common strategy for AI, Data and Robotics in Europe with the needs of vertical sectors, with technology innovators and with researchers.

In particular the Partnership will work to raise awareness of the opportunities and benefits, economic, societal and environmental, that arise from the wider adoption and use of AI, Data and Robotics. This combined with the leverage generated by the Partnership from commercial organisations and other stakeholders will result in structural and societal impacts that contribute to the European policy objectives for AI, Data and Robotics, as set out in the relevant Commission Communications.

The Partnership will engage with industry and research to gain investment in the strategy and its collective actions in order to meet well defined mutually beneficial objectives. Ensuring that industry both drives and invests in an R&I agenda that delivers identifiable added value from research and innovation. In doing this the Partnership will identify the state of the art while identifying gaps and opportunities to advance AI, Data and Robotics in Europe and will use this ongoing analysis to inform and direct strategy with the aim of influencing policy.

2.3.2 Achieving Additionality

The Partnership will establish leadership for AI, Data and Robotics in Europe based on the essential needs of a European approach to these technologies for research and industry. The Partnership will connect to the prime companies in Europe who utilise, deploy and develop smart systems and will integrate and assess their needs while aligning these with the research community to mutual benefit.

The Partnership will connect industries and businesses along the European supply chain that can define a common strategic approach to AI, Data and Robotics and persuade them to invest alongside the public sector, both at a national and European level. Thereby sharing the innovation and uptake risk between public and private sectors to generate the alignment needed to address both market and societal challenges.

The Partnership will create collaborations with the other horizontal technologies, such as cybersecurity, smart networks and services and internet-of-things, high-performance computing, electronics, photonics, components, and systems, software and machine vision. It will ensure that in areas where AI, Data and Robotics applications rely on the contribution of other horizontal technologies engagement with those communities allows it to define clear points of interaction and take the opportunity to leverage synergies through collaboration beyond the actions of the work programme.

The Partnership will utilise the tangible and intangible resources of its members and associates around the domains and sectors where AI, Data and Robotics impacts. It will create multiplicative value by brokering collaboration both directly through funded actions and indirectly through networks and the promotion of infrastructure development.

2.3.3 Member State Collaboration

The Partnership will seek engagement with the Member States and associate countries on two levels, representing a strategic and practical approach. In this it is appreciated that the matrix of engagement between Member States and all Partnerships creates a significant interaction load on both Partnerships and Member States and the Partnership expects both Member States and the Commission to deliver sustainable mechanisms to address this issue.

At a strategic level Member States will be invited to connect with the Partnership by providing representatives sitting on the Partnership Board and to take part in, or host, major Partnership events. Further interaction will be coordinated through the Commission relating to the coordinated plan and the member state programme committee. Where practical, engagement with Member States will be focused and targeted around key strategic developments, such as work programme prioritisation, where synergies with national programmes can be explored or around key issues where either Member States or the Partnership can add value through mutual engagement.

At a more practical level, the Partnership will also create local "grassroots" engagement with Member States through the use of appointed Ambassadors taken from membership of the association. These local member state "experts" will be expected to build and nurture contact with national bodies, network with them and bring into the Partnership contacts and information around member state strategy, programmes and activities. The Ambassadors will be appointed by the Board of Directors based on an open process of application from members. These appointments will be for a fixed term and it is expected that Ambassadors will be appointed to all member states and associate countries. In time the scheme can be extended to deliver representation in major regions.

In particular, the Partnership seeks to engage with Member States to build an efficient collaborative, inclusive and open network establishing the basis to achieve high impact for AI, Data and Robotics for all and in all of Europe by exploring the opportunity for alignment and complementarity between European and Member State activities. Most of the members of BDVA, euRobotics, ELLIS, and CLAIRE are active inside member state initiatives and EurAI itself is an umbrella organisation of 29 European national AI associations.

2.4 Partner composition and target group

2.4.1 Membership, target groups and stakeholders

The ambition of the Partnership is to encompass a wide range of viewpoints into its strategic vision and operation by developing activities around a broader range of topics and issues addressing economic, societal and environmental aspects of AI, Data and Robotics.

In order to ensure full engagement from all areas of AI, Data and Robotics in the Partnership it is essential that the balance between these technical areas is maintained throughout the decision making and strategic elements of the Partnership. To this effect a constituency-based model forms the basis of governance within the Partnership.

The AI, Data and Robotics Partnership will extend the membership of the existing partnerships in terms of breadth and depth. It will deepen the membership by attracting a wider range of members from the existing types of member, set out above, because of the broader and more integrated scope of the Partnership.

The following types of organisation will build the membership base of the Partnerships:

Europe's leading research organisations with expertise in the foci of the current partnerships. They bring an essential perspective on the current state of the art and the identification of European strengths and weaknesses which is critical to setting strategic direction. The AI research communities represented by the three main associations, EurAI, ELLIS and CLAIRE are all engaged in the process of creating the new Partnership and it is expected that the organisations who's members make up the membership base of these AI communities will in turn become members of the private side of this Partnership. This will significantly broaden the expertise and engagement from the existing European AI community and their engagement is a critical part of the formulation of research strategy and direction and the alignment to industrial need that sits at the core of this Partnership.

Large End Users from key industry sectors that directly deploy technologies from the current Partnerships. They are needed to bring vertical market perspectives and ensure core business needs are addressed in short, medium and long term strategy. They are also needed at an operational level to support the operation of the Partnership and give strength and direction.

