



Alliance for
Internet of Things
Innovation

Advancing EU IoT Research and Innovation

AIOTI's position on Horizon Europe and Digital
Europe

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Executive Summary

Europe's future economy will be founded on the ability of organisations to extract insights from information gathered through next-generation digital infrastructures and transform them into products, services and experiences to create new jobs, value, productivity and competitiveness. The next-generation Internet of Things (IoT) will play a central role in creating this future.

To achieve this, both the Digital Europe Programme, aiming to create a world class infrastructure and capabilities enabling the public and private sector (large and small) as well as the Horizon Europe Programme are key to success and the AIOTI welcomes them. The European Commission's (EC) Horizon Europe (HEU) framework programme seeks to build on the success of its predecessor, the Horizon 2020 Programme (H2020). The Alliance for Internet of Things Innovation (AIOTI), the leading European, member-driven organisation for IoT Innovation (www.aioti.eu), that brings together industry, research, academia and representatives of society, is committed to creating successful IoT ecosystems by accelerating the adoption of Europe's digital future and helping to drive it along the Digital Europe and Horizon Europe Programmes.

The AIOTI endorses and supports both program proposals but considers several elements to be undervalued or missing; there is room for improving the HEU to pave the way for next-generation enabling technologies and maximising the programme's impact. Examining the HEU Programme and its three pillars - Open Science, Global Challenges and Industrial Competitiveness, and Open Innovation - this position paper provides new insights and highlights areas that require further discussion and consideration, specifically in the areas of:

- Creating sustainable innovation platforms that both large and small companies can access, stressing that infrastructure as such does not imply a powerful, accessible, reliable and sustainable collaboration platform for fast innovation and deployment.
- IoT and digitisation based on distributed systems and intelligence for resilience, safety and security.
- Creating a European Partnership including IoT stakeholders focusing on integration, as a key constituent of Digitising Europe across sectors and across disciplines and embedding the several KETs.
- Paying more attention to non-functional aspects of digitisation/IoT and earning trust (which is rightfully addressed in the Digital Europe Programme).
- Focussing on industry-led projects with a challenge-based approach involving stakeholders in business, technology, legal and ethical aspects, users and various sectors of society.
- Strengthening and further developing digital innovation hubs (DIHs) with a focus on SMEs



- Strengthening the budget of the pillar Industrial Competitiveness, and minimising overhead
- Involving industry in Europe in the design of research and innovation missions.
- Mechanisms to support industrial investments in enabling technologies and their applications (LSPs, innovative procurement).
- Securing digital industrial expertise and experience on every review board.

AIOTI very much welcomes the creation of the Digital Europe Programme (DEP), and the new digital focus of the Connecting Europe Facility (CEF) instrument addressing deployment, to bridge the gap between research and innovation and investment in a world-class digital infrastructure.

However, the aim of achieving a wide uptake and deployment of innovative digital solutions within an EU framework notably with a role for small and medium enterprises requires collaboration platforms to be established on this infrastructure, which requires intensive and constructive orchestration of the ecosystems).

The AIOTI endorses and supports DEP's proposals while recommending among other that IoT is specifically included as a critical element of trans- and interdisciplinary nature in the digital transformation that brings the convergence of key enabling technologies and stakeholders.

Many more detailed and practical recommendations can be found in the report, but in general, the position paper describes improvements to both the Horizon Europe mission-oriented approach and the Digital Europe Programme, that increase their ability to deliver on the programmes potential to combine interdisciplinary and inter-sectoral research and innovation activities with infrastructure, capabilities and domain-specific and application-oriented approaches. This paper looks at research and innovation priorities for IoT and key enabling technologies (KETs) and how future IoT technologies and applications will drive change across industry sectors, the European economy and society in general, including convergence with next-generation tactile/cognitive IoT, decentralised technologies and distributed architectures, IoT knowledge-driven edge processing (AI) and trustworthiness.

Recognising that leading in innovation in an increasingly competitive global environment requires considerable resources, there are recommendations in relation to budgets, funding mechanisms and harmonisation, in the context of the wider European, co-investment, stakeholder and risk landscape. Rules for operational flexibility and simplified administration are covered, along with research and innovation ecosystems and value networks, including the European network of Digital Innovation Hubs, the EIC Accelerator, and the need for an updated partnership landscape.



1. Introductory remarks

In early June 2018, the EC published its plans for the new programmes – Horizon Europe – that will build on the achievements and success of the previous research and innovation programme (Horizon 2020) and Digital Europe programme to keep the EU at the forefront of global research, innovation and deployment of a world-class digital infrastructure.

AIOI, representing a wide range of stakeholders in the digital innovation landscape and engaged in research, innovation, and the development and deployment of IoT technologies and applications by creating IoT ecosystems to accelerate the adoption of IoT technologies and applications across industries and society, has appraised these plans with great interest.

We welcome many of the proposals of the Commission and are committed to helping implement them. However, there are several elements critical for success that are undervalued or missing, and we therefore explicitly state our recommendations for improvement in this AIOI position paper.

AIOI is a stakeholder-driven organisation representing significant players from different domains within the European R&D and industry IoT ecosystems. The members of the AIOI are participants in European R&I programmes and bring different perspectives of the European industry landscape. AIOI, with its various working groups, is active in the fields of standardisation, ecosystems, energy, mobility, health, buildings, smart cities, manufacturing and other industries.

AIOI with its various working groups is active in the fields of standardisation, research, ecosystems, policy, health, farming, smart cities, mobility, manufacturing, energy, buildings, and other industries. Our aim is to strengthen the dialogue and interaction among IoT players in Europe with the objective to foster a dynamic European ecosystem that can accelerate IoT adoption. We are fully supportive of a Horizon Europe Programme that pursues excellence to strengthen Europe's ability research and innovation power and a Digital Europe Programme which provides a strong infrastructure while realising that such infrastructure will only bear fruit when collaboration across industry, academia and society on an application level takes place. This is an important goal for the AIOI to accomplish.

