

Innovation Pulse

The innovation landscape of
Artificial Intelligence and Digital Twin
Technologies: Driving Innovation and
Transformation

Welcome to the Innovation Pulse

Based on insights from Wheesbee, PNO's proprietary Business Intelligence platform focused on research and innovation, Innovation Pulse delivers actionable intelligence to make informed decisions, drive innovation, and stay ahead in your industry. This report has been generated based on your selected topics: *Artificial Intelligence, Digital Twin*.

The Approach & its Significance

Innovation Pulse is designed to guide readers through the dynamic landscape of the selected innovation sector. It begins with exploring Patents, which indicate the cutting-edge inventions shaping the future. This is complemented by in-depth Research Papers, which provide a deeper understanding of the scientific and technological principles behind these innovations.

Moving forward, Projects highlight the practical applications of these concepts, showcasing real-world implementations and the emergence of new opportunities. To empower engagement and investment, we present Funding and Collaboration Opportunities, followed by Competitor Insights to frame the advancements within the competitive market context.

The rationale behind this structure is to offer a panoramic view of the sector's trajectory, from conceptual inventions to market-ready applications. By navigating this path, readers can identify emerging trends, understand the current state of play, and anticipate future developments, thus enabling informed decision-making and strategic foresight.

What to Expect

As a subscriber, you can look forward to regular updates that keep you abreast of the latest developments in your area of interest, ensuring you stay informed and ahead of the curve. Stay tuned for periodic insights to enhance your innovation strategy.

About Wheesbee

Wheesbee is an information database platform created by Innovation Engineering, which is part of the PNO Group. It is a comprehensive resource for businesses seeking insights into historical and current innovations and future opportunities in the field. With its extensive database and analytical capabilities, Wheesbee enables informed decision-making by providing valuable historical context and updates on emerging trends. By leveraging this wealth of information, businesses can confidently navigate the world of innovation, staying agile and positioning themselves for success in an ever-changing market.

Wheesbee numbers



+150 mln
PATENTS

981

on report's topics
in the last 5 years



+270 mln
PAPERS

4.512

on report's topics
in the last 5 years



+1 mln
FUNDED
PROJECTS

857

on report's topics
in the last 5 years



+700
FUNDING
OPPORTUNITIE

3

on report's topics
in the last 5 years

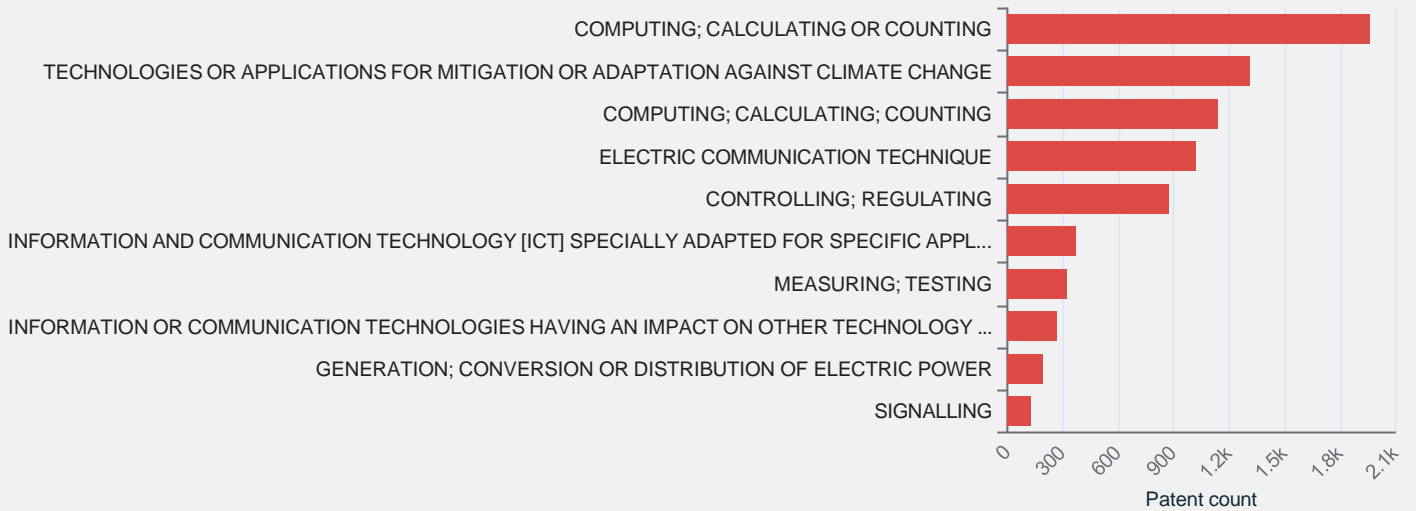


+400
COLLABORATIO
N

2

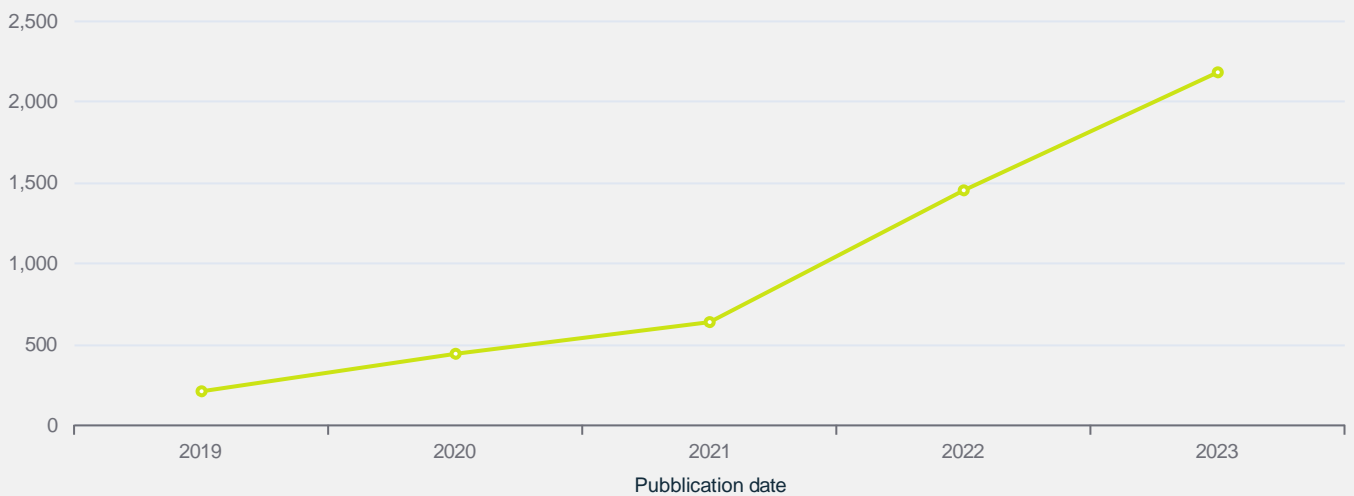
on report's topics
in the last 5 years

Most relevant CPC categories of patents



The CPC (Cooperative Patent Classification) system categorises patents by technical content. This graph unveils innovation trends in *Artificial Intelligence*, *Digital Twin* research and development by analysing CPC code frequency. Utilise this analysis to identify emerging technologies, prioritise research areas, and make informed decisions on intellectual property strategies and investment opportunities.

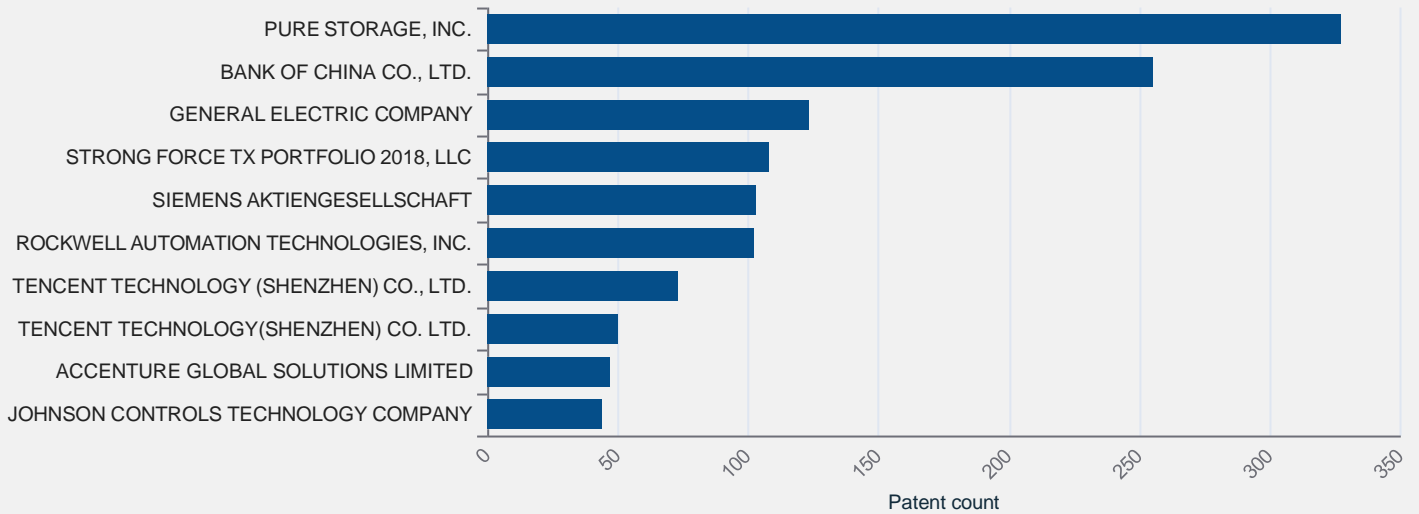
Patents trend



Discover the patent landscape of *Artificial Intelligence*, *Digital Twin* over the past five years. Tracking annual patent filings reveals fluctuations and emerging patterns, reflecting the pace of innovation and technological advancements. Use these insights to drive strategic decisions regarding collaborations and investments in your field.