Suppliers and manufacturers related to the existing foci are important to understand the state of the market both in terms of technical maturity and deployment.

Industrial AI Community: While there are very few corporations in Europe dedicated to AI there are many large European based corporations for whom AI is a critical and necessary enabling technology. In some cases these companies are already members of the existing Partnerships, or have strong links to them. This Partnership will provide a new focal point for the elaboration of industrially led AI challenges and will directly engage the AI expertise in these corporations in the development of an industrially based AI strategy for Europe and in the alignment of opportunity with the academic research communities.

SMEs are needed because they represent the agile development of new technology and are numerous within the AI, Data and Robotics markets and supply chains. They have a unique perspective on the development of these technologies and are crucial to its uptake and deployment.

Entrepreneurs and innovators are necessary because of the novel application areas where AI, Data and Robotics can be used. Their involvement in the activities and strategic developments around innovation has great value.

Associations related to existing Partnerships bring expertise, typically from parallel technology areas[79], and from key vertical market sectors to create a broader alignment of strategy and technology mapping. In addition, associations help for a faster scaling-up.

Investors, VCs and incubators: The ambition of the new Partnership is focused on increasing leverage and investment in AI, Data and Robotics. Much innovation in AI,

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[79] The SRIDA details collaborations with key associations that are proposed for the AI, Data and Robotics Partnership.

Data and Robotics happen within SMEs, spin-outs and within incubators. The Partnership will seek strong relationships with VCs, investors (public and private) and incubators to deliver innovation strategy and connectivity to investment for the SME and start-up communities in AI, Data and Robotics.

Regulation and standards communities: The Partnership will preside over a period of significant expansion in the use of AI, Data and Robotics in Europe. Major barriers to the deployment of AI, Data and Robotics are less likely to arise from technical limitations and more likely to be the result of regulatory and compliance issues, of legal issues and the need to validate and verify the performance, safety and trustworthiness of AI, Data and Robotic systems in complex real world operating environments. For this reason, the Partnership will actively seek to engage with all stakeholders concerned with constructing, managing and delivering the regulatory environment for AI, Data and Robotics.

EU 13 and EU15: The Partnership will actively seek to develop connections to EU13 countries where the advanced deployment of AI, Data and Robotics technologies is more nascent.

In strict terms the membership of the Partnership is defined as membership of the new association where members expect a reciprocal benefit for their membership fees.

Broader membership of the Partnership can be defined as those engaged in funded actions, or those attending or contributing to Partnership events and activities. In respect of this broader membership the Partnership will target stakeholders who are unlikely to become direct members of the association but who's involvement is critical to the aims of the Partnership. These additional stakeholders can be identified in different broad groups:

Sector actors: In all sectors there are actors that will be impacted by AI, Data and Robotics but who will not desire to become members of the association. In some cases industry associations and trade bodies, who are association members, may provide suitable representation, in other cases, for example in healthcare, it will be desirable to establish direct links. These links need to be created actively and for some sectors and areas of work Digital Innovation Hubs may provide a secondary layer of connection through the network orchestrators being members of the association. In other areas collaboration with other European Partnerships, such as Smart Communications or Photonics may provide the necessary linkage. The interaction with sector based end users will help the Partnership to widen their understanding of sector specific industrial challenges as well as enable access to critical resources, e.g. specific data assets, required for transforming deployment challenges into solutions. In all these cases the Partnership will seek to ensure that there are paths open for a diverse range of sector actors to engage with the activities of the Partnership.

Consumer and citizen groups: There are multiple groups that represent different interests and sectors related to consumers and citizens. There are numerous NGOs and citizen engagement organisations that encompass different demographic and regional groupings and different perspectives ranging from consumer safety to the protection of minority rights and organisations devoted to disseminating information to particular citizen segments. Approaching and engaging with these organisations requires specific expertise and knowledge and the Partnership will seek to engage with public policy experts to identify and setup communication channels to foster this wider engagement.

Trustworthiness stakeholders: The remit of the Partnership directly addresses the promotion and development of trustworthiness. This is impossible to achieve without engagement with key trustworthiness stakeholders including consumer groups, privacy watchdogs, and ethics based associations and groups[80]. If the deployment of AI, Data and Robotics is to flourish at scale then the concerns of these groups need to be addressed and reflected in the strategy and actions of the Partnership. To achieve this the Partnership will make direct contact with such groups and ensure their engagement in directed activities.

Finance and entrepreneurs' groups: There are a wide range of national, European and global groups that have an interest in AI, Data and Robotics both from the perspective of economic impact and the perspective of investment. At a global level the World Economic Forum and OECD have all engaged extensively in examining the impact of AI, Data and Robotics and the Partnership needs to establish engagement at this level. The European Investment Bank and the European Structural and Investment Funds (ESIF) have a remit to invest in the growth of companies and support infrastructure for research. AI, Data and Robotics has attracted considerable investment from Venture Capital and from innovation funds, sovereign funds and private funds. The Partnership is aware of, and will build appropriate relationships with, all of these actors so that they can engage with developing a broader strategic agenda on investment in AI, Data and Robotics.

2.4.2 Other Partnerships

It is envisaged that the Partnership will develop close ties with other, strongly related European Partnerships[81]. These will be expressed in the development of mutual activity around the scoping of joint topics of interest and common areas of concern. This Partnership will involve key members from other Partnerships in events and activities to bring alignment and external expertise. In particular the development of joint frameworks of interest will help in the alignment of technologies with the intent that, later in the execution Horizon Europe and Digital Europe, joint actions can be developed.