We look forward to intensive interaction and collaboration with the EC on the implementation of Horizon Europe – the Framework Programme for Research and Innovation and Digital Europe programme.



2. Maximising the Impact of Horizon Europe

Paving the way for next-generation enabling technologies

The future development of the European economy will be based on the ability of large enterprises, SMEs, public administrations, research organisations and start-ups to extract insights from information gathered through next-generation digital infrastructures and transform them into products, services and experiences to create new jobs. This economic growth will boost the European Union's productivity and competitiveness, which is crucial for sustaining its socio-economic model and values.

Already in 2018, we are experiencing the emergence of a great wave of enabling technologies, from Next-Generation Internet (NGI), High-Performance Computing (HPC), Industrial Data Platforms, Internet of Things/Industrial Internet of Things (IoT/IIoT) and Edge Computing to Artificial Intelligence (AI) and Distributed Ledger Technologies (DLTs) across all domains. While there is ongoing research in these areas, we need to keep our minds open to the development and adoption of new technologies that will emerge in the future.

Beyond 2020, the focus must shift to ensuring that, collectively, we can access the knowledge and the fusion technologies necessary for extracting reliable, trustworthy, valid and accurate insights from the data that are generated in order to make useful and meaningful decisions for businesses and the society. We must also understand the limitations of the technologies and never stop questioning the ethical and moral dimensions surrounding their use.

New industrial assets to reinforce our competitiveness

The growing number and complexity of valuable industrial data assets is already giving rise to new industrial and research challenges. Digitisation and the industrial data economy have led to an explosion of data and information. Without novel computational tools and paradigms, we will not be able to manage the rapidly increasing complexity of these data. Cross-sectorial, cross-organisational, trans-disciplinary and cross-technological environments will enable research and innovations in both new and existing technologies by combining the capabilities of the various technical domains.

This paper summarises AIOTI's initial feedback on the Horizon Europe package proposal as released by the European Commission (EC) on June 7th, 2018 [1][2]. Since its publication, we have gathered input from our members and present their comments in the pages that follow. For ease of reference, in each section, we will also provide a summary of:

- AIOTI Endorsements of the current positions as outlined in the HEU proposal or of statements made by other contributors and thought leaders.
- AIOTI Recommendations to address the needs of the European IoT ecosystem and increase the relevance and impact of the investments made through the HEU framework.



3. Horizon Europe Programme Structure

Horizon Europe is structured across three strands/pillars structure: I. 'Open Science', II. 'Global Challenges and Industrial Competitiveness' and III. 'Open Innovation', each with a well-defined share of the budget and clear objectives, outcomes and impacts to address technological, societal and global challenges.

The impact of the programme and its specific instruments needs to be continuously evaluated to demonstrate their benefits in enhancing growth, creating jobs, supporting the sustainable societal development and providing more extensive social benefits. These measures may lead to corrective actions during the programme or even discontinuation and re-investment of the funds if not satisfactory.

AIOTI Endorsements

- AIOTI supports the 3 Pillars structure to strengthen the EU's global scientific leadership and re-engage citizens by setting ambitious new missions for EU research.
- AIOTI welcomes the measures for maximising the innovation potential across the EU and provides support for the Member States lagging in their efforts to make the most of their national research and innovation potential.
- AIOTI agrees that the completion of the Digital Single Market and the growing opportunities from the convergence of digital and physical technologies require a stepping up of investments and supports the plans that Horizon Europe contributes to these efforts, with a substantial increase in spending on central digital research and innovation activities compared to the Research and Innovation Framework Programme Horizon 2020.
- AIOTI endorses strengthening the European Research Area by focusing on sharing excellence and reforming and enhancing the European research and innovation system, while monitoring and evaluating the Framework Programme and disseminating and exploiting results; modernising European universities; supporting enhanced international cooperation; and guiding science, society and citizens.
- AIOTI supports the industry's focus on Pillar II – 'Global Challenges and Industrial Competitiveness', reflecting its role in Europe's economy of providing productivity, progress, jobs and prosperity, as well as contributing to solving the global challenges.
- AIOTI supports the continuation of the Societal Challenges pillars under Horizon 2020 that support interdisciplinary approaches and technology neutrality.



AIOTI Recommendations

- AIOTI advises that Pillar III. 'Open Innovation' be further strengthened to allow companies to deliver breakthrough innovation and cross the chasm from niche technology to mainstream market by providing mechanisms for encouraging broad industry participation from starts-up, scale-up and fast-growing companies to participate, including innovative SMEs, mid-caps and large global players.
- The complex change in mobility technologies and applications and the emergence of the Internet of Vehicles and autonomous vehicle applications combining mobility, AI, IoT, 5G and real-time data processing require new solutions for future mobility applications. In this context, AIOTI advises on the creation of a Mobility research priority that is separate from Climate and Energy.
- That further detailed explanations are incorporated into Pillar I. 'Open Science' and Pillar III. 'Open Innovation' to address the needs of targeted applicants and involve them in an early stage and further elaborate on the thematic connections between the Pillars.
- AIOTI further recommends refining the thematic Clusters in Pillar II ('Global Challenges and Industrial Competitiveness') to increase the capacity for generating new knowledge and new technologies at different technology readiness levels. Efforts should be made to maximise the synergies and trans- and interdisciplinary approaches of the Clusters regarding the scope and details of the Areas of Intervention and to provide more uniformity and streamlining.



4. Delivering the mission-oriented approach

The Horizon Europe is built on a mission-oriented approach that seeks to address European challenges by stimulating scientific and industry-driven solutions. These missions have the potential to combine interdisciplinary and inter-sectoral research activities in conjunction with domain-specific application-oriented approaches for the benefit of European growth and competition. A combination of top-down and bottom-up input to the policy design process is likely to yield the most significant impact.