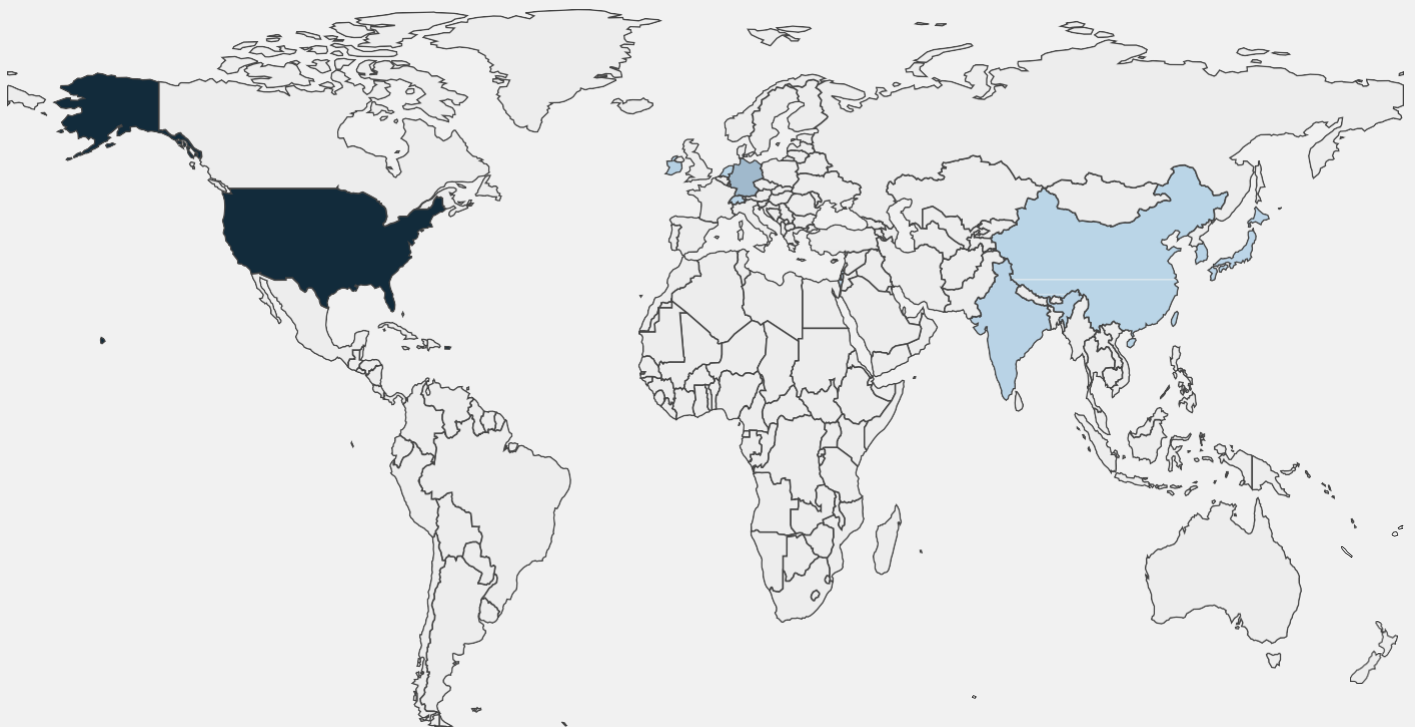
Mapping intellectual property leaders: top patent applicants

Leading patent applicants



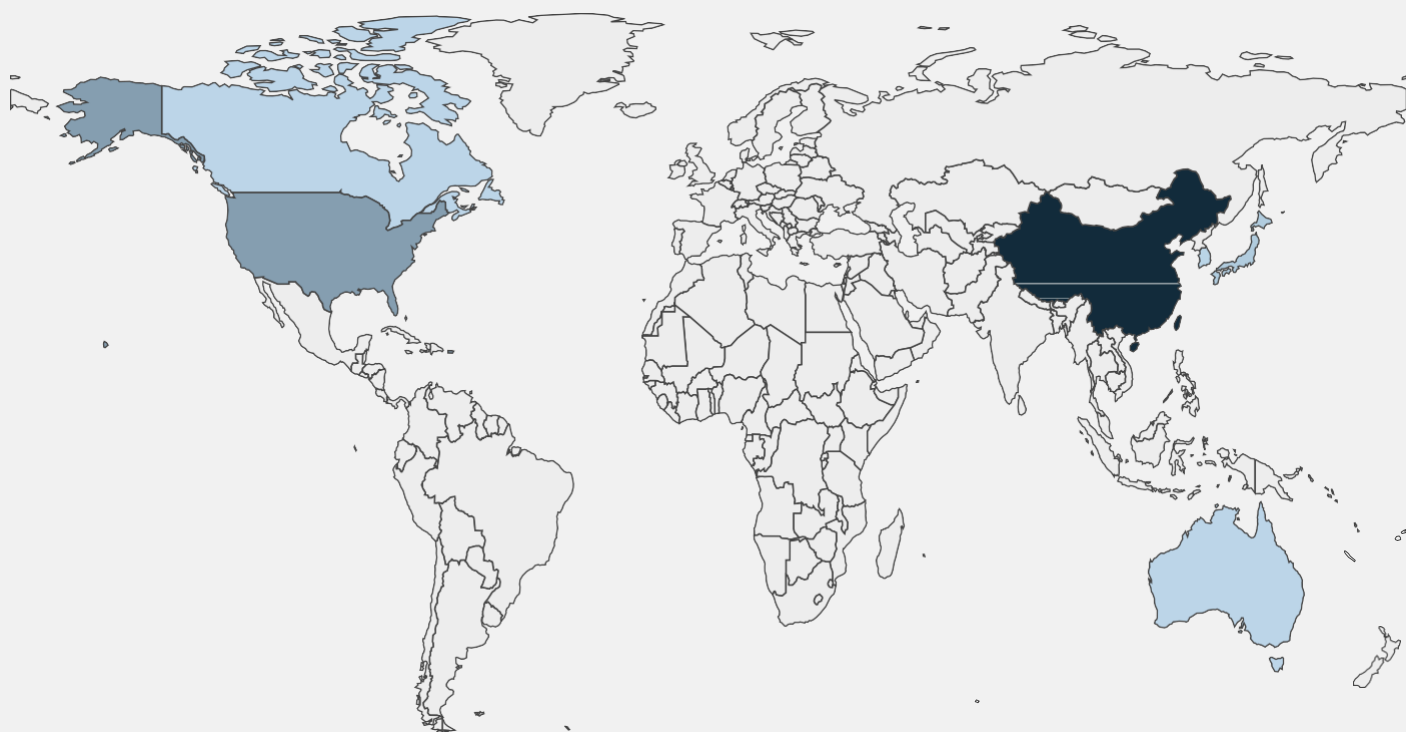
The top patent applicants give you a clear view of the field's most active entities in patent filings. This data-driven analysis helps you identify the leading players driving innovation and technological advancements. Use these insights to make informed decisions and explore potential partnerships within the rapidly evolving industry in *Artificial Intelligence, Digital Twin*.

Countries with the most patent applicants



This chart displays the top applicant countries within the *Artificial Intelligence, Digital Twin* industry, giving you a bird's-eye view of where the most patent applications originate and where innovation is thriving. By understanding which countries are leading the charge in research and development, you can pinpoint key players, spot emerging trends, and even uncover opportunities for collaboration or competition.

Patents jurisdiction



Who's leading the innovation race? A patent jurisdiction map offers insights into geographic concentrations of innovation and considerations for companies regarding where to file patents over the past five years in the industry. If you seek to protect your intellectual property and maximise its competitive advantage, the map offers strategic guidance on where to prioritise patent filings.

These patents focus on innovative applications of artificial intelligence (AI) and digital twin technologies across various fields. Digital twin technology is leveraged to enhance operational efficiency, optimize resource allocation, improve target identification, and ensure accuracy in simulations. In the culinary sector, it aids in designing efficient kitchen layouts, while in naval applications, it assists in target learning and identification for naval ships under diverse sea conditions. Additionally, AI is employed to eradicate errors in engineering programs and to make personalized recommendations for users. These technologies collectively aim to improve system design, operational effectiveness, and personalized user experiences.

Virture Kitchen Artificial Intelligence Simulation System based on Digital Twin: This invention provides a system that uses digital twin technology to design efficient kitchens. It analyzes kitchen appliance specifications, food types, and chef workflows to optimize resources. The system utilizes AI algorithms to simulate and generate optimal kitchen design, helping restaurant business founders to effectively organize both physical and human kitchen resources.

METHOD OF ARTIFICIAL INTELLIGENCE TARGET LEARNING AND TARGET IDENTIFICATION FOR NEXT GENERATION NAVAL SHIP USING DIGITAL TWIN: This method involves AI-based target learning and identification in naval ships. It uses digital twin technology along with three-dimensional rendering in varied sea environments to construct target image databases. These images facilitate AI learning to enhance the accuracy of identifying targets in sensor system images, enabling prompt responses.

SYSTEM OF ARTIFICIAL INTELLIGENCE TARGET LEARNING AND TARGET IDENTIFICATION FOR NEXT GENERATION NAVAL SHIP USING DIGITAL TWIN: Similar to the method, this system employs AI and digital twins for naval target identification. It involves receiving target images, simulating sea environments for three-dimensional rendering, and developing databases. This aids AI learning for accurate enemy target recognition in naval operations, ensuring quick responses.

SYSTEM, METHOD, AND PROGRAM FOR DETERMINING ITEM OR SERVICE DESIRABLE FOR USERS: This system uses a novel approach to determine desirable items or services for users. It involves acquiring user data, calculating a multi-dimensional score to represent user features, and using the score to identify preferences. This approach personalizes recommendations by analyzing user data comprehensively.

METHOD AND SYSTEM FOR ERADICATING PROGRAMMATICAL ERRORS FROM ENGINEERING PROGRAMS IN A TECHNICAL INSTALLATION: The invention addresses programmatic errors in engineering programs using AI. By capturing input-output signals and simulating predicted signals, it can foresee and correct error states within a digital twin of a controller device. The AI model modifies the engineering programs, enhancing reliability and performance.