2.4.3 International considerations

International competition in AI, Data and Robotics is intense both in terms of developing new markets, exploiting technology and in terms of acquiring the best talent. Europe has declared, through the commitment of the Member States to the "Coordinated Plan on AI", that it will work to focus the alignment of national and European AI efforts and to develop a European approach that engenders European fundamental rights. This provides a uniquely European dimension to AI that the Partnership will foster and promote.

Commercially the spread of AI technology is a global enterprise and in the area of standardisation and regulation there is much to be gained by establishing international norms and processes that will allow global trade in AI products and services. However much of what AI, Data and Robotics products and services deliver is tightly integrated within products and services that are already regulated and standardised. Therefore in many cases the focus is on how to shift and modify existing regulation and legal

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[80] For example the participants in the Humane AI flagship proposal.
[81] The SRIDA details collaborations with key European Partnerships that are proposed for the AI, Data and Robotics Partnership.

frameworks to adapt to the challenges AI creates. Where it is appropriate the Partnership will address these international (beyond Europe) aspects of AI, Data and Robotics and will contribute to international efforts.

Research is similarly international in nature and the Partnership will foster European researchers in maintaining and enhancing their significant presence internationally. To do so it will promote international collaboration especially where this creates an inward flow to Europe.

Strategically Europe needs to retain sovereignty over its data and expertise and to ensure that AI, Data and Robotics develops along the human centric and trustworthy path that Europe has set out, while at the same time maintaining globally strong commercial value in the AI, Data and Robotics sector. A key objective is to ensure non-dependence on external technology that might compromise this European approach and, in the limit, this may create barriers to international collaboration that does not or cannot, align with these principals.

3 Planned Implementation

3.1 Activities

3.1.1 Achieving the Partnership Objectives

The objectives of the Partnership will be achieved through a combination of activities and instruments (Section 3.1.3). Firstly, through the roadmap based actions developed through the Partnership. Secondly, through activities that will develop the community and ecosystem of the Partnership and finally, through the promotion of AI, Data and Robotics carried out by the Partnership (Section 2.2.4).

3.1.2 Communication and Outreach

Creating a recognisable, unique identity that provides connectivity between the different elements of the Partnership will help bring different and currently diverse actors in the Partnership together. It is envisaged that this identity will respect the different bodies that make the Partnership while providing a basis for unification.

Alongside this the Partnership will establish a communication strategy targeted for each key stakeholder group. Given the raised ambition of this partnership and the need to extend its reach it is important to develop a strong communications delivery that can target messages and create outreach to create impact for the Partnership.

3.1.3 Instruments to achieve impact

The Partnership will make use of a range of instruments to achieve its objective. These instruments will be used in combination across the strategic areas to deliver impact.

1) **Novelty Exploration:** Actions that develop and explore novel technology at the earlier stages of development and that range from fundamental to applied research up to innovation and deployment challenges.

2) **Lighthouses:** Lighthouse projects address major vertical market segments such as healthcare, manufacturing, mobility, fin-tech, agri-food, energy and utility infrastructure. Lighthouses are designed to engage large scale end users in combination with technology providers to deliver both foresight and demonstrators that validate technical solutions in real world environments.

3) **Infrastructure Development:** These actions encompass the development of resources within the ecosystem. For example the development of shared resources, platforms, repositories of data or algorithms. Networks of excellence and innovation hubs, shared testing facilities or interoperable API specifications.

4) **Cascade Actions:** Actions focused on SMEs and small Mid-Caps to develop translation and the exploration of new use cases and markets. These can provide a rapid response to emerging areas and foster SMEs in collaboration with end user problem owners.

5) **Community Building:** The development of connectivity between the wide range of stakeholders in the Partnership will need active processes to engage and connect them throughout the Partnership. These actions take place at multiple levels and over a range of timescales. For example workshops leading to reports on key issues, Coordination and Support Actions in the work programme. High

level meetings with major AI, Data and Robotics industry or focused groups around a key technology.

6) **Mission based Challenges:** Actions to address large scale challenges around European Missions as identified by the Commission. These actions focus all aspects of AI, Data and Robotics on individual missions by establishing large scale actions that address specific challenges to progress the goals of the mission using AI, Data and Robotics technologies.

7) **Challenge based Competitions:** Competitions provide the opportunity to develop skills and address core challenges. They provide high profile opportunities to demonstrate and showcase the current state of the art. They stimulate media coverage and provide policy makers with practical visions of achievement.

8) **Actions to stimulate uptake:** This includes regulatory sandboxes, CSAs to support standardisation activities or even some research actions meant to find solutions to implement regulatory requirements such as trustworthy AI, privacy preserving technologies, etc…

3.1.4 Actions outside of the work programme

As the Partnership becomes more established it will build actions aligned to the strengths of its members. Such actions may be partly or completely independent of the work programme. These actions will be member led and use the Partnership as a launch pad. They will depend on support from members and will align to their needs and scale. For example, industrial members can fund competitions addressing a common objective, or they may offer grants to address a key challenge. They might provide sponsorship for larger scale public events or provide access to testing facilities from their own assets. These actions will be built up over the lifetime of the Partnership with the aim of widening the reach of the Partnership.

3.1.5 Activities and events

In addition to the actions funded through the work programme the Partnership will engage in a range of activities in network building and stimulation to strengthen and cohere the communities between AI, Data and Robotics. These will build on the success of existing events and activities but with expanded scope to match the Partnership.