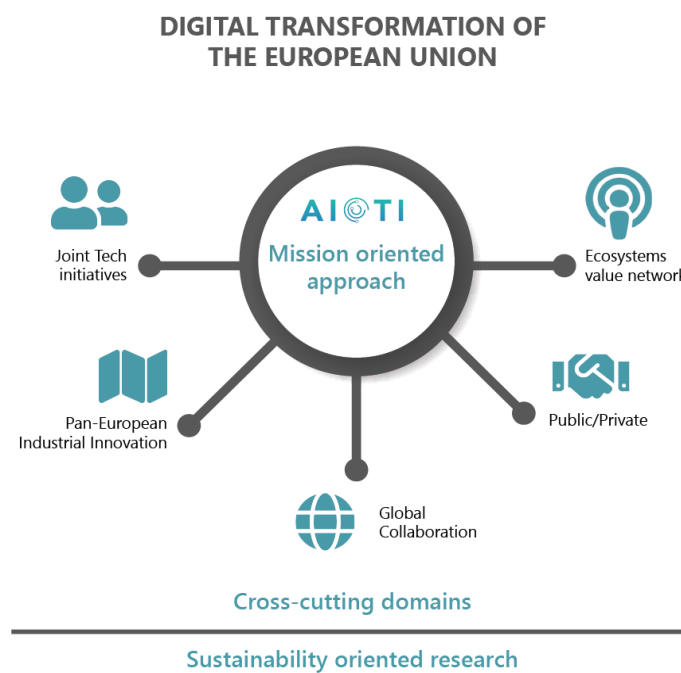


Figure 1: Horizon Europe - Mission oriented approach

Mission boards

Given the importance of their role, the mission board members should be selected on the basis of their expertise and ability to contribute to the future development of a dynamic Europe. Diversity will be vital in ensuring that they are open to innovation and new ways of working.

AIOTI believes that industry active in Europe should be actively involved in the design of research and innovation missions. This could be achieved by requiring the mission boards to have at least one industry member in order to bring different and market driven perspectives. Mission managers should be selected based on proven expertise and, preferably, possess industry experience.



Besides, the missions should be defined in close collaboration with agents of the innovation ecosystem and with society at large.

The missions themselves may require accompanying policy measures to support their adoption. One example might be a measure that stimulates the introduction of new technologies or the phasing out of older ones (e.g., polluting technologies, when addressing the EPS Climate Change objectives of 550 g CO₂/KWh). Another example might be new technologies that will help to implement a secure, reliable, resilient, accessible, cost-efficient, market-based, pan-European, integrated low-carbon energy system supplying the whole economy and paving the way for an entirely CO₂-neutral and circular economy by the year 2050, while maintaining and extending global industrial leadership in energy systems during the energy transition [6].

Key enabling technology-driven missions

Regarding the work itself, mission-driven research and innovation must build upon strong technological know-how. This means that Horizon Europe should continue to focus on the advancement of Key Enabling Technologies (KETs) in pre-competitive innovation networks. KETs have been an essential tool for structuring calls in Horizon 2020, and a means to learn empirically and explore technological and market/deployment risks. In the Commission's new proposal they are limited to a single cluster. As KETs cut across topical areas, we recommend that the Commission explicitly incorporate the KETs across the entire structure of Horizon Europe.

Global quality, productivity, and competition

The programme's mission-based approach should include mechanisms to re-energise the manufacturing sector, which is globally recognised as a bastion of quality, as well as the new services sector. Both are key to employment and prosperity within the EU, but to remain competitive at a global level traditional companies must transition to production models that are smarter and offer more customised products of high added value.

The combination of human-machine capabilities, new materials, lower energy costs, and broader collaboration must be explored to support and accelerate digital transformation across the EU. Across the EU, investment in Information (IT) and Operation Technologies (OT) will help reduce the gap between industry leaders. Research and development priorities must be placed on those technologies that offer interoperability between different domains. The development of algorithms in distributed settings on edge devices, for example.



Supporting maker communities can also help address the skill and technology gap that exists across the EU, concerning new generations becoming more active participants in the development of new technologies.

AIOTI Endorsements

- AIOTI strongly welcomes the mission-based approach focusing on societal challenges and industrial competition, with bold, ambitious goals and strong European added value to tackle issues that affect citizens' daily lives.
- AIOTI endorses the non-prescriptive approach that focuses on the “what” and not the “how”.

AIOTI Recommendations

- Missions should be open regarding the technologies to be used (i.e. they should be technology-neutral).
- Industry should be actively involved in designing missions; for instance, by having at least one member with industrial experience on their boards.
- Missions should be specific and actionable, with measurable and clear objectives.
- Missions must be suitable for providing substantive contributions to solve contemporary and future societally relevant issues, and for achieving greater identification with Europe.
- Horizon Europe should start with a limited number of missions, introducing mechanisms for continuous monitoring and periodic evaluation of the impact of individual missions in order to improve and enhance the scope and effectiveness of implementation.
- The AIOTI-suggested missions include:
 - Large-scale, seasonal energy storage (“Power-to-X”) to become a commercially viable alternative to fossil-based backup power generation by 2022.
 - Secure, privacy-protecting, and trusted digital infrastructures for European companies, public organisations, and citizens in place by 2027.
 - Integrated transport systems with self-driving, emission-free vehicle solutions reducing vehicle congestion by 60% across Europe by 2030.
 - Fully flexible manufacturing based on cyber-physical production systems realised across several industry verticals by 2027.
 - Collaborative human-machine systems to increase productivity, reliability, security, and safety within EU manufacturing, construction, and process industries.
 - The increase of energy efficiency in buildings by 30% by 2030.



- Food production increase by a 2x factor whilst reducing the environmental footprint by a 2x factor, by 2030.
- Reduction of pollution across the EU and particularly in cities by 30% by 2025.
- Increase the reliability, safety, privacy, security, transparency, and accountability of systems based on IoT, AI, machine learning involving machine-to-machine and human-to-machine interactions by 60% by 2030.
- Increase the defence technologies by 50% by 20130 to counter the effect of external influences on European businesses and citizens.
- Increase the efficiency of the European supply chain by 30% and ensure supply chain continuity, security of supply and decarbonisation by 2030.
- Strengthening European creative and service industries through emerging technologies by a 2x factor by 2030.
- Reduce human trafficking and mass migration crises by 50% by 2030.
- Introducing regulatory and policy initiatives to stimulate the intro of new technologies or the phasing out of older ones, while supporting cybersecurity drive.
- All mission programmes should create sustainable platforms that can continue to progress on the route to market beyond the public funding stage.