Virture Kitchen Artificial Intelligence Simulation System based on Digital Twin

ID: KR102333583B1 Patent office: 🇰🇷 KOREA, REPUBLIC OF Published: 01/12/2021

Applicants: LESIK CO., LTD.

METHOD OF ARTIFICIAL INTELLIGENCE TARGET LEARNING AND TARGET IDENTIFICATION FOR NEXT GENERATION NAVAL SHIP USING DIGITAL TWIN

ID: KR102127657B1 Patent office: 🇰🇷 KOREA, REPUBLIC OF Published: 29/6/2020


Applicants: HANWHA SYSTEMS CO., LTD.

SYSTEM OF ARTIFICIAL INTELLIGENCE TARGET LEARNING AND TARGET IDENTIFICATION FOR NEXT GENERATION NAVAL SHIP USING DIGITAL TWIN

ID: KR102127655B1 Patent office:  KOREA, REPUBLIC OF Published: 29/6/2020

Applicants: HANWHA SYSTEMS CO., LTD.

SYSTEM, METHOD, AND PROGRAM FOR DETERMINING ITEM OR SERVICE DESIRABLE FOR

ID: JP2022138104A Patent office:  JAPAN Published: 22/9/2022

Applicants: FAMC LLC

METHOD AND SYSTEM FOR ERADICATING PROGRAMMATICAL ERRORS FROM ENGINEERING PROGRAMS IN A TECHNICAL INSTALLATION

ID: EP4254200A1 Patent office:  EUROPEAN UNION Published: 04/10/2023

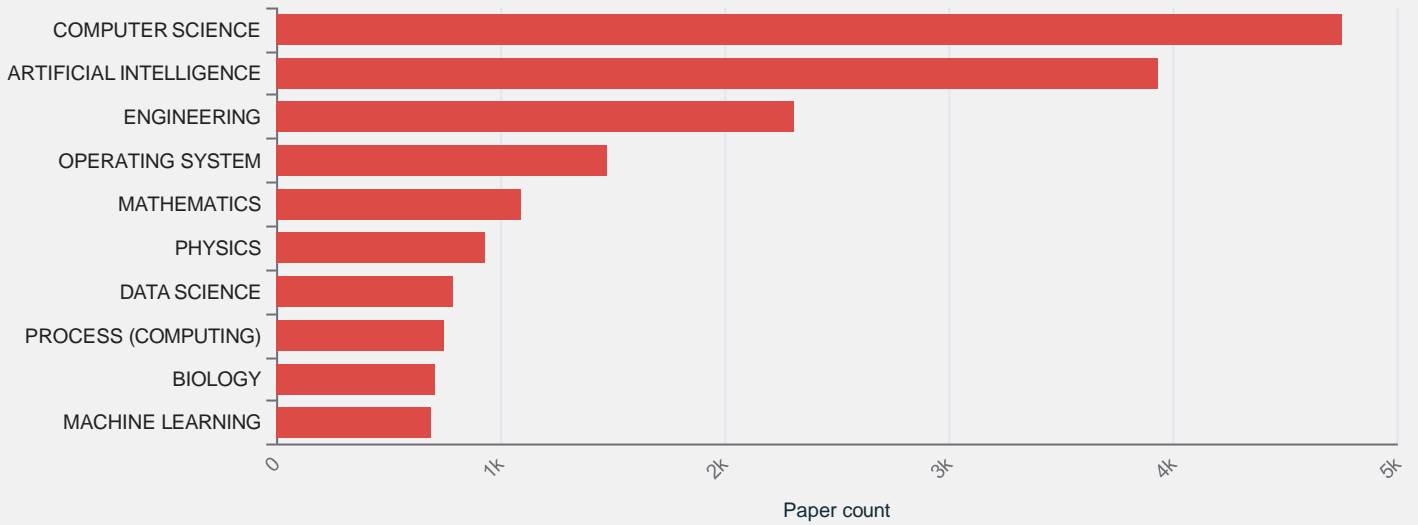
Applicants: SIEMENS AKTIENGESELLSCHAFT

DID YOU KNOW?

Patents are valuable assets for companies, requiring investment to develop and protect. Their protection locations can indicate market growth areas. Examining applications and applicants reveals insights into technology, strategies, and key players. At PNO, we carefully analyse patents as a key element of market and technology intelligence.

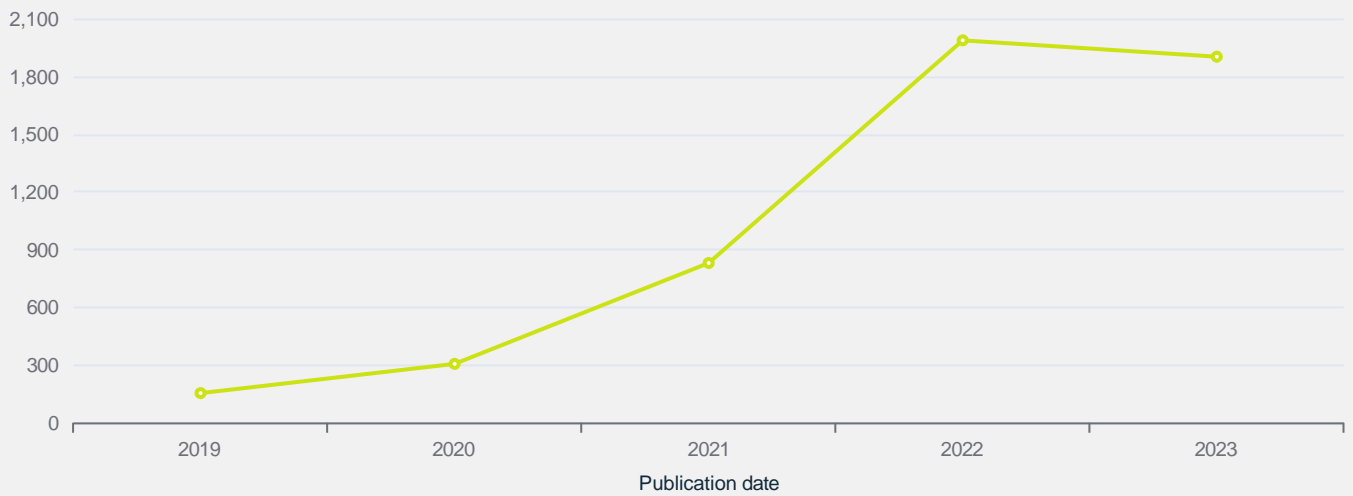
For more insights into intellectual property and state-of-the-art developments about *Artificial Intelligence*, *Digital Twin*, [contact us](#) to unlock new pathways to innovation.

Most relevant scientific topics



Analysing key scientific topics uncovers fundamental themes that can guide the direction of upcoming research. This approach identifies current areas of focus and predicts future trends, ensuring that research efforts are aligned with the most promising and impactful areas of innovation.

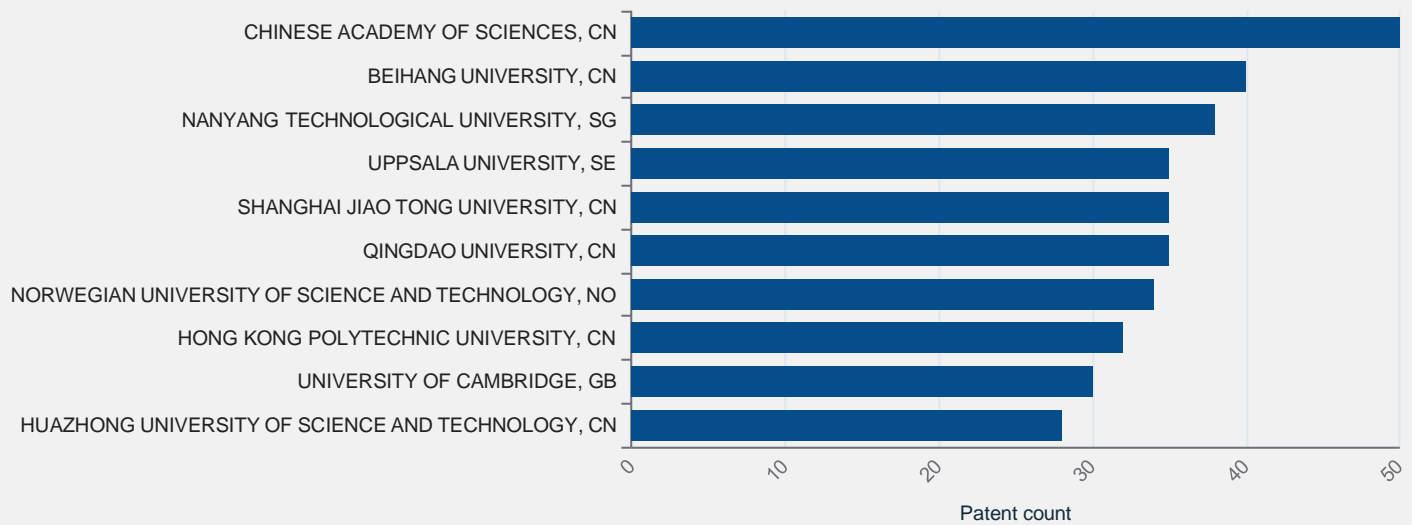
Papers trend



Research Papers are pivotal in highlighting research and innovations that dictate an industry's direction. They offer a window into the intricacies and advancements within a subject area.

Leading institutions contributing to papers publication

Leading institutions contributing to papers publication



These top contributors drive research in the field with innovative approaches, groundbreaking discoveries, and influential publications. Identifying these key players offers invaluable insights into the evolving landscape, fostering collaboration and exchange within the research community.

Countries with the most active publishing institutions



This graphic highlights the countries at the forefront of research and development on *Artificial Intelligence, Digital Twin*. Showcasing the most active participants in R&D provides a clear picture of global innovation dynamics and the leading hubs of research activity. Use this knowledge to forge strategic partnerships, anticipate emerging trends, and cultivate collaborative opportunities worldwide.