The Partnership will ensure that there are transparent processes for the setting up and scoping the above-mentioned activities, such as fora and workshops. It will ensure that the range of activities is balanced in terms of accessibility and between detail and general topics of interest.

This growing group of stakeholders and the extended reach of the Partnership will necessitate the development of new events and forms of dialogue. In particular the following areas will need increased focus:

a) **Ecosystem**: The Partnership will create cohesion within the Ecosystem by establishing cross-associational/organisational Task Forces that can connect and unify the different constituencies within the Partnership. It will be important to establish a common framework of terminology around, technology, function and application areas so that documents produced by the Partnership can be read and understood in common. As the cohesion increases within the ecosystem it will be possible address extended objectives related to the Impact areas.

b) **Skills and acceptance:** The Partnership will engage with employer and employee groups in order to develop conversations on both skills needs and on the changing nature of work caused by AI, Data and Robotics. Initially this will encompass smaller working events and working papers with the possibility to host or contribute to a major event around skills after the second year of the Partnership.

c) **Business models and Organisation:** The Partnership will support the improvement of existing and the development of new business models, organisational forms and leadership strategies to support the effective adaption and use of AI, Data and Robotics-technologies. Concrete actions could include workshops and fora for sharing and collecting best practices.

d) **Market and Innovation Enablers**: There is a strong need to ensure that the AI, Data and Robotics Innovation Ecosystem in Europe is well founded and can attract and retain talent. This requires all identified innovation enablers to be well supported both publicly and privately and for innovation activities to be connected between different funding sources and modes of innovation and development. The Partnership will promote access to data, to digital innovation hubs, to experimental facilities and sandboxes. It will also engage with sources of finance to support investment strategies aligned with the scope of the Partnership in relation to technology and sector.

e) **Regulation:** The Partnership will convene small group workshops in each major sector to examine the impact of regulation around AI, Data and Robotics. The Partnership proposes to form an industry group to create a white paper on regulation and AI, Data and Robotics.

f) **Standards:** The Partnership will create a Task Forces around standardisation to gather industry needs and develop viewpoints. In the first instance this group will need to consider its priorities with respect to standards, for example identifying key areas within interoperability, data standards and modularity, where it can develop value and secondly develop an approach that can be taken by the Partnership to stimulate standards-based activities.

g) **Research:** The Partnership will promote industry academia collaboration to ensure that research is aligned with industry need and that industry is aware of the opportunities presented by applied and fundamental, novel and excellent research. It will set up groups aligned with interest that create connection points to key areas of interest across the technical and sectorial scope of the Partnership.

In addition to these strategic activities the Partnership will also establish connections with related stakeholders, funded actions and initiatives. These will be developed over time as the Partnership matures. These connections may be formalised through Memoranda of Understanding. The following should be taken as a few examples of the type and range of connection opportunities the Partnership will consider:

Digital Innovation Hubs and existing infrastructure

Digital Innovation hubs are an important part of the innovation ecosystem in Europe. There are a number of Digital Innovation Hub Networks that exist, notably those set up within the Robotics community and in Smart systems. These networks will be extended through the Digital Europe Programme and AI based hubs will be added. In addition the Centres of Excellence set up by ICT-2020-48 will have characteristics of Digital Innovation Hub networks. The Partnership will establish links to these networks

and explore how to connect to them and how they might use the Partnership to expand their reach. Where there is mutual benefit joint activities will be developed.

Access to finance

In order to create translation opportunities there needs to be good access to finance. This manifests itself at a number of different levels:

- The funding of infrastructure to support AI, Data and Robotics. This might range from investment in distributed HPC across Europe, the setting up of regulatory sandboxes, data spaces, platforms or the conversion of existing infrastructure, such as road or rail networks, so that it can be used for AI, Data and Robotics R&I. Funding infrastructure can be shared between European and National public funding, or be based on mixed public and private funding. The Partnership has a role in identifying need and stimulating sources of funding that can address the need. It can also engage with European specific public funding and communicate opportunity to stakeholders.

- The deployment of AI, Data and Robotics at scale will require funding, for example in healthcare or agri-food where AI, Data and Robotics systems need to be funded and installed. Here the identification of the return on investment is critical to unlocking scale-up funding. The Partnership has a role to play in highlighting success stories and in developing awareness of the opportunities AI, Data and Robotics brings. This will have a strong sectorial element and will need to take into account the different value chains that operate in each sector.

- While much of the economic gain from AI, Data and Robotics will come from its impact on existing value chains and businesses there is a significant element that will come from novel technology, new business models and from SME's and start-ups that are able to scale. The Partnership has a role in attracting Venture Capital funding and providing a focal point that can allow VC funds to access AI, Data and Robotics in Europe. This will happen through the fora and events where VCs are able to engage with the community but also through dedicated VC events that the Partnership can support or launch.

Brokerage and Work Programme support

The Partnership will support each work programme call with brokerage events organised in conjunction with the appropriate Commission units.

Large scale events

The Partnership will run community building events in the form of European Forums. These will address both academia and industry and are attended by both members and non-members. The Partnership proposes to create a European AI, Data and Robotics Forum using the same format as existing fora. This will be designed to complement the primarily academic conferences (IROS, ICRA, IJCAI, NIPPS, ICML, ECAI, ECML, ICML, NeurIPS, AAAI, etc.) that are held alternately in Europe. This new AI, Data and Robotics Forum will be designed to also complement the existing Forum events and to create a sense of community within Europe around AI, Data and Robotics.

