information
management
Unit
imu.iccs.gr

enabling the knowledge organization

IMU is a research unit of ICCS
Institute of Communication and Computer Systems
of the National Technical University of Athens

IMU operates within ICCS
the Institute of Communication & Computer Systems of NTUA

- ICCS is a non-for-profit **research institute**, established in 1989
  - Ministry of Education & National Technical University of Athens
  - Associated to the School of Electrical & Computer Engineering
- **Mission**: perform top-quality research and development activities
  - and provide scientific services to private and public bodies1

- Research ➔ in EU official rankings ICCS ranks among the **top 3 Institutions** in Greece and the top 20 – 30 in the EU
- Innovation ➔ founded incubator EPI.noo in cooperation with NTUA
- Start-ups ➔ actively participate in spinoffs e.g. PhosPrint and CIBOS
- Education ➔ support young scientists (> 1,600 scholarships)
- Tech transfer ➔ joint actions with industry associations

- Laboratories:
  - Software engineering
  - Robotics
  - Photonics
  - Biomedical
  - Computer Networks
  - Energy Management
  - Information Management

500
Researchers

>4,500
Projects (1989-2023)

168
Active Projects (2022)

26 m €
Average annual budget

We are active members in European and international partnerships on Artificial Intelligence and Cloud Computing

[AI, Data and Robotics Association (ADRA)]

[Big Data Value Association (BDVA)]

[International Data Spaces Association (IDSA)]

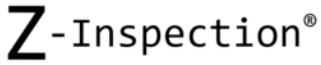
[GAIA-X European Association for Data and Cloud]

[CAIRNE, the Confederation of Laboratories for AI Research]

[European Factories of the Future Research Association]

[Industry 5.0 Community]

[Etami (Ethical and Trustworthy Artificial and Machine Intelligence)]



[Z-Inspection process to assess Trustworthy AI]

Meet the team

- **Three (3) faculty**
  - Professor in Information Technology Management
  - Professor in Decision Support Systems
  - Assistant Professor in Management Information Systems
- **Nine (9) senior researchers**
  - post-doctoral researchers
    - Ph.D.s in Electrical and Computer Engineering
    - and post-graduate diplomas in:
      - Business Administration and
      - Information Technology
- **Seventeen (17) researchers and PhD students**
  - with diploma degrees in engineering and post-graduate diplomas in:
    - Business Administration
    - Information Systems
    - Computer Engineering
    - Telecommunications

IMU - Information Management Unit of ICCS

- IMU is a **multi-disciplinary unit** engaged in research and technology development activities in **Information Technology Management**.
  - IMU carries out research and innovation activities within ICCS of NTUA

- Our mission is **to support knowledge-driven organisations with trustworthy AI services and data-driven, secure and reliable computing infrastructures.**

- We design, develop and validate innovative **models, methods and tools for:**

  - Human-centric **trustworthy Artificial Intelligence and Data Analytics** to support optimized decision-making
  - Context-aware, **secure processing of computing resources across the cognitive computing continuum** from cloud to edge devices

Research areas

- **Analyse: from Data to Insight**
  - Data and knowledge discovery, sharing and exchange
  - Machine learning and prescriptive data analytics
  - Data harmonization and semantic interoperability
  - Privacy preserving and compliance technologies
  - Interoperable data spaces and secure data exchanges

- **Compute: from Cloud to Edge**
  - Cloud service modeling and management
  - Resource