The collection of papers underscores the transformative potential of digital twin technology across various fields, heralding new horizons in human interaction, healthcare, manufacturing, and intelligent systems. Emphasizing the intersection of digital twins with artificial intelligence (AI) and the Internet of Things (IoT), these studies explore innovative applications ranging from enhancing human-machine collaboration in public spaces to pioneering developments in health monitoring and predictive healthcare. They also address the architecture of digital twins within cyber-physical systems and intelligent manufacturing, outlining both opportunities and challenges, including socio-economic repercussions and technological credibility issues. These explorations advocate for the integration of digital twins into practical frameworks, exemplifying how digital replicas can optimize processes, bolster safety, and facilitate innovation.

Collaboration Robots with Artificial Intelligence (AI) as Digital Doubles of Person for Communication in Public Life and Space: This paper explores the creation of digital twins in social services, focusing on intelligent process management and human interaction. It integrates AI and cognitive psychology to enhance decision-making in extreme situations. Despite the socio-economic challenges and credibility issues regarding human-machine interaction, the paper emphasizes the potential of digital twins to improve behavior models and robot applications in real-world contexts.

The Convergence of Digital Twin, IoT, and Machine Learning: Transforming Data into Action: This study investigates the synergy between digital twins, IoT technologies, and machine learning, highlighting their role in revolutionizing the perception of globalization. It delves into the architectural and applicative facets of digital twins, emphasizing their adaptability in intelligent manufacturing. By exploring pressing issues like data security and fusion, the paper reflects on the emerging capabilities of AI-facilitated models in transforming data into actionable insights.

Application and Research of Digital Twin Technology in Safety and Health Monitoring of the Elderly in Community: This research focuses on the implementation of digital twin technology for monitoring elderly safety and health. By employing AI, vision sensors, and deep learning algorithms, it develops a real-time monitoring and alert system for falls. The system's efficacy was validated through trials in a Shanghai nursing home, demonstrating its ability to enhance elderly care by providing timely alerts and allowing customizable safety settings.

An architecture of an Intelligent Digital Twin in a Cyber-Physical Production System: The paper outlines an architecture for integrating digital twins within cyber-physical systems for intelligent automation. It emphasizes the need for synchronization, real-time data acquisition, and simulation capabilities, augmented by AI. By proposing methods like the Anchor-Point-Method for data integration, the study demonstrates how intelligent digital twins can revolutionize automated production systems and enhance predictive maintenance and autonomous functions.

Development and Verification of a Digital Twin Patient Model to Predict Specific Treatment Response During the First 24 Hours of Sepsis: This paper details the creation of a digital twin model for predicting sepsis treatment responses. Using causal AI approaches and simulations, the model was tested in a medical ICU to observe real-time patient interactions. The study concluded that digital twins enhance predictive accuracy, offering a virtual testing environment that may lead to improved patient outcomes, although notable errors such as coding discrepancies were identified.

Collaboration Robots with Artificial Intelligence (AI) as Digital Doubles of Person for Communication in Public Life and Space

Authors: Evgeniy Bryndin

Published: 27/10/2019

The Convergence of Digital Twin, IoT, and Machine Learning: Transforming Data into Action

Authors: Maninder Jeet Kaur, Ved P Mishra, Piyush Maheshwari

Published: 23/7/2019

Application and Research of Digital Twin Technology in Safety and Health Monitoring of the Elderly in Community

Authors: Jie Zhang, Hong Qian, Hongyuan Zhou

Published: 30/11/2019

An architecture of an Intelligent Digital Twin in a Cyber-Physical Production System

Authors: Behrang Ashtari Talkhestani, Tobias Jung, Benjamin Lindemann, Nada Sahlab, Nasser Jazdi, Wolfgang Schloegl, Michael Weyrich

Published: 01/9/2019

Development and Verification of a Digital Twin Patient Model to Predict Specific Treatment Response During the First 24 Hours of Sepsis.

Authors: Amos Lal, Guangxi Li, Edin Cubro, Sarah Chalmers, Heyi Li, Vitaly Herasevich, Yue Dong, Brian W. Pickering, Oguz Kilickaya, Ognjen Gajic

Published: 16/11/2020

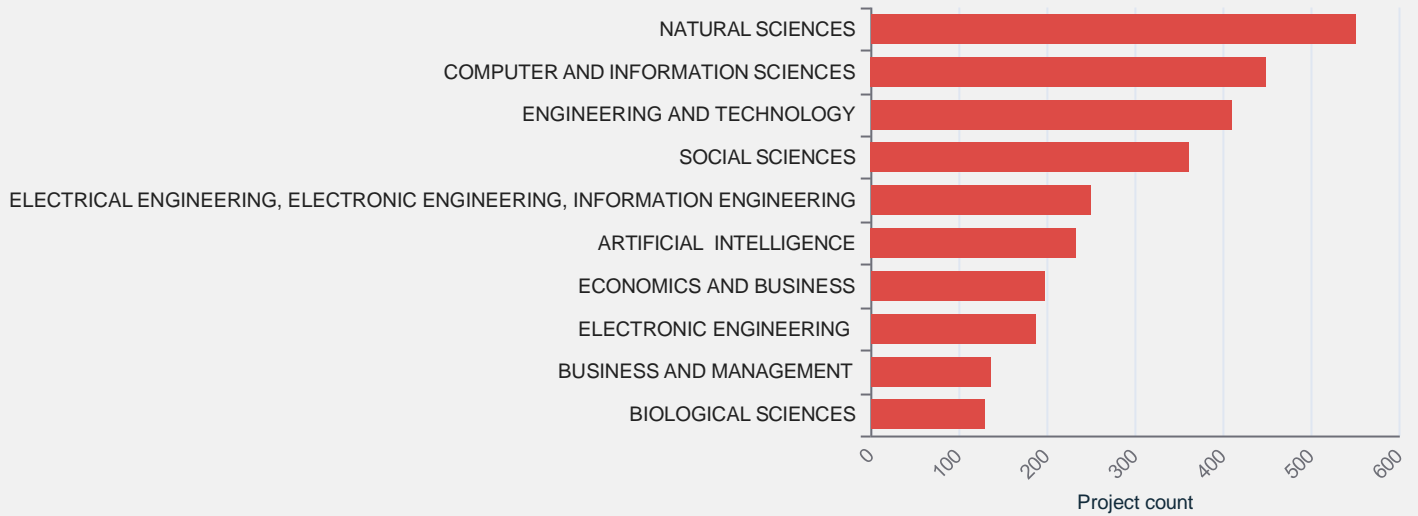
DID YOU KNOW?

Papers offer valuable technological details and reveal the scientific community's focus over time. They help identify real experts and their collaborations. However, finding and reading through them can be challenging, so selecting the right topics carefully is important.

Please [contact us](#) for deeper insights into relevant scientific publications and expert guidance on *Artificial Intelligence, Digital Twin*.

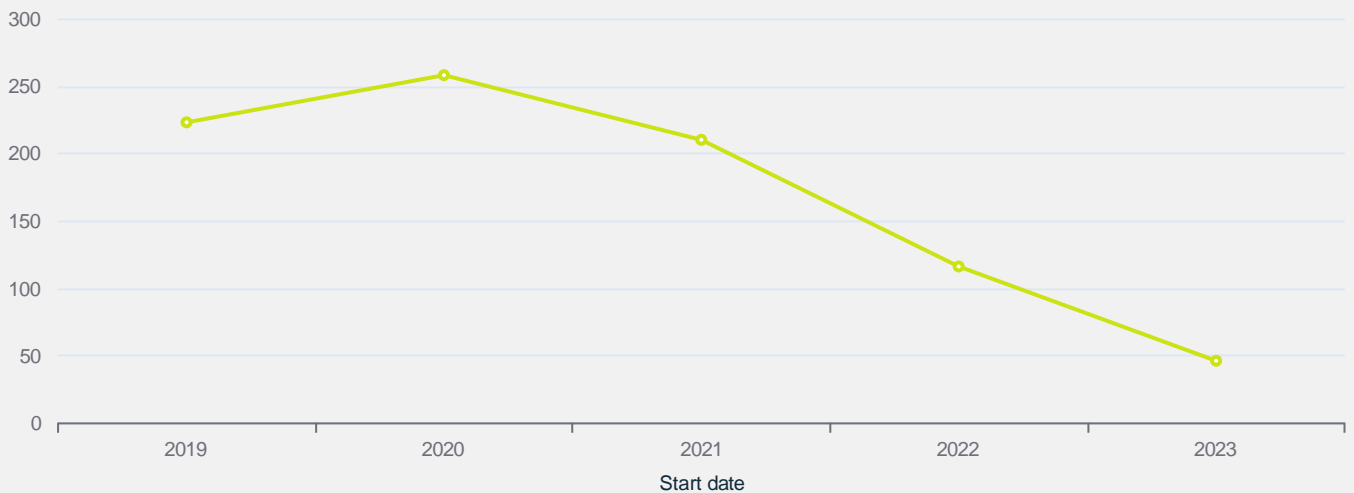
The R&D Funding Landscape

Most relevant fields of science



Identify critical innovation and research focus areas to streamline your efforts and stay aligned with current trends with this focused view of the top scientific sector of public-funded projects related to *Artificial Intelligence, Digital Twin*.

Funded projects trend



By analysing the number of projects funded in these five years, you'll gain valuable insights into shifting priorities and strategic allocations within the R&D investment landscape. Use this data to inform your strategic decision-making and resource allocation in the field.

Mapping Collaborative Dynamics: Most Active Participants in R&D&I Projects

Most active projects participants



By identifying key contributors to *Artificial Intelligence*, *Digital Twin* projects, you can discern the driving forces behind innovation and collaboration in the field, enabling you to make informed decisions and foster potential partnerships.

Countries with the most active projects participants



The geographic distribution of these top participants provides insights into global collaboration patterns and regional expertise on *Artificial Intelligence*, *Digital Twin*

Top R&D Funded Projects

The theme of these projects centers on leveraging digital twin technology enhanced by artificial intelligence across various industries to optimize operations, improve safety, and enhance product quality. By creating virtual models, these projects aim to provide deeper insights and predictive capabilities that are crucial in fields ranging from energy storage to healthcare and agriculture. The integration of innovative technologies like AI, IoT, and blockchain plays a significant role in addressing current challenges such as reducing CO2 emissions, ensuring efficient energy storage, predicting disease progression, and optimizing industrial processes. Collectively, these initiatives contribute towards sustainable practices, operational efficiency, and enhanced decision-making processes, all pivotal to advancing digital transformation and facing contemporary global challenges.