In addition, euRobotics runs a highly successful European Robotics Week that takes place in November each year. This is primarily a citizen outreach event where academic laboratories and companies open their doors to the public and put on events such as demonstrations, public hackathons, lectures and debates. Each year is

themed around a topical subject. The Partnership will extend or complement this using the same format. BDVA runs two additional events, the European Big Data Value Forum (EBDVF) and Big Data Value Meet-up for all stakeholders and partners in its actions funded through the work programme. The format of these events will be mirrored to develop an event for all stakeholders receiving funding through the AI, Data and Robotics based parts of the Commission Work programmes.

3.1.6 Call preparation

In addition to the above events a separate stream of work will be established to address the strategic direction of roadmap development. This will draw on all relevant stakeholders including vertical and horizontal stakeholders with a contribution to make to the roadmap as well as stakeholders from major/critical industries to understand and include their vision. It will utilise its own outreach activities including surveys, workshops and approval processes. This stream of work will interface directly with the governance structure.

3.1.7 Mechanisms to ensure complementarity

Achieving this in and for Europe will require open and inclusive collaboration between different stakeholders who each bring their own, unique specialised technological expertise to the table – which can range from embedded systems, communication and security, to computing and domain applications, among others. Fortunately, there are currently many major initiatives in Europe that strive to deepen this kind of horizontal collaboration, which will be increasingly necessary in the years ahead.

3.1.8 Interaction points

With regard to the interface between each Partnership, and particularly between the horizontal Partnerships, the work of this Partnership has already, within the current version of its SRIDA, set out the interaction points between the key Partnerships where it expects to connect. The SRIDA[82] details these interactions and future work on road-mapping will define these interactions in sufficient detail to ensure that the scope assigned to each Partnership is clear when formulating the work programme. There is also a need to balance between horizontal and vertical Partnerships when considering the closer to market aspects of this Partnership.

3.1.9 Overlaps

The Partnership will work with other partnerships under Horizon Europe where it believes there may be a crossover in orientation or overlaps in initiatives funded through Horizon Europe. In conjunction with the other partnerships, it will convene a meeting prior to the completion of the orientation process where each partnership can discuss potential overlaps in their proposed work programme. This may lead to the following actions:

a) Each partnership agrees to enter into a joint action with a funding balance that is proportionate to the benefit derived for each partnership

b) There is an agreement to offset common themes so that they do not appear in the same year. This may be an appropriate response where the overlap is imprecise.

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[82] http://www.bdva.eu/sites/default/files/AI%20PPP%20SRIDA-Second%20Consultation%20Release-September%202019%20-%20Online%20version.pdf

c) There is an agreement that one or other of the partnerships takes on the shared topic and that it is dropped by the other Partnership.

d) There is an agreement to alter the scope of the overlapping topics so that there is a clear delineation between the two topics, essentially removing the overlap.

In the event that no agreement can be reached each partnership will be requested to flag the overlap during the development stage of the work programme. It is envisaged that where overlaps may occur at the orientation stage these may be resolved later when work programme input is refined in a greater level of detail.

For overlaps outside of Horizon Europe the mechanisms for correction are more difficult to define because there is no mechanism for each partnership to be able to scrutinise each possible action in all of the programmes. Such an assessment must be left to the Commission services to identify and all that the Partnership can offer in this respect is to be responsive to any substantiated overlaps that are brought to their attention within a timeframe that would not impact on the formation of consensus from their members.

3.1.10 Synergies with national and sectorial programmes

The Partnership will develop links to Member States and provide an overview of major national policies by appointing national ambassadors from the membership. As already described in Section 2.3.3, Partnership's members can be appointed as ambassadors for a member state or region. In their ambassador role, they build and nurture contact with national bodies to foster alignment in strategy, programmes and activities. It is expected that the ambassadors are able to represent the Partnership at national events and within national policy conversations.

The Partnership will seek to align European and national programmes and activities where there is a clear European advantage in doing so. Areas such as regulatory alignment, approaches to trustworthiness, data privacy and cybersecurity all have a combined national and European dimension where the Partnership will cultivate links and collaboration.

3.2 Resources

3.2.1 Private-side contributions

Achieving the objectives and impacts of the Partnership requires the addition of private side contributions to the activities of the partnership. These contributions will come from actors who directly engage in the activities of the Partnership, both within the related work programme and within the wider actions of the Partnership. These contributions will take many different forms, from in-kind contributions to major investment in production facilities. They will also be spread in time over many years and notably beyond the expected lifetime of the Partnership. The leverage ratios for the current partnerships indicate a 3-7 times multiplier over direct EC investment, depending on the technology area being analysed. It is expected that private side investment will achieve a 5 times multiplier for EC investments within the scope of this Partnership. However private side investment levels depend heavily on global and local economic conditions and as a result of the COVID-19 crisis adjustments to private side investment expectations may be needed.

With regard to the investments made in support of the objectives and impacts within the Partnership it is expected that most private side investment will accrue to "*Reinforce a strong and global competitive position of Europe in AI, Data and Robotics*" and to "*Secure European sovereignty over AI, Data and Robotics technologies and knowhow*". With a more balanced public/private investment, including that from members states, in "*Establish European leadership in AI, Data and Robotics technologies with a high socio-economic impact*".