5. Research and innovation priorities for next-generation IoT

IoT technologies and applications are critical enablers of digital transformation across industries and society, and developments in this field can provide essential contributions that strengthen scientific and technological foundations, increase competitiveness, tackle the most important global challenges and ensure sustainable development of the EU. In this context, IoT research and innovation must be considered in conjunction with the KETs defined by the EC [4],[5].

5.1. Key Enabling Technologies

KETs are investments and technologies that will allow European industries to remain competitive and capitalise on new markets. The economic impact of KETs is considerable, and they have enormous potential for growth and employment. AIOTI concurs that the sizeable markets created by KETs sustain significant employment in the EU, and small and medium-sized enterprises (SMEs) are expected to account for much of the future job growth in KETs.

The EC predicts that countries and regions that fully exploit KETs will be at the forefront of advanced and sustainable economies. Deployment of KETs will contribute to achieving reindustrialisation while simultaneously meeting energy and climate change targets, making them compatible and reinforcing their impact on growth and job creation. Thus, all the research topics of the KETs, with their dedicated research priorities, need to be covered. Also, the focus of the applied research must be on the intersections of the KETs that align the capabilities of the technology and on deep semantic interoperability among the data from different domains, thus enabling integrated cross-domain services (e.g., building data algorithms in distributed settings on edge devices).

AIOTI Endorsements

- AIOTI supports the principle that the KETs must present the key technological building blocks for the Horizon Europe's missions.
- AIOTI welcomes the addition of "Artificial Intelligence", "Digital Security" "Connectivity" and "Life Sciences Technologies" to the original six KETs that were the focus of Horizon 2020.



AIOTI Recommendations

- Having due regard to the strong interdependencies and synergies between IoT technologies and the new KETs, AIOTI recommends the creation of new KETs as an additional area of intervention within its budget in the 'Digital and Industry' cluster.
- Particular budgetary attention needs to be dedicated to AI, digital security and connectivity, three KETs indispensable for boosting European competitiveness in the coming decade and for enhancing the capabilities of next-generation IoT technologies and applications.
- Emphasis should be given to non-functional topics such as reliability, safety and trust in distributed systems, including distributed IoT architectures, to ensure the high reliability and quality of future industrial systems and products in the digitalised data economy, which faces rapidly increasing complexity. Such emphasis is necessary, for example, to minimise expensive, time-intensive system certification of the end-product, modular certification and 'certification inheritance' for complex distributed systems.

5.2. IoT technologies and applications

Internet technologies will drive the next wave of global competitiveness. In particular, next-generation IoT as part of the NGI developments will be a key enabler of the digital transformation of industrial sectors, the economy and society.

IoT across industrial sectors

IoT/IIoT technology, integrated into the next-generation of Consumer/Business/Industrial Internet infrastructure and digital platforms, coupled with AI, modelling and simulation and DLTs, HPC, photonics and nano-electronics across industrial sectors can form the foundation of improved and eventually entirely new products and services. The combination of AI, physical/digital/cyber models and IoT technology brings new challenges, for instance, the need for addressing distributed IoT architectures and decentralised security mechanisms.

Another key to raising the benefit of products and infrastructures to a new level is the creation of 'digital twins' as full digital representations of physical assets that provide both the elements and the dynamics of how an IoT device operates and lives throughout its life cycle. This will ease the design of novel products, improve the lifetime performance of buildings and rail infrastructure, and make data, such as the origin of food or repair instructions, available to consumers and, e.g. maintenance workers.



Integration and convergence of technologies and next-generation tactile/cognitive IoT

To achieve this goal, multi-disciplinary research and innovation is required across industrial sectors to provide novel solutions for simulation algorithms (faster, multi-scale, multi-physics), either embedded or executed on the edge, as well as semantics and tool infrastructure to lower the barrier for creating and interlinking digital twins in all domains of technology and society. Achieving this goal will also require incorporating and adapting methods from areas like AI, software technologies, augmented reality (AR) and virtual reality (VR) technologies. IoT research and innovation activities across industrial sectors require the development of technologies such as the following:

- Sensing and actuating technologies for smart devices,
- Electronic components and systems and their co-integration with computational units,
- Tactile/cognitive IoT technologies,
- Flexible and comfortable materials for human-friendly interactive objects,
- Connectivity technologies expanding the spectrum and moving to Tera Hertz flexible use for providing higher capacity and near zero latency Internet, and development of cognitive edge networks.
- Neuromorphic computing powering AI and IoT applications,
- Integrated quantum computing,
- Systems for trusted and energy-efficient smart networks,
- Technologies that support inclusive and highly personalised access to objects, information and content, and
- Service infrastructures (connectivity beyond 5G, AI, software-defined infrastructures, edge infrastructure, cognitive edge platforms, distributed ledger IoT/IIoT platforms etc.).

Other technologies will enable real-time capabilities, virtualisation and decentralised management: ultrafast and flexible radio, edge computing, distributed ledger technologies, shared contexts and knowledge. The pursuit of interoperability, multi-modal interactions and discovery should also continue to be areas of considerable interest.



The approach can involve convergence or integration and IoT-enabled platforms with a broader business vision of IoT as a combination of connected devices, software, platforms, stakeholders, information and apps. Over its whole life cycle, a complete industrial product or process can be accompanied by a virtual representation that allows design optimisation, process control, life cycle management, predictive maintenance, risk analysis and many other features.

The key is that these elements should be integrated into IoT ecosystems and value networks.

Robust systems through decentralised technologies and distributed architectures

The development of IoT applications and distributed ledgers will focus on significantly reducing failure points in networks, providing for secure traceability. The use of distributed architectures, cryptographic signatures, smart contracts, identity authentications and public and private permissions will strengthen the security of IoT edge devices and applications.