TWAICE predictive analytics and digital twin ecosystem to optimise and automate batteries second life and re-use: TWAICE offers a solution for optimizing battery life cycle, tackling safety and cost issues through a predictive analytics platform. Utilizing digital twins and AI, it provides detailed insights on battery health, promoting strategic decisions in energy and mobility sectors while reducing CO2 emissions.

Edge AI-deployed DIGItal Twins for PREDICTing disease progression and need for early intervention in infectious and cardiovascular diseases beyond COVID-19: DIGIPREDICT employs Edge AI to develop personalized digital twins, aiding in predicting disease progression in COVID-19 and related conditions. By integrating digital biomarkers and organ-on-chips, the project aims to support early medical intervention, advancing collaborative research and technology across Europe for better patient-specific solutions.

AI powered Digital twin for lighting infrastructure in the context of front-end Industry 4.0: AI-TWILIGHT integrates AI with digital twins to innovate in the European lighting industry. Focused on customizable and connected lighting products, it promises to decrease time-to-market and total ownership costs. The project applies AI-driven self-learning models, enhancing product design and performance forecasting across various lighting applications.

NEXT GENERATION BATTERY MANAGEMENT SYSTEM BASED ON DATA RICH DIGITAL TWIN: The ENERGETIC project

pioneers advanced battery management using data-rich digital twins and AI. Aimed at optimizing battery usage for both transport and stationary applications, it strives for reliable, safe operations. By integrating AI models with Edge and Cloud resources, it enhances battery life predictions and diagnostic capabilities.

Digital twins for the optimization of agrifood value chain processes and the supply of quality biomass for bio-processing: BBTWINS seeks to optimize the agri-food value chain using digital twins. Targeting sustainability and efficiency improvements, it integrates AI, IoT, and blockchain within a unified platform. The project aims to enhance biomass utilization and establish traceable, high-value bio-based products, strengthening the EU agri-food sector's resilience.

TWAICE predictive analytics and digital twin ecosystem to optimise and automate batteries second life and re-use

CLOSED

Funding Country:  European Union Start date: 01/10/2022 End date: 30/9/2024

Authority: European Commission Source: [link](#)

Programme: Horizon Europe Total cost: € 3.091.250 Project funding: € 3.091.250

Edge AI-deployed DIGItal Twins for PREDICTing disease progression and need for early intervention in infectious and cardiovascular diseases beyond COVID-19

ACTIVE

Funding Country:  European Union Start date: 01/1/2021 End date: 31/12/2024

Authority: European Commission Source: [link](#)

Programme: Horizon 2020 Total cost: € 5.978.343 Project funding: € 5.978.343

Digital Twin

Edge AI

Organs-on-Chip

Digital biomarkers

Wearables

COVID-19

coronavirus

AI-aided clinical prediction

personalized medicine

interstitial fluid

hyperinflammation

drug repurposing

AI powered Digital twin for lighting infrastructure in the context of front-end Industry 4.0

ACTIVE

Funding Country:  European Union Start date: 01/6/2021 End date: 31/1/2025

Authority: European Commission Source: [link](#)

Programme: Horizon 2020 Total cost: € 18.089.914 Project funding: € 18.089.914

LED

Digital twin

lifetime prediction

Digitalised design flow

Industry 4.0

Lighting infrastructure and product

NEXT GENERATION BATTERY MANAGEMENT SYSTEM BASED ON DATA RICH DIGITAL

ACTIVE

Funding Country:  European Union Start date: 01/6/2023 End date: 31/8/2026

Authority: European Commission Source: [link](#)

Programme: Horizon Europe Total cost: € 4.170.167 Project funding: € 4.170.167

Battery Management Systems

Digital Twins

AI

Battery Sensors

Cloud and Edge Computing

Data driven models

Multiphysics Models

Digital twins for the optimization of agrifood value chain processes and the supply of quality biomass for bio-processing

ACTIVE

Funding Country:  European Union Start date: 01/6/2021 End date: 31/5/2025

Authority: European Commission Source: [link](#)

Programme: Horizon 2020 Total cost: € 5.258.380 Project funding: € 5.258.380

Digital twins

blockchain

logistics

biomass valorization

sensors

simulation

fertilizers

proteins

fruit processing

meat processing

feedstock

salts

protein

snacks

nutraceutical

waste

DID YOU KNOW?

Projects are crucial for turning innovative ideas into real-world applications. Analysing projects in *Artificial Intelligence, Digital Twin* allows you to spot emerging trends and strategic shifts in the industry. These insights reveal key players, funding sources, and collaborative networks driving innovation.

[Contact us](#) to explore how these insights can help you navigate the landscape of R&D projects and capitalise on new opportunities for growth and collaboration.

Ready to secure funding for your projects? Here's a roundup of the top funding opportunities tailored for you. Explore these avenues to support your innovative ideas and propel your research forward.

HORIZON-CL5-2024-D3-02-01: Digital tools for CSP and solar thermal plants

[OPEN](#)

Deadline: 04/02/2025 Country:  Europe

Overall budget: 6.000.000 € Max funding amount: 3.000.000 €

Grantor body: [European Commission](#) Source: [link](#)

Beneficiaries: LARGE INDUSTRY, SME, PUBLIC BODY, RESEARCH ORGANIZATION, NGOS, OTHER

Sectors: ENERGY, ENVIRONMENT, ICT

Technology: ICT, Other

Energy sector

digital tools

Expected Outcome:

Project results are expected to contribute to some of the following expected outcomes: - Improved performance of concentrated solar power (CSP) plants.

- ♦ Improved performance of concentrated and/or non-concentrated solar thermal heat and/or cold plants.
- ♦ Reduced operation and maintenance costs of CSP plants.
- ♦ Reduced operation and maintenance costs of concentrated and/or non-concentrated solar thermal heat and/or cold plants.
- ♦ Reinforced role of CSP plants in the power market.
- ♦ Reduced greenhouse gas emissions.
- ♦ Achievement of the CSP targets of the Strategic Energy Technology Plan.

Scope:

Support will be given to the innovative application of digital tools (or to the application of innovative digital tools, or both) in CSP and/or concentrated solar thermal heat and/or cold and/or non-concentrated solar thermal heat and/or cold plants. Any type of application of the digital tools is in the scope (e.g., component control, performance measurement, self-diagnostic, ancillary services to the power system, digital twins, etc.). Artificial intelligence techniques are also in the scope. Proposals are expected to bring and demonstrate measurable benefits of the proposed digital tools in terms of operation, maintenance, and flexibility of the plant. Where applicable, the digital tools should support night baseload generation from thermal energy storage. Where applicable, the demonstration should span a continuous interval of at least six months covering all possible incidence angles of the direct solar radiation.

Type of Action Innovation Actions

HORIZON-CL5-2024-D3-02-04: Critical technologies for the future ocean energy farms

OPEN

Deadline: 04/02/2025 Country:  Europe

Overall budget: 8.000.000 € Max funding amount: 4.000.000 €

Grantor body: [European Commission](#) Source: [link](#)

Beneficiaries: LARGE INDUSTRY, SME, PUBLIC BODY, RESEARCH ORGANIZATION, NGOS, OTHER

Sectors: ENERGY, ENVIRONMENT, ICT

Technology: ICT, Other

energy sector

ocean energy farm

environment

Expected Outcome: Project results are expected to contribute to all of the following expected outcomes:

- Increased performance of ocean energy technologies with the focus on sustainability, operation and maintenance of ocean energy devices.
- Improved knowledge on how to operate ocean energy devices, their availability, maintainability, reliability, survivability, and sustainability.
- Reduction of LCOE approaching SET Plan targets (actions should clearly justify the estimated LCOE at project start and end using a recognized calculation methodology).

Scope: Projects should address at least one of the following areas:

1. Components and systems used in ocean energy devices need to be resistant to corrosion and the heavy loads they are subject to. Develop new sustainable materials with improved fatigue, damping, stiffness, sustainability and bio-fouling management or other cost-reducing characteristics. Materials such as reinforced concrete, polymers, composites, and concrete-steel/composite-steel hybrids systems have demonstrated some advantages such as reduced costs. Demonstrating the potential benefits of these new sustainable materials in ocean energy converters, moorings and foundations whilst ensuring structural integrity, durability and circularity is required. Advance the design of sustainable tailored mooring and connection of electrical or other power transmission systems for floating or subsea wave and tidal devices. Advance combined mooring and electrical connectors or hydraulic power transmission to reduce component cost and number of connection operations, included in systems for sharing an anchor between devices in arrays. Develop novel systems for safe and quick connection/disconnection that do not require large vessels and/or diving teams.
2. Instrumentation for condition monitoring and predictive maintenance of ocean energy devices. Apply recent advances in condition and structural health monitoring from other sectors to ocean energy – particularly those currently developed for offshore wind. Apply latest sensor technology to existing ocean energy deployments. Document and share experience on sensors performance and reliability, and methods for adapting them to the harsh ocean energy environment. Improve transmission or storage of data collected from sensors, such as underwater data transmission.
3. Use of AI in ocean energy technology development. Develop or apply advanced simulation of ocean energy systems. Use of big data with analysis of data streams, application of big data methods and machine learning, including artificial intelligence, or digital twin models for the design, installation, operation and decommissioning of ocean energy devices. Improvements in the discrete technology areas should be developed holistically – e.g. work on monitoring instrumentation should be consistent with work on moorings & connections. The innovative technologies should not significantly harm the environment (DNSH principle), and have low impact on ecosystem biodiversity and consider potential mitigation measures. The projects should by using the precautionary principle elaborate proposals for acceptable harm and what low impact on biodiversity mean.