As to an assessment of the necessary level of investment required to achieve the stated impacts this will be determined by the direction Europe takes with respect to the global competition on AI. There is a minimum necessary investment to achieve the level of infrastructure and eco-system building that will have an impact and allow Europe to develop its chosen path in deploying AI, Data and Robotics. Given the raised ambition expressed by both the private and public sides this must be set higher than the investment that has been made in Horizon 2020 and potentially it may need to be equivalent to the investments made by global competitors, although care must be taken to compare like with like in terms of both the scale and timing of investments. In the limit if the European AI, Data and Robots industries decide that it is important to challenge the dominance of the primary US AI companies, or Chinese manufacturing this would require a significant scaling of investment from both public and private sides. However the current differences in business environment and operation between Europe and its competitors and the different baselines may mean that gains are better built on a European orientation for AI that focuses on delivering European strengths into a global market.

Levels of Contribution

The data from IDC (see Section 2.1.5) suggests that companies are already planning to invest in AI, Data and Robotics in Europe to a significant level. However it is critical to success that this planned investment is fully realised. From the perspective of the Partnership the more critical contribution will be to the actions of the Partnership itself. Major industries will face similar issues around the development of AI, Data and Robotic products and services and a shared, pre-competitive, perspective can be fostered by their active engagement in the actions of the Partnership. Irrespective of the actual leverage ratio the commitment of public support, when applied appropriately, will inevitably create impact. The nature of the corresponding private contribution will depend on need and market maturity.

With respect to SME and early stage investment the Partnership will make full use of European investment instruments such as InvestEU and links to the EIB and EIC as well as making VCs and private side investors aware of the opportunity offered by European expertise in AI, Data and Robotics embedded in SMEs, start-ups and incubators across Europe.

In terms of contributions made to the activities of the Partnership and specifically to the associated work programme the raised public investment in AI, Data and Robotics will create a corresponding raising of associated private side investment both directly in Partnership related actions and in further investment to bring innovation to market. Such investments will depend on the expected rate of return which depends on the viability of AI, Data and Robotic technologies being applied to critical business use cases.

Types of contribution

The following general principles apply to Partnerships:

"The resources contributed by the private side will be mainly of three types:

1.   In-kind contributions to the funded projects (on the basis of non-reimbursed eligible costs), with lower funding rates for higher TRLs;

2.   In-kind contribution for additional activities foreseen in the SRIA not covered by Union funding;

3.   Investments in operational activities that are spent beyond the work that is foreseen in the SRIDA;"

The specificities of how these principles will be implemented in this Partnership will be further elaborated.

Tangible partner contributions into the activities of the Partnership fall into a number of categories that relate both to the Partnership itself and the actions that it carries out:

- Contributions to the operation of the Partnership
- Contributions to the actions under the work programmes
- Contributions to support actions under the work programme
- Contributions to infrastructure
- Contributions supporting research and innovation derived from the work programme actions
- Contributions to the translation of research and innovation outcomes to the market
- Contribution to the Partnership's Impact areas

In each case contributions may be direct or indirect and may be in a number of different forms, for example direct grants, loans, venture capital, sponsorship, prizes or contracted work, or in-kind contributions based on personnel, access to facilities, open licences, data sets, patent support etc.

In addition, partners may make intangible contributions to the activity of the Partnership by promoting its activities within their organisations and networks, by providing brand association and endorsement of the Partnership or by promoting best practice outcomes within their organisations and networks. In addition, industry may contribute to the Partnership by providing well founded problems and challenges that can shape and stimulate research and innovation.

Measuring Contributions

The Partnership will continue to use its access to key market analysis provided by IDC and Accenture. It will also conduct its own surveys relating to the impact of the Partnership and the funded actions. It will use the monitoring indicators, set out in the previous section to assess both its own performance reflected in private investment and the level of private investment, of all kinds, in the funded actions and their subsequent success.

3.2.2 Investments and framework conditions for deployment

There are some necessary conditions for effective deployment of the Partnership:

1) That the required levels of public investment made through the framework programme are sufficient to leverage the private investment needed to achieve transformational impact across Europe.

2) That an acceptable contractual arrangement can be reached with the Commission.

3) That the scaling up of innovation in Europe, and in particular SME growth, is supported by an entrepreneurial investment environment that can smoothly deliver investment from start-up through to market scale without companies having to seek funding outside of Europe.

4) That infrastructure investments made in AI, Data and Robotics infrastructure such as HPC are able to cope with the increased demand created by the Partnership.

5) That differences in approach to AI, Data and Robotics regulation across Members States can be addressed so as to level the market.

3.3 Governance

3.3.1 Governance structure

The Partnership will be represented by the "AI, Data and Robotics" Association established as an international non-profit organisation under Belgian law. The Association will be primarily based on organisational membership from companies and academia/research institutes with balanced representation between the different groups representing AI, Data and Robotics and between the industrial and research communities. The association will work towards gender balance in its representational structures and on ensuring that important groups such as SMEs, start-ups, end users and other innovation forces are also represented appropriately.

In addition, when needed transparent cooperation agreements will be established between the Association and existing associations such as e.g. BDVA aisbl, euRobotics aisbl, EurAI, ELLIS or CLAIRE, and EU-funded projects (i.e. HumaneAI or AI4EU).

Any organisation based in Europe can apply to become a member of the Association.