Decentralized technologies and distributed architectures allow for intelligent edge devices in various communication networks to maintain low latency and high throughput and provide scaled solutions.

Next-generation IoT knowledge-driven edge processing

The creation of knowledge-driven services enacted by IoT and AI in the industrial sector requires developing technologies for condition-based monitoring to provide insights into the availability, performance and quality of production assets involved in manufacturing processes. Additional opportunities exist in other domains, such as smart living for an ageing society for using these knowledge-driven services.

AIOTI supports finding mechanisms enabling the free flow of data and open access to data for mutual stakeholders' benefit so that organisations can cooperate in IoT ecosystems (open digital environments) and build constructive, trust-based relationships.

Trustworthiness in IoT technologies, applications and ecosystems

IoT trustworthiness refers to attributes such as security, privacy, reliability, safety, availability, resilience and ability to connect, and with the inclusion of AI techniques, integrated solutions should be fair, reliable safe, private, secure, inclusive, transparent and accountable.



Security in the IoT field is a growing concern, particularly given the increasing penetration of IoT systems into industrial applications. The move to edge computing, the growth of IoT and AI and distributed architectures require new security architectures and concepts. However, they also bring new opportunities for reliable, dependable and secure functions. Further research is thus needed on distributed IoT security technologies on the user (machine/human) - end-to-end centric design while integrating autonomous identity recognition through machine learning, AI and swarm intelligence.

In this context, trust and trustworthiness are key considerations for IoT/IIoT applications. Concerns and challenges related to trust, security and privacy directly affect the acceptance and growth of IoT. Increasing trust in technology and in the organisations involved in delivering IoT products and services is essential so that users can confidently enrol in data sharing initiatives in complex value chains. This is a complex issue involving technological, behavioural, cultural and human-machine interaction considerations. Indeed, this objective can only be achieved by agreeing upon and implementing effective standards, as well as continuing to share information and educate users.

AIOTI Endorsements

- AIOTI strongly endorses the development of next-generation IoT technologies and applications as an integrated part of the NGI and as key enablers of the digital transformation of industrial sectors of the economy and society.
- AIOTI supports the development of next-generation IoT towards a human-centred ecosystem, in line with European social and ethical values.
- AIOTI strongly supports Horizon Europe's proposal for the development of next-generation IoT technologies and systems for trusted and energy-efficient smart network and service infrastructures (connectivity beyond 5G, AI, software-defined infrastructures, edge infrastructures, cognitive edge platforms, etc.), enabling real-time capabilities, virtualisation and decentralised management (ultrafast and flexible radio, edge computing, distributed ledger technologies, shared contexts and knowledge), interoperability, multi-modal interactions and discovery, inclusive and highly personalised access to objects, information and content.

AIOTI Recommendations

- AIOTI proposes research and innovation priorities in the area of next-generation tactile/cognitive IoT via a dedicated cluster.



- Supporting IoT, simulation and physical/digital/cyber models and DLTs applications in real-world cases with the involvement of end users to build trust and address the challenges of 5G-enabled ubiquitous connectivity next-generation IoT embedded in the NGI infrastructure by providing standardised and interoperable solutions to ensure EU industrial and technical leadership.
- Trans- and interdisciplinary approaches across the clusters to ensure the integration and convergence of technologies in IoT applications addressing different missions, integrating IoT-enabled horizontal platforms with broader business visions of IoT as a combination of connected devices, software, platforms, stakeholders and information and apps as part of the larger integrated IoT ecosystem and value networks.
- Mechanisms to support industries to invest significantly in sensing and actuating technologies, electronic components and systems, and their co-integration with computational units as enablers of next-generation tactile IoT, including innovative solutions for flexible and conformable materials for human-friendly interactive objects, neuromorphic computing powering AI and IoT applications, or integrated quantum computing.
- AIOTI recommends investing more in focussed industry-led projects - e.g., Spearhead/Lighthouse/Flagship—with a challenge-based approach and also considering non-functional topics such as reliability, safety and trust in distributed systems. These focussed projects should bring together several key players representing the points of view of business, technology, legal and ethical aspects, user groups and various sectors of society.
- AIOTI recommends strengthening and further developing digital innovation hubs (DIHs) for the development of the industrial digital economy—e.g., for SMEs to find the technology, development processes, and test beds. These DIHs must play a key role in making digital technologies widely accessible by SMEs, as well as in disseminating the results and knowledge of the focussed projects by organising workshops, seminars and master classes.



6. Budget, funding mechanisms and harmonisation measures

Exploring and reaching the next frontier of innovation requires considerable resources. To keep up with global competitors, Europe must increase its financial contribution and find new ways to encourage co-investment from other stakeholders. This balance must be reflected in the funding mechanisms provided by Horizon Europe, which should consider short- versus long-term actions and high risk—high impact versus medium risk—incremental impact measures.

A venture capital fund for scaling-up of market-ready technology with a high Technology Readiness Level (TRL) has the benefit of distributing financial risk, encouraging ambition and reducing the time from innovation to mass adoption.

The proposed measures to align EU and national funding and to simplify co-funding are also warmly welcomed by AIOTI. The effect will be to increase the funding available, for large firms and SMEs alike, and to complement national-level funding, rather than merely replace it. A particular point of interest is the funding of activities that create collaborative platforms for IoT innovation, providing access to multiple actors that include SMEs and start-ups and creating a multiplier for further innovation and economic development. These funding mechanisms need to support measures to strengthen cross-border, interdisciplinary cooperation that brings together the best European players from science, industry and society and drives European added value.

AIOTI Endorsements

- Enhanced coordination/ synchronisation of EU research development and innovation work programmes (Horizon 2020/Horizon Europe) and Structural and Cohesion funds (ESIF) and EFSI (Juncker Plan) with national and regional efforts (especially for mission-driven R&D).
- Cross-border, interdisciplinary cooperation that brings together the best European players from science, innovation and industry can drive the creation of European added value. As such, we fully support the proposals made in the report of the independent High-Level Group on maximising the impact of EU research and innovation programmes “LAB-FAB-APP- Investing in the European future we want” [3].
- AIOTI supports Horizon Europe providing particular budgetary attention to new key enabling technologies such as Connectivity, AI and Digital Security that can support European leadership in next-generation IoT technologies and applications.
- Setting a more ambitious goal for climate mainstreaming across all EU programmes, with an overall target of 25% of EU expenditure contributing to climate objectives.