Projects should demonstrate how improvements in the different technology topics can be applied to multiple different ocean energy devices – for example to a wide range of floating devices, or a wide range of sub-sea devices

Type of Action Research and Innovation Actions

HORIZON-JU-IHI-2024-08-02-two-stage: Novel Endpoints for Osteoarthritis (OA) by applying Big Data Analytics

OPEN

Deadline: 23/4/2025 Country:  Europe

Overall budget: 14.000.000 € Max funding amount: N/A

Grantor body: [European Commission](#) Source: [link](#)

Beneficiaries: LARGE INDUSTRY, SME, PUBLIC BODY, RESEARCH ORGANIZATION

Sectors: HEALTH PHARMA LIFESCIENCE, ICT

Technology: ICT, Other

disease

osteoarthritis

big data analytics

AI based solutions

Expected outcome:

The action under this topic must contribute to all the outcomes listed below, by integrating existing data sets (clinical registries, prospective observational trials and real-world evidence data, for example from medical claims and biobanks as well as genotypic and epigenetic information), and data collections from historical and ongoing clinical trials (provided by industry partners).

- Algorithms and models, including Artificial Intelligence (AI)-based models, that are adaptable to differences in data availability have been developed and validated in different datasets to allow for the identification of osteoarthritis (OA) patient subpopulations (phenotypes/endotypes) that will benefit from specific, targeted treatment approaches. The identification of subpopulations will be based on:
 1. the patient-specific burden of osteoarthritis with focus on underlying drivers (e.g. metabolic disease) and multi-morbidity/holistic patient profiles;
 2. the evaluation of underlying pathways driving local vs. centralised pain in joint disease and the correlation of symptoms to joint tissue pathology;
 3. the identification of key risk factors for pain in joint disease that can be linked to structural disease progression providing insights into the symptom–structure discordance in OA;
 4. the detection of joint areas at risk of progression and quantification of structural progression to a more advanced stage;
 5. the measures from existing innovative tools such as functional assessments with mobility and activity assessing devices (including algorithms) to reflect independence, gait measures, and assessments of muscular strength and function, as well as balance and coordination to subtly measure functional changes;
 6. evaluating the differences and commonalities of osteoarthritis (OA) and inflammation-driven joint diseases such as psoriatic arthritis (PsA), rheumatoid arthritis (RA), erosive hand osteoarthritis (eHOA).

A validation strategy is provided for a selected set of novel endpoints to measure and predict OA disease progression that enables planning of regulatory implementation pathways. This validation strategy supports innovative outcome-based and patient-centred development approaches for medicines and other therapeutic options to be discussed by regulatory authorities, health technology assessment (HTA) bodies, healthcare providers, patients, scientists and industry, shaping new approaches to the development of efficient treatments in OA and respective regulatory frameworks;

A decision tool is developed – based on the predictive models – that supports shared decision-making for patients, their caregivers and healthcare providers according to the predicted disease progression, the most likely associated OA disease drivers and the current disease burden;

A robust, trustworthy, and interpretable AI framework is established, that enables the development of guidelines or determines any boundaries for predictive modelling at various stages of value generation e.g. biological discovery, patient subgrouping, and clinical trials enrichment. Measures to mitigate the risk of bias and discrimination are implemented including, but not limited, to:

1. careful consideration of data sets to ensure diversity and inclusion (or account for the lack thereof);
 2. the running of bias-unaware AI models and provision of fairness metrics;
 3. applying AI models within frameworks mitigating bias and promoting fairness during the pre-processing, in-processing and post-processing phases.
- Data platform(s) are designed and implemented to allow a workable and efficient collaboration across the participating organisations in their respective geographies, respecting each data contributor's access, privacy and consent approaches, which can be facilitated by federated data sharing. This outcome may serve as a blueprint for other data collaborations under the umbrella of the EU's newly implemented AI act and data policies ^{1, 2}.

It is expected that certain existing assets like clinical data, algorithms, and data storage infrastructure will be used as background in this action. Therefore, beneficiaries intending to participate in this data-driven action need to be comfortable with the principle that ownership of specific deliverables / project results which would be considered direct improvements to a beneficiary's background asset, will need to be transferred back to the beneficiary who contributed the background asset to the project. Provision for, and conditions relating to such transfers should be specified in the project's consortium agreement.

Scope:

Osteoarthritis (OA) has no cure and affects the lives of more than 500 million people worldwide with widespread individual, societal and economic consequences. Economic consequences pertain on one hand to health care utilisation and health care spending, OA is however also associated with relevant economic impact on the individual due to missed days at work, early retirement, and substantial out-of-pocket expenditures. Since OA primarily affects the elderly, females, patients with lower levels of education and socio-economic status and certain ethnicities, the associated economic risk hits already vulnerable populations. OA has long been underestimated in its impact; the disease negatively affects social functioning and ranks 7th for years lived with disability in people over 70 years. With its impact on activities of daily living, OA is a major risk factor for loss of independence. Additionally, OA is associated with increased mortality.

Despite major research efforts and increasing insights into the mechanism, epidemiology, risk factors and natural history of OA, various development efforts over the years have failed to provide a disease-modifying treatment. The epidemiology as well as clinical and biological insights strongly suggest the existence of several pheno- and endotypes of osteoarthritis; failure to account for those differences critically hampers progress in the field. The implementation of innovative approaches to stratify the patient population, predict the course of disease and define patient-relevant endpoints is specifically relevant in an ageing society with a high prevalence of obesity, metabolic syndrome, and multi-morbidity. Furthermore, there is an increasing prevalence of post-traumatic secondary OA in relatively young individuals affected at the prime of their lives. First studies towards the clustering of patient groups and development of predictive models have been published suggesting the feasibility of these approaches. Bringing all those insights together requires the collaboration of experts from various fields and can only be achieved in the concerted action of a public-private partnership, including existing initiatives.

The overall aim of this topic is to build a public-private partnership that is able to integrate and leverage the plethora of existing and currently collected data on OA, as well as the increasing insights and expertise gathered over decades of research. Further, the goal is to use a data driven approach to significantly progress the field by leveraging the novel opportunities that have emerged thanks to increased computing power and innovative methodologies in big data analysis, in order to:

1. integrate different perspectives to improve the understanding of osteoarthritis as a complex disease;
2. foster progress towards regulatory validation of patient-relevant endpoints to measure and predict OA disease progression as well as alternative endpoints to measure response to treatment;
3. allow predictive modelling while actively seeking feedback to incorporate the perception of patients, care givers, primary care physicians and regulators.

The action generated by this topic should pave the way towards transforming the current isolated research efforts and static late-stage development approaches into a more patient-centred and simplified (more inclusive/enriched patient population, shorter study duration, potential enablement of the evaluation of preventive or early therapeutic strategies based on predicted outcomes, cost-effectiveness etc.) as well as sustainable part of clinical research and development. This aim is supported by increasing the insights into OA as an heterogeneous disease with various underlying patient risk

profiles, patho-mechanistic pathways and underlying genotypic/epigenetic/ metabolomic/transcriptomic phenomena based on big data. Such insights will allow for the creation of integrated risk profiles combining clinical and multi-omic approaches (e.g. clinical characteristics, transcriptomics, proteomics, genetic markers, and in-depth multimodal imaging data).

These advances are needed to support the development of patient-relevant and cost-efficient integrated health care solutions including focused, individualised treatments for specific patient segments. The use of AI-based approaches is crucial for the integration of the totality of existing patient datasets and mechanistic disease insights to better understand disease drivers in various tissues of joints thereby upscaling, broadening and/or sharpening current methodology.

The proposed action must:

- gather and provide access to high quality data – including clinical data from trials (mainly data from placebo arms from studies run outside the project) provided by the pre-identified industry consortium and by applicants as well as prospective observational data, registry data and cohort data including genetic, imaging, soluble biomarker, and data from wearables among others;
- provide a flexible federated data lake house with appropriate tools for access, management and governance, data curation, integration, and augmentation for consequent high-performance analytics using for example new or contributed AI (foundation) models and modelling workflows. This infrastructure will deploy existing or newly developed approaches or implementations to host and analyse disparate data assets ranging from public, commercial, and not-for-profit observational and trial clinical data to -omics, images, or data from wearables. In their proposal applicants should address key challenges around federated data collection, data privacy, data transfer, data storage, data processing, curation, and harmonisation of data, etc. to achieve a comprehensive understanding of OA by upscaled, big data analytics from:
 1. genetic analyses (GWAS);
 2. AI-driven big data analyses for identification of clinical patterns in phenotypes and endotypes;
 3. algorithm-based imaging analyses of whole joints and peri-articular tissues;
 4. the evaluation of performance assessments using novel technologies and devices.
- generate and provide a validation strategy for a risk model of disease progression by evaluating whether and to which extent risk factors and predictive models identified in the literature and the above-mentioned data sets are reliably predictive for the progression of structural joint changes as evidenced by imaging, pain and functional decline documented by patients and ultimately leading to joint replacement surgery. The combination of surrogate markers such as imaging [1] with medical history and medication, as well as with predictive markers (plasma- based multi-omics, polygenic risk scores) [2][3], patient reported outcome data and data from wearables or performance tests [4], will generate a more refined predictive engine in analogy to, for example, established fracture risk prediction algorithms in osteoporosis;
- work towards a broad consensus between all stakeholders especially linking patients, caregivers and healthcare providers' perspectives to regulatory and health technology assessment (HTA) bodies. This will enable the elaboration of a set of endpoints relevant to these groups depending on the phase of development of treatments (i.e. early phase trials for medication or device efficacy, while late-stage development needs to prove effectiveness, which may necessitate different sets of outcomes), incorporating the various domains of assessments, and taking into account the predominant effect (structural or symptomatic) of the evaluated treatment. This will help to shape new regulatory frameworks for accelerated targeted OA treatment development based on big data analyses, in- silico trials, digital twin approaches and similar innovative trial designs;
- use data analysis and modelling to provide evidence and knowledge that could enable the evaluation of existing innovative tools (such as functional assessments, imaging approaches etc.) and innovative treatment solutions for OA, based on their scientific validity and feasibility as a prerequisite. Design a strategy to progress them towards regulatory validation and implementation. The action should provide an exploratory and interactive platform to evaluate the validity and user-preference of novel methods of evidence generation, such as the use of data from wearable devices, innovative imaging, and surrogate markers for joint replacement surgery;
- model short- and long-term economic and public health impact from OA including morbidity and mortality. These new risk models should support benefit/risk assessment as well as quality and efficacy assessments of therapeutic interventions in patients diagnosed with OA to prevent or delay the onset of disease progression, but also avoid overtreatment and thereby optimise the use of health care resources;

- develop a decision tool based on predictive models that can support shared decision-making between physicians, patients and their caregivers to select the intervention best suited to address the various stages and symptoms of OA in an individual patient, integrating also patient reported outcome and experience measure (PROMs and PREMs) data as well as patient preferences. The diversity of patients at risk or affected by the disease must be considered when discussing patient-relevant outcomes to enable the focused development of treatments and healthcare solutions specific to the needs of individual patients;
- leverage real-world evidence (RWE) data to address the diversity of patients including sex and gender, ethnicity, and race disparities to develop patient engagement strategies. This should enable engagement with specific groups for the design of OA outcome trials and better promotion of OA management.