Collaborations with other initiatives (Horizontal: such as e.g. IoT, communication and high-performance computing, etc) will be established through MoUs or through the membership scheme of the Association. Verticals such as e.g. manufacturing, agriculture, healthcare) and industry associations (from different verticals such as VDMA, CONFINDUSTRIA, COCIR, MedTech, …), having a lot of SME's and users as members, will be addressed to achieve a significant scale-up in Europe for AI, Data and Robotics (to facilitate the roll- and deployment of the technology).

The EC may form a Leaders' Group by selecting C-Level representatives from relevant organisations (research, industry and others, such as trade unions, etc., as appropriate), that are expected to become members of the Association, in case they are not members yet. The role of the Leaders' Group is to supervise on the high-level strategy for the Partnership.

The Board of Directors (BoD)

The Board of Directors is elected by the General Assembly, which represents the constituencies of the Association. The election rules will ensure representational balance within the board. Directors can only be employees or appointed representatives of members of the Association and are elected by members of the Association. The board will be constructed so that there is a balance of representation of large industry, SME and research-academia and a balance of representation between AI, Data and Robotics.

Partnership Board (PB)

The Partnership Board is the mechanism for dialog in between the Public and Private side to reach objectives of the contractual agreement of the Partnership. The PB comprises members nominated by the private side (normally a subset of the BoD) ensuring proper representation of the wider community of stakeholders and representatives from the EC and Member States.

General Assembly

The General Assembly is composed by representatives from the members of the Association. All members of the Association have the right to send a nominated representative to the General Assembly to represent the interests of the member organisation.

Task Forces

Task Forces can have different responsibilities, for instance to develop a strategic roadmap document or to take care of verticals or other technical and non-technical challenges. All Task Forces will have a mandate describing scope and objectives that will be updated regularly. Any individual who belongs to a member organisation can belong to a Task Force. Task Forces will be setup, agreed and monitored by the Board of Directors.

3.3.2 Governance of vision and objectives

The Task Forces provide top down (translating the strategic directions coming from the Leader's Group) and bottom up (mapping the stakeholders approaches to meet these strategic directions) structures that reach out into the communities and allow the Association to flexibly address key issues and connect to a wide range of different stakeholder groups. They provide the core mechanism to create cohesion and discussion within the Association. The Task Forces report to the Board of Directors. The Board of Directors is responsible for ensuring that the Association is able to achieve its vision and strategic objectives. The Commission, external stakeholders (e.g. representatives of other horizontal initiatives), and representatives of Member States can be invited to participate in the Task Forces.

3.3.3 Governance to achieve coherence

The Association has to consider the research and innovation landscape of the EU and Member States, the market needs and the high-level visions provided by the Leader's

Group in the formulation of the Strategic Research, Innovation and Deployment Agenda, the corresponding roadmaps for its implementation, and the priorities and strategic orientations to the Work Programme (Horizon Europe Programme and Digital Europe Program mainly). The Partnership Board will support establishing coherence in between the European Commission priorities and the partnership (e.g aligning roadmaps with missions, specific TF to address overarching challenges such as Covid-19 pandemic, climate change, etc.).

The Board of Directors will consider all these inputs and continuously work in consultation with members through the established Task Forces for this purpose.

In addition, the strategic orientation of other partnerships, that have a strong interaction with this Partnership, will be taken into consideration in the formulation of strategies and roadmaps. The objective is to build coherence across the wider work programme, to identify opportunities for joint actions and create interrelationships that foster mutual benefit between partnerships, and overall ensure complementary and avoid redundancy/ duplication.

3.3.4 Governance for transparency and openness

The Board of Directors will oversee the operation of Task Forces and ensure that consensus building is fair, open and transparent. The Association will develop a coherent view of all Task Forces' input and consider prioritisation criteria, top down strategy and intervention logic when making its recommendations to the Board of Directors. The Association will ensure a holistic approach to the development of advice to the Board of Directors.

The Board of Directors will periodically examine the performance of the Association against its stated objectives and KPIs and in this will examine transparency and openness.

The General Assembly provides a forum for members to address issues of transparency and openness.

3.3.5 Involvement of the Commission in the Partnership

The Commission will be engaged in the Partnership through a contractual arrangement with the Association. Commission's requests will be addressed directly by the Association or via the Leaders' Group.

The Commission will engage with the Association in a timely and effective manner to establish an orientation and prioritisation for the work programme, provide guidance and discuss direction on strategy and discuss and explore operational issues relating to the operation of the Partnership, as appropriate. This will be done via the PB and the ongoing participation in Strategic Task Forces. The PB will meet at least twice a year (more often when needed) and engagement of Commission officials in Strategic Task Forces will be done in a regular basis. The PB will monitor actions from the private side to take into account the input from the Commission. Commission direct contributions in Task Forces will ensure effectiveness in the process.

The work programme and the funded actions resulting from the Association and the broader Partnership will be managed by the Commission.

The Commission will interact with the Partnership regarding policy and regulation that falls within the scope of the Partnership.

The Commission will determine the interaction between Member States and the Partnership. The Commission will define and manage the interaction with the Leader's Group.

3.4 Openness and transparency

3.4.1 Openness and transparency of participation

The Partnership will develop services and events that attract members from across all regions in Europe and is open to membership from organisations and associations that meet the membership criteria set out in its Statues and Bylaws.

The Partnership will attract members and attendees at events from all of Europe, all countries and all regions. The Partnership is open to all sectors and will be broad, open and transparent in its approach. Membership of the Partnership Association will entail membership fees that will be appropriate and fair. These fees will fund the running of the association and ensure its financial independence.