AIOTI Recommendations

- Call on the European Parliament and the Council to scale-up the overall budget to at least €120bn, by shifting budgets within the actual MFF (no extra money) to maximising the innovation potential across the EU
- A €15 billion allocation to a specific cluster of 'Digital and Industry' that supports the convergence of next-generation Industrial-Tactile IoT, AI, IT and OT security, interoperability and standardisation across the industrial digital value chain.
- Increase Pillar II Global Challenges and Industrial Competitiveness's share to at least 60% of the total Horizon Europe budget.
- Incorporate financial mechanisms that support the creation of EU-grown collaborative platforms and facilitate access to innovators and transfer to industries via participation in standards and open source.
- Provide minimum budgets for individual Areas of Intervention within the Clusters to ensure proper planning security, orientation and predictability.



7. Rules for operational flexibility and simplified administration

The EC has identified and adequately addressed the simplification of administrative rules for participants. The EC focuses on excellent research, innovation and impact; it considers excellence and impact as well as disruptive and incremental innovation. This should be strengthened and followed up in HEU.

The importance of applying the right evaluation criteria and selecting evaluators who are aligned with the programme mission should not be underestimated. The evaluation criteria should cover the scope of the EU's role in the network of Digital Innovation Hubs and drive the creation of innovation platforms with simple access by SMEs.

The Horizon Europe programme rules should create mechanisms so that individual entities/innovators can better access funding (public and private), and other resources (e.g., platforms, infrastructure, testbeds, teaching factories, etc.) and this access should apply to all stakeholders involved in the research, innovation, experimentation and deployment of market activities.

AIOTI Endorsements

- AIOTI ensures that access to research data is 'as open as possible, as closed as necessary'.
- AIOTI welcomes the continuity of Horizon 2020 concerning eligible costs and recommends further simplification of the reimbursement of personnel cost (specifically allow Horizon 2020's 'usual accounting principle' to apply).
- AIOTI welcomes the proposed modifications to state aid. In the case of combined Member State funding, simplified pre-approval of funding shares is very important to leverage synergies between Horizon Europe and policy funds.

AIOTI Recommendations

- AIOTI recommends that the rules must generally:
 - Support efficient exploitation of results, avoid barriers and consider the interests of all parties involved in collaborative research.
 - Protect intellectual property.
- Reducing high oversubscription rates in individual areas. The appropriate measures should be considered on a case-by-case basis (e.g. a two-phase application procedure or a focused, topic-oriented call for proposals).



- The inclusion of the Annual Productive Hours (APH) into the Horizon Europe rules for participation as the fixed APH number requires knowledge of the usual accounting practices, the type of organisation (RTOs, SMEs etc.) and the country.
- A balanced approach between trust and control regarding the audits and control systems because this will enable a cost-effective audit system.
- Further measures to increase success rates and to reduce administrative burdens so that more industry becomes involved.
- Introduce a 20% budget call flexibility, allowing the use of funds according to the quality of the applications submitted.
- Introduce incentives to increase industry participation in research and development projects.



8. European research, innovation ecosystems and value networks

Large-scale pilot and experimentation programmes, which capitalise on innovation ecosystems and technology platforms, including the IoT, should activate networks that can stimulate the generation of knowledge-significant socio-economic value in the future.

IoT ecosystems created around these instruments offer the mechanisms to encourage and streamline the participation of all actors in the innovation process. Larger players should continue to receive support, as they have the resources to establish platforms on which new, collaborative innovations can be created.

Building on the experience gained during Horizon 2020, cascade funding mechanisms should be leveraged to open large-scale pilot and experimentation programmes to new actors from the innovation ecosystem.

Beyond large-scale pilot programmes, the creation of knowledge spaces and experimentation testbeds must be made accessible through fair and clear rules to enable actors (both internal and external) to leverage substantial EU research and innovation investments and contribute towards more sustainable innovation ecosystems. These mechanisms could be used to scale demonstration and experimentation projects. The demonstration projects are necessary to validate scientific and technological principles and solutions, but the partners involved do not always have the skills or the remit to exploit these opportunities. This should be explicitly recognised, and alternative methods of taking research and development to market should be explored.

Giving individual entities/innovators access to funding (public and private) and other resources (e.g., infrastructure, testbeds, etc.) necessary to accelerate integration will help bring launches and innovative scale-ups to market. The EU network of PPPs and Digital Innovation Hubs will be particularly useful resources to leverage for this goal.

These collaborative spaces should also be channels for identifying and planning for future skill needs. Regulatory aspects, which can act as either drivers or barriers to market deployment, should also be considered in these new contexts. Feedback should also be provided to policymakers before regulations are enacted.



AIOTI Endorsements

- AIOTI supports the introduction of a separate part of the programme called 'Strengthening the European Research Area'.
- AIOTI supports equal representation of male and female researchers across programme participation, calls for proposals, applications and evaluations.
- AIOTI welcomes the introduction of the "EIC Accelerator", which aims to ensure better access to capital to fund the growth of companies. The EIC Accelerator also supports European research and innovation ecosystems and value networks that focus on transferring research and innovation results to the market.
- AIOTI supports the introduction of the ethical dimensions and societal impacts of the research and innovation funded under Horizon Europe.
- AIOTI supports the proposed sharing-excellence mechanisms, which have immense potential to narrow the innovation gap between the Member States.

AIOTI Recommendations

- Horizon Europe should foster mission-based, industry-led, large-scale experimentation approach of a cross-sectoral and trans-disciplinary nature. These large-scale experimentation programmes should be ambitious in scope by acting on ground-breaking themes and bringing together key technology, business, legal, ethical, user group and societal players.
- Introduce measures to support and ensure that the results are deployed and implemented in the market and society, thereby maximising the impact of EU-funded research and innovation. This should be addressed in conjunction with the execution of programmes, mainly (but not exclusively) for large-scale experimentation programmes, rather than upon completion.
- Introduce ethical considerations for new technologies that involve a combination of IoT, AI and robotics.