The action should contribute to addressing the research needs outlined in the Regulatory Science Research Needs initiative¹, launched by the European Medicines Agency (EMA), assessing the utility of real-world healthcare data to improve the quality of randomised controlled trial simulations and patient and public involvement and engagement.

Therefore, applicants are expected to consider the potential regulatory impact of the results and – as relevant – develop a regulatory strategy and interaction plan for generating appropriate evidence as well as engaging with regulators in a timely manner (e.g. national competent authorities, EMA Innovation Task Force, qualification advice).

Consideration should be specifically given to patient and public involvement and engagement in the implementation of all of the above activities. The applicants are expected to leverage prior learnings, for example, previous experiences that have demonstrated the importance of transparent and accessible structures to receive input from patients, caregivers and health care providers as key stakeholders and integrate expertise from various fields relevant in this context [5]. The continuous and active engagement of all groups is indispensable to meet patients' and providers' needs and leverage synergies between practitioners and scientists, especially to ensure the sustainability of potential outputs.

Applicants should provide in their proposal evidence that they have in place all permissions (legal, ethical) needed for accessing the data necessary to implement the action.

Note that the implementation of prospective clinical studies is not supported by this topic.

Expected Impact:

The project should contribute to all of the following impacts:

- the federated integration of big data from disparate data sources including the use of digital twin and similar methodological approaches will lay the foundation for advanced clinical trial designs that allow for more efficient and smaller trials, as well as the reduction of patients' burden and exposure to placebo;
- the development of predictive models for disease progression and joint replacement, which are crucial to efficiently discuss treatment strategies, support assessments of quality in health care and equitably plan and allocate health care resources. In addition, such predictive models can revolutionise outcome trial designs, shortening the trial duration and patient burden as well as reducing development costs. The aspired modular flexibility to data availability allows for their sustained use in various settings and economic circumstances;
- the stratification of different patient groups and targeting of treatments to patients' needs and preferences, which enables the development of successful therapies, informs development strategies, improves patient and caregiver engagement and optimises trial designs. This stratification also supports data-based shared decision making for health care solutions in clinical practice;
- availability of tools that enable specific functional measurements and reflect the real-life treatment benefit for patients. These tools have been positively evaluated for practicality and scientific validity and could be used for systematic assessments complementing clinical and patient reported information. All of the above will allow for better trial designs that can demonstrate the treatment benefits of medicines and health care solutions in early development programmes with limited numbers of patients.

DID YOU KNOW?

R&D projects offer a glimpse into the future, showing technological progress over the next 5 to 10 years as readiness improves and risks decrease. Exploring key players in these projects can reveal valuable collaborations and connections. Our team's expertise in the EU arena, funding, and innovation simplifies these analyses, ensuring you find the right support for your project.

Have questions? [Let's discuss](#) how to turn your ideas into tangible results and identify the partners you need.

Are you looking to collaborate? Here's a curated list of collaboration opportunities in the field of *Artificial Intelligence*, *Digital Twin*. Explore potential partnerships, collaborative projects, and networking avenues to drive innovation and advancement in this field.

Microneedle biosensor and remote monitoring system for hormone treatment.

Deadline: 13/6/2025 Status: PUBLISHED Country:  Europe

Sectors: ICT, HealthPharmaLifeScience

Abstract:

A Spanish-German research consortium developed a biosensor and an intelligent remote monitoring system that provides accurate, real-time information on hormone levels to patients and professionals. Data processing techniques, such as AI Artificial Intelligence or Machine Learning, provide patterns for better treatment of hormonal pathologies.

They look for companies interested in acquiring this technology for commercial exploitation through patent licensing agreements or further development.

Partners sought: *No specific requirements*

ERICA: Development of high-performance ocean Energy technologies based on advance materials, Repair and maintenance and system digitalization

Deadline: 21/1/2025 Status: PUBLISHED Country:  Europe

Sectors: NanotechMaterial, Energy

Abstract:

Project is aiming to work on the following pillars:

- ◆ Components and systems used in ocean energy devices need to be resistant to corrosion and the heavy loads they are subject to.

Develop new sustainable materials with improved fatigue, damping, stiffness, sustainability and bio-fouling management or other cost-reducing characteristics. Materials such as reinforced concrete, polymers, composites, and concrete-steel/composite-steel hybrids systems have demonstrated some advantages such as reduced costs.

- ◆ Instrumentation for condition monitoring and predictive maintenance of ocean energy devices.

Apply recent advances in condition and structural health monitoring from other sectors to ocean energy – particularly those currently developed for offshore wind. Apply latest sensor technology to existing ocean energy deployments.

- ◆ Artificial Intelligence (AI) in ocean energy technology development.

Develop or apply advanced simulation of ocean energy systems. Use of big data with analysis of data streams, application of big data methods and machine learning, including artificial intelligence, or digital twin models for the design, installation, operation and decommissioning of ocean energy devices.

Partners sought: *No specific requirements*

DID YOU KNOW?

“Open Innovation” is now a reality in the industry, but implementing it can be challenging due to the need for connections and the ability to scout global R&D competencies. At PNO, we excel in scouting technology providers, setting up open innovation challenges, building international partnerships, and maximising opportunities for network growth and project advancement.

Our linking service simplifies finding collaborators and forming strategic partnerships. [Contact us](#) to start building partnerships that will shape the future of *Artificial Intelligence, Digital Twin*.

Discover your competitors

Analysing leading competitors' performance across various metrics such as research output, involvement in EU-funded projects, and patent ownership sheds light on the landscape of competitive strengths and collaborative opportunities within *Artificial Intelligence*, *Digital Twin*. Here's a glimpse into what we've uncovered about your competitors:

SAMPLE COMPANY



211 Patents



20 Papers

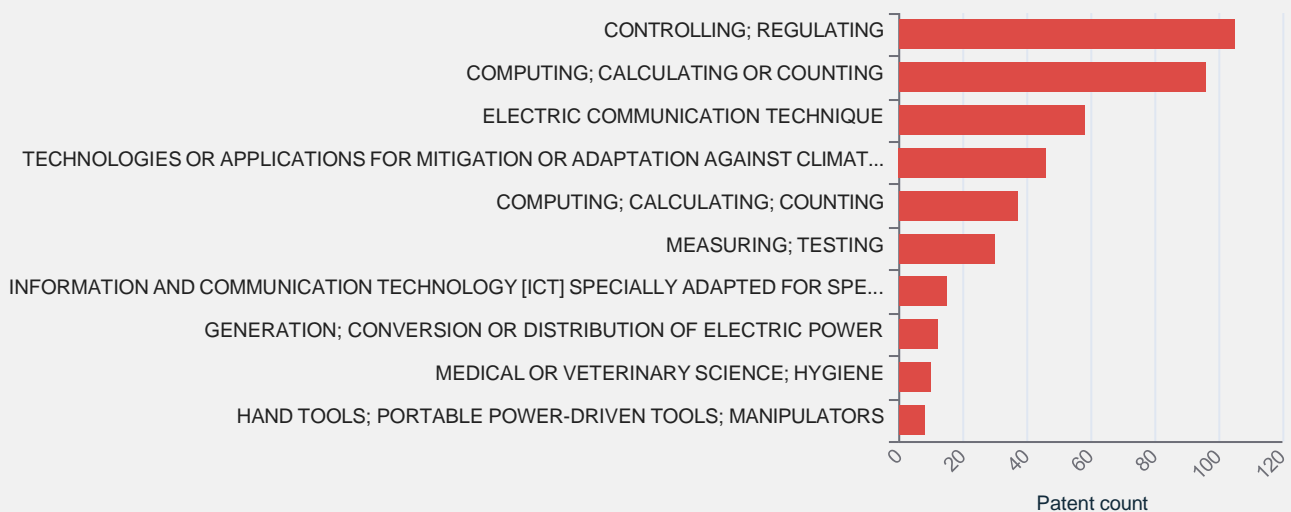


78 Projects

Patents trend



Top CPC categories



SAMPLE COMPANY



211 Patents

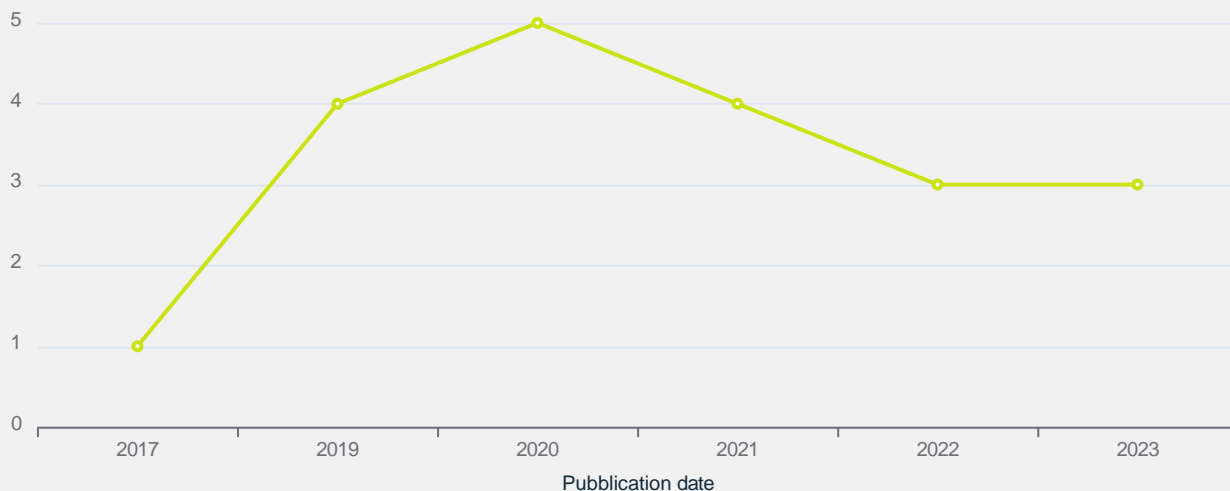


20 Papers

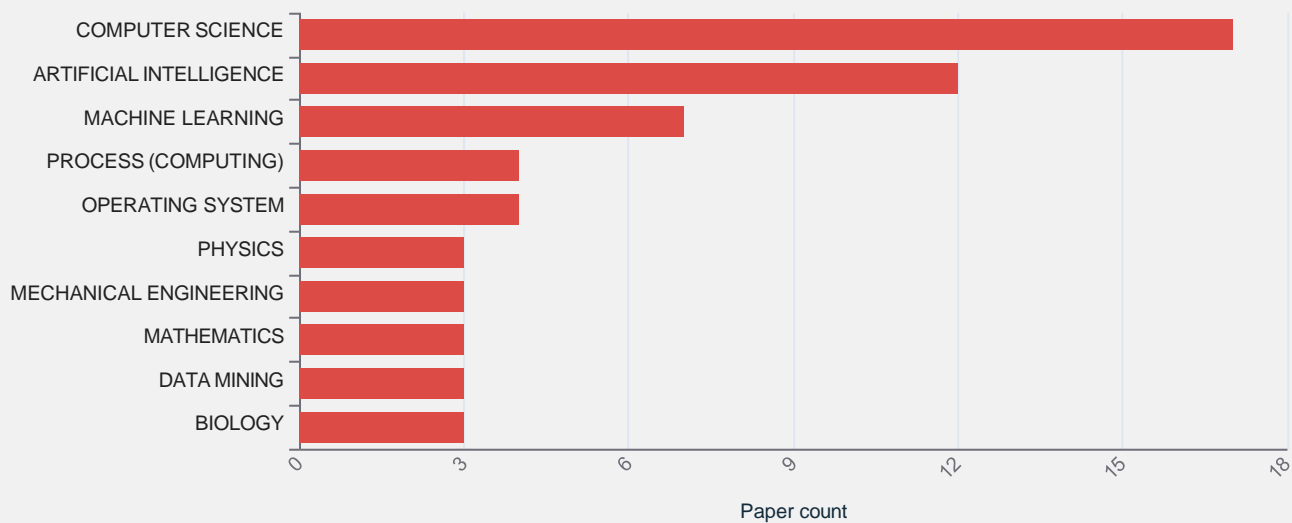


78 Projects

Papers trend



Top scientific topics



SAMPLE COMPANY



211 Patents

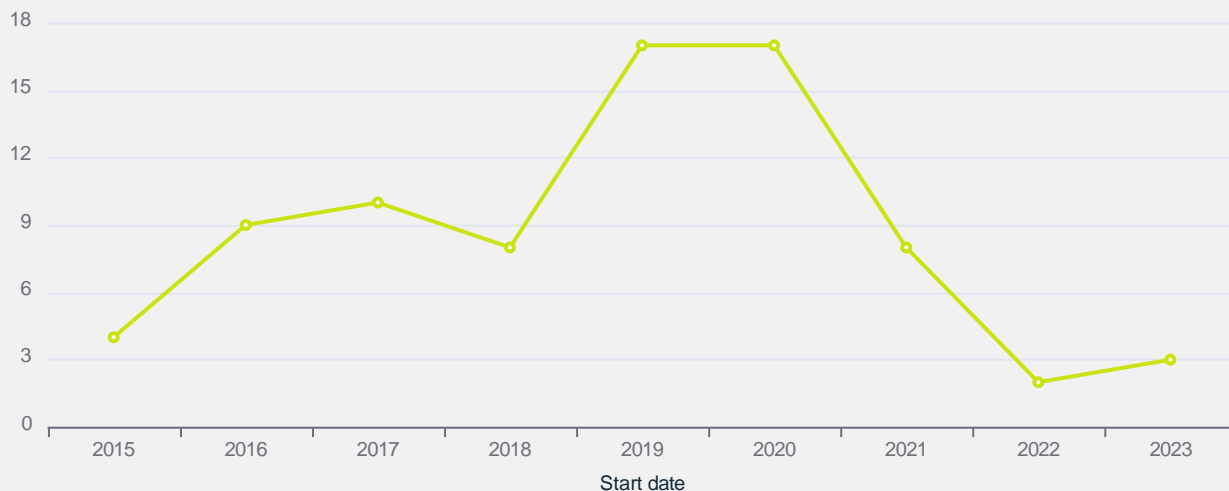


20 Papers

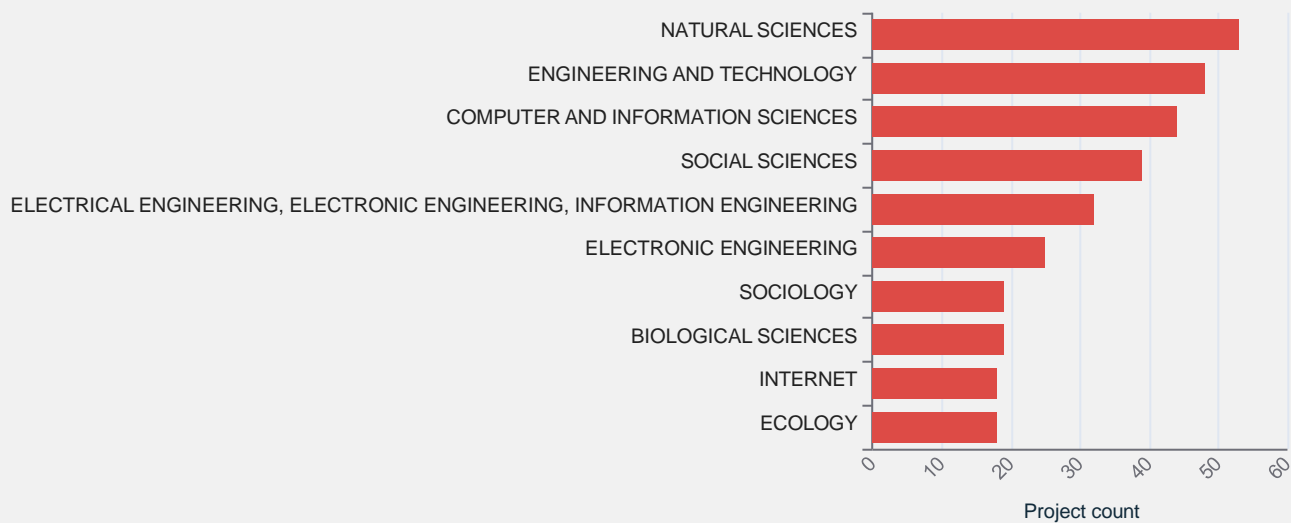


78 Projects

Projects trend



Top fields of science



DID YOU KNOW?

By examining all innovation signals, you can uncover unknown competitors. With a competitive intelligence service, you can compare, analyse, and strategise effectively, using the latest insights for informed decisions.

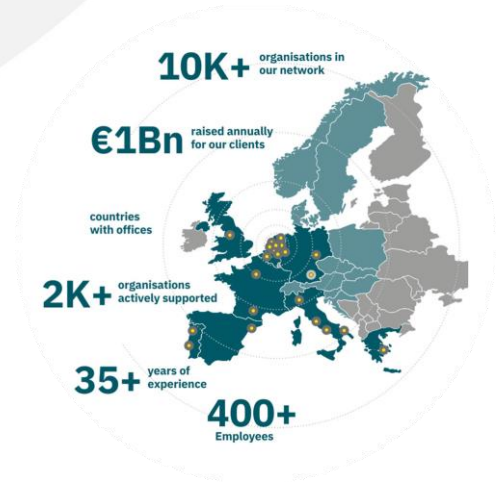
Our expertise spans multiple technologies, enabling you to leverage data-driven decision-making. [Connect with us](#) today to empower your business for success.



We would be glad to hear about your experience with the Innovation Pulse [in this short survey](#).

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For over three decades, PNO has been a pioneer in innovation and funding across Europe, with a strategic footprint in nine countries. As the continent's premier independent public funding and innovation consultancy, PNO excels in harnessing research, development, and innovation (RD&I) from publicly funded projects, securing over 1 billion euros annually for our clients' R&D and market strategies. Our robust global network and team of over 400 professionals create synergies with key industry players, fostering connections and financing for transformative ideas.



PNO's R&D Advisory Services & Support

PNO's R&D Advisory services are built on a foundation of extensive experience, aiming to enhance R&D returns and support sustainable development through smarter innovation processes. Our team of analysts and consultants, equipped with proprietary methodologies and advanced IT solutions, delivers insights and hands-on support to drive impactful innovations. We assist our clients in navigating market trends and identifying emerging technologies, while also offering:

- Structured analysis of internal processes for innovation enhancement
- Knowledge-based decisions informed by market and technology trend
- analyses Facilitation of access to new partners and technologies
- Development of innovative international ecosystems
- Structuring and implementation of new innovation projects, including project management and access to subsidised finance



Choosing PNO means partnering with a trusted ally dedicated to unlocking the potential of your projects and driving significant change. We offer customised innovation services, supporting our clients throughout the innovation journey.

If you're intrigued, we invite you to explore our services and contact us. Together, let's turn your innovative visions into reality.

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