The Board of Directors is responsible for ensuring the openness and fairness of the Partnership and the Secretary General is responsible for implementing fair policy with regard to diversity and inclusion.

3.4.2 Openness and access to the partnership

The Partnership is committed to communicating and disseminating the outcomes of the Partnership and the outcomes of the work programme. The Partnership will seek to engage new members and relevant external partners in the process of defining common priorities and to join the Partnership. All calls issued under the work programme will be open to all organisations that qualify.

Membership of the Partnership will entitle individuals affiliated to member organisation to attend Partnership events. Members will have an advantage in accessing information and events.

3.4.3 Assuring transparency

Assuring easy and non-discriminatory access to the information about the calls, funded actions and the outcomes of calls is guaranteed by the Commission as a part of their running and management of the call process. The Partnership will provide open access to information through its web-based resources and through events and fora. The Partnership will work with its members and the Board of Directors to ensure that there is good transparency concerning the activities of the Partnership and to assess the external visibility and delivery and public access to information relevant to the Partnership.

3.4.4 Growing the Partnership

Membership of the Partnership will be open and transparent. Any organisation will be able to apply to become a member of the Partnership. The Partnership will operate a pro-active recruitment policy consisting of a portfolio of activities ranging from the a) the ongoing presence in relevant fairs and events to present the Partnership and to inform and invite new participants to join, b) the active involvement of national and regional initiatives, and NCP networks by providing them customised information packages to be passed forward to their constituencies and c) the strategic building of

collaborations with other partnerships, standardisation bodies, user communities, etc. that allow to create additional channels for awareness and engagement. The pro-active recruiting policy will be monitored and updated by the Board of Directors as necessary throughout the Partnership.

The Partnership will operate an international membership option where these members are deemed to enhance the European ecosystem and where collaboration provides opportunities for Europe in a global context. For example, in setting standards or creating regulatory alignment, or where the use of assets, such as regulatory sandboxes, may provide an advantage to European researchers or innovators.

3.4.5 Work programme development methodology

The process to develop work programmes has the following objectives:

- To be objective in choosing the topics for the work programme
- To take a strategically led evidence-based approach to prioritisation
- To have a transparent consensus process that sets the orientation
- To use strategic guidance in selecting instruments and topics
- To consult with key stakeholders on the impact of specific choices

At each round of development, the Partnership will convene a panel of stakeholders to set the high-level strategy for the call. This panel will consider the strategic alignment with Commission objectives, the current outcomes of the work programme and the SRIDA roadmap. From these considerations it will set out high level priorities relating to instruments, funding balance, and technical and sector-based priorities. This will be tested with a consensus process in the wider community. The Panel will consider all input from the consensus process and develop an orientation document for consideration by the Partnership's Board of Directors.

Once feedback on the orientation is available from the Commission a more detailed set of options for the work programme will be developed that can be used as the basis for more detailed discussions with members. Typically consensus building around the range of topics will take place through workshops. From this an editing group will formulate the input to the Commission that will contain suggested text, rational for the topics chosen, a suggested structure (in accordance with guidance from the Commission) and a relative budget balance between instruments in notional amounts. An executive summary of this final input will be shared with the Board of Directors for approval.

Member States will be indirectly involved early in the process by their oversight position in the proposed Partnership Board.

At this point a communication for Member States will be prepared that includes an overview of the topics selected and a rational for their selection together with an extended impact description. It is preferred that this communication is delivered to the relevant Member State committee by a delegation from the Partnership so that there is a clear line of communication between the Partnership and Member States.

The editing panel will be available for consultation by the Commission units during the work program approval process to formulate updates and editing should this be required. It is expected that where this process involves joint initiatives that the process

outlined above are conducted with the joint partner and with the relevant Commission and Member State representatives.

4 Appendix

4.1 Different categories of funded actions

Technical Impact: Funded actions that generate technical impact either through the creation of new technology or through the integration and adaptation of technology to demonstrate the ability to address a new application area. Metrics of success are based either on improvements to operating capability, for example faster operation, lower cost, greater range, improved decision making etc. or on categorical change where a new means of addressing a technical or application challenge is found, proved or benchmarked. With respect to these actions, that generate technical impact, the Partnership needs to foster fora where new ideas can be exposed to a wider audience, provide the opportunity to make connections to end users, for example through the Digital Innovation Hubs, and ensure that the outcomes of individual projects are considered when identifying success stories.

Community Impact: Certain funded actions focus on generating communities, these may be Coordination and Support Actions that have an explicit focus on creating and developing communities but this may also be a side effect of larger R&I actions or actions focused on developing networks round research and innovation, such as the Digital Innovation Hub networks and the AI centres of excellence. The Partnership will connect with these actions to identify areas of synergy and ways for these actions to interface with the actions of the Partnership to mutual benefit.

Infrastructure Impact: Funded actions focused on delivering infrastructure have direct relevance to the Partnership. Such actions include the AI On-Demand-Platform and actions related to pilots, demonstrators, data spaces, testing environments etc. The Partnership will assist in the development of wider access to these resources and provide strategic direction to future development.

Market Impact: Funded actions that are based on use cases and nearer market opportunities are important to the impact of the Partnership. The Partnership will set strategy around the areas where market gains can be maximised and will direct members towards these actions. The Partnership will take up the promotion of success stories and ensure that its large scale events act to promote and present the outcomes from actions that have market impact.