9. Public-Private Partnerships, Joint Technology Initiatives

Horizon Europe provides an updated partnership landscape, moving from PPR and JTIs towards European partnerships. The expertise of industry must be brought to bear in this transition period.

Contractual Public-Private Partnerships (PPPs) and JTIs, with industry-driven strategic research and innovation agendas, should be continued. However, too much fragmentation should be avoided so that industry has clear fora to engage ecosystem. AI as a horizontal KET should be driven by organisations that have a track record, such as AIOTI, and integrate newly established players.

The role of the public sector, as an early adopter of EU-funded results to help achieve policy objectives, must be strengthened. Alignment with missions and schemes for the public procurement of innovative solutions (PPI) should be encouraged and considered when calls are being designed. This would be a way to incentivise the final deployment of technology matured within EU-funded projects and to de-risk adoption.

AIOTI Endorsements

- AIOTI supports the proposal for a new generation of European partnerships and increased collaboration with other EU programmes.
- AIOTI welcomes the Horizon Europe proposal to streamline the number of partnerships that the EU co-programmes or co-funds with partners such as industry, civil society and funding foundations, to increase their effectiveness and impact in achieving Europe's policy priorities.
- AIOTI endorses the Horizon Europe proposal to promote active and operational links with other future EU programmes, such as Cohesion Policy, the European Defence Fund, the Digital Europe Programme and the Connecting Europe Facility, as well as with the international fusion energy project ITER.

AIOTI Recommendations

- AIOTI recommends that next-generation IoT should get a dedicated partnership instrument due to its key enabling role in the digitising process, broad cross-sector application characteristics covering a multitude of enabling technologies, complex innovation ecosystems with cross-disciplinary involvement, critical success factors (trust), IoT platforms and experimentation in society.
- Describing better the planned review of the existing partnerships by clearly defining the criteria, conditions and future concepts of these European partnerships and their impact.



- The nature and scope of the use of partnership instruments be defined by the stakeholders involved and reflect the role of the key players participating in the process.
- Using existing good practices in PPPs, Joint Technology Initiatives (JTIs) or European Institute of Innovation and Technology (EIT) Knowledge and Innovation Communities (KICs) to measure or evaluate impact ('hard' or 'soft' KPIs).
- Investing in large-scale pilot projects with a challenge-based approach of a cross-sectoral and trans-disciplinary nature. These industry-led large-scale pilots need to define thematic ground.



10. European Agencies

10.1. European Institute of Innovation and Technology (EIT)

The Knowledge and Innovation Communities (KICs) of the European Institute of Innovation and Technologies (EIT) are essential resources that strengthen the knowledge triangle (business, education and applied research). These KICs are industry-driven communities, and they improve Europe's ability to innovate by nurturing entrepreneurial talent, supporting new ideas and bridging the gap between applied research and commercialisation.

Sufficient budgetary resources should be made available to fund these communities. The budget for EIT has been set at €3 billion, which represents just a minor increase at current prices. Given their role in supporting the monetisation of research, we recommend a more substantial increase to utilise the impact of the KICs, increasing the collaboration with regions (e.g. by opening co-location centres). Well-functioning partnerships, whether they be KICs or other groups, should be used as benchmarks to stimulate successful collaboration models.

10.2. European Innovation Council (EIC)

AIOTI regards the establishment of the European Innovation Council as a positive step towards fostering innovation in European programmes and policies. Disruptive, risk-taking, market-creating innovation should always be supported without immediate ex-ante regulations or guidelines.

Despite the investment that has led to scientific and research leadership in specific fields, Europe still lags behind other world regions regarding the creation of scale-ups. Support for both start-ups and scale-ups is required. There is evidence of market failure when successful companies that are created in Europe choose to relocate to the US to scale-up. Further, Europe must make it easier for global entrepreneurs to choose scale-up locally. This continent offers many advantages over other world regions, including legal certainty, established markets, harmonious regulation (mostly) and quality of life.

AIOTI strongly supports strengthening the European Venture Capital Fund-of-Funds, which is a fund that supports far-reaching innovation. The SME instrument programme, given its success in Horizon 2020, also warrants strengthening, along with the Fast Track to Innovation fund.



We also firmly believe that the most effective way to foster break-through innovation is to continue developing the Single European Market, notably the Digital Single Market (DSM), by introducing innovation-friendly policies and regulations while reducing bureaucracy and red tape.

AIOTI Endorsements

- AIOTI welcomes the continuation of the EIT in its current form and supports its positioning in the third pillar.
- AIOTI supports the EIC's establishment, which will help the EU become a frontrunner in market-creating innovation by bringing high-potential breakthrough technologies from the lab to the market while helping the most innovative start-ups and companies reach scale-up status.
- AIOTI endorses the idea that the new EIC will help identify and fund fast-moving, high-risk innovations with strong potential. This will create entirely new markets and provide direct support to innovators through two main funding instruments. One instrument will be for early stages and the other for development and market deployment.
- AIOTI supports the complementary nature of the EIT and EIC.

AIOTI Recommendations

- AIOTI recommends that the EIC should seek a collaborative relationship with EIT KICs. Further, the EIC should define unique elements and demonstrate the complementary nature of the EIC and EIT instruments to avoid overlapping.
- The EIC should address legislative and regulatory issues that hinder growth and innovation by carefully guiding the implementation of the "Innovation Principle" when developing new policies, regulations or guidelines.
- The EIC should not change the existing rules, funding rates or guidelines for participation, as industry players value stability and legal certainty. Policy instruments with proven effectiveness should remain unchanged.



11. Digital Europe Programme (DEP)

AIOTI welcomes the creation of the Digital Europe Programme, and the new digital focus of the Connecting Europe Facility (CEF) instrument addressing deployment, to bridge the gap between research and innovation and investment in a world-class digital infrastructure.

DEP is mainly implemented through co-ordinated and strategic investments with Member States, notably through joint public procurement, in digital capacities to be shared across Europe and in EU-wide actions that support interoperability and standardisation as part of developing a Digital Single Market. This requires building a strong relationship with local stakeholders.

Financing for research and innovation in next-generation digital technologies is continued and reinforced in the next multiannual financial framework under the Horizon Europe Programme. DEP will work hand-in-hand with Horizon Europe, providing crucial investments in research and innovation (with Digital Europe building on these results to create the necessary infrastructure) as well as supporting deployment and capacity-building, which in turn will provide input for future research in AI, robotics, HPC and big data.

AIOTI Endorsements

- AIOTI welcomes the synergies with HEU and CEF.
- AIOTI acknowledges that CEF supports the large-scale roll-out and deployment of innovative new technologies and solutions in the fields of transport, energy and digital physical infrastructures, in particular those resulting from the Framework Programmes for research and innovation; the exchange of information and data between the Framework Programme and CEF projects will be facilitated by highlighting technologies from the Framework Programme with a high market readiness that could be further deployed through the CEF.
- AIOTI considers it very important that DEP focusses on large-scale digital capacity and infrastructure-building in HPC, AI, Cybersecurity and advanced digital skills, aiming at wide uptake and deployment of critical existing or tested innovative digital solutions within an EU framework in areas of public interest (such as health, public administration, justice and education) or market stagnation (such as the digitisation of businesses, notably small and medium enterprises).
- AIOTI endorses the idea that DEP will ensure that research and innovation needs related to digital aspects are identified and established in the programme's strategic research and innovation plans; this includes research and innovation for HPC, AI,



Cybersecurity; combining digital with other enabling technologies and non-technological innovations; support for the scale-up of companies introducing breakthrough innovations (many of which will combine digital and physical technologies); the integration of digital across the pillar 'Global Challenges and Industrial Competitiveness'; and support for digital research infrastructures.

- AIOTI supports the idea that DEP capacities and infrastructures are made available to the research and innovation community, including for activities supported through the programme, novel digital technologies developed through the programme, and the programme's initiatives for the development of skills and competencies curricula.

AIOTI Recommendations

- AIOTI recommends that IoT/IIoT be explicitly included in the DEP Programme by providing open platforms and access to industrial data spaces so that the IoT/IIoT is made available across the EU, providing testing facilities and knowledge to small businesses and local innovators.
- AIOTI recommends that IoT/IIoT is included as a critical element of trans- and interdisciplinary nature in the digital transformation that brings the convergence of key enabling technologies such as nano-electronics, connectivity, AI, cybersecurity with distributed ledger technologies, mobile edge computing based on interoperability, integrated software-defined infrastructures, edge infrastructures, cognitive edge platforms and cognitive cloud.
- AIOTI recommends the integration of IoT/IIoT into CEF as part of the connectivity infrastructure to give public authorities and businesses (e.g., SMEs, start-ups) access to IoT/IIoT testing and experimentation facilities in Member States and across Europe, while increased investments in research and innovation under Horizon Europe should ensure that the EU stays at the forefront of scientific and technological developments in IoT/IIoT to address future societal challenges.
- As the integration of IoT/IIoT devices into the next-generation Internet is increasing exponentially, AIOTI recommends the financing of a state-of-the-art IoT/IIoT cybersecurity HW/SW infrastructure as well as support for the development of necessary skills and knowledge for ensuring an appropriate ethical and legal framework.



12. Global Collaboration

The EU and its member states should strengthen collaborative activities with other countries on shared priorities for their mutual interest/benefit and for solving common, non-differentiating technological and societal challenges.

The global aspect of missions should be considered during the design phase, with collaborative activities envisaged, such as joint projects, common standards and piloting solutions previously tested in the EU. By promoting collaboration beyond EU borders, EU companies have better opportunities to understand and expand their markets.

AIOTI Endorsements

- AIOTI supports the EC proposal to enhance and strengthen international cooperation.
- AIOTI supports the EC's goal to make Horizon Europe more open to the participation of third countries.

AIOTI Recommendations

- AIOTI suggests including the global dimension at the mission design stage and evaluating the partnerships with third countries and other world regions to add value to future solutions to global challenges. Value can be determined from either a research/technology or a market perspective.
- Working with other countries to simplify rules to cooperate at the international level in research and innovation projects with mutual interest.
- The introduction of measures to simplify the rules used in cooperation calls in Horizon Europe.
- Collaborative activities with other countries should be based on shared priorities for mutual interest/benefit and recommend that to prevent the unfair transfer of knowledge, and it should be possible in specific cases to avoid including third country applicants.



13. About AIOTI

AIOTI is a multi-stakeholder platform for stimulating IoT innovation in Europe, bringing together small and large companies, start-ups and scale-ups, academia, policy makers and end-users and representatives of society in an end-to-end approach. We work with partners in a global context. We strive to leverage, share and promote best practices in the IoT ecosystem and be a one-stop source of information on all relevant aspects of IoT innovation for our members. Further, we proactively address key issues and roadblocks barring the economic growth, acceptance and adoption of IoT innovation in society.

AIOTI's contribution goes beyond technology and addresses horizontal elements across application domains, such as defining policies, creating joint research roadmaps, stimulating cooperation in IoT ecosystems and driving the convergence of standards and interoperability. We also put these goals into practice in vertical application domains that have societal and economic relevance.

AIOTI partners with the European Commission on IoT policies and stimulus programmes, helping to identify and remove obstacles to IoT innovation. Additionally, we promote the rapid comprehension, deployment and replication of IoT innovation in real-scale experimentation in Europe, with a global perspective. AIOTI is a member-driven organisation with equal rights for all members, striving for a well-balanced representation from all stakeholders in IoT and recognising the different needs and capabilities of all. Our members believe that we are the most relevant platform for connecting to the European IoT innovation ecosystem, in general, and the best platform for finding partners for real-scale experimentation, specifically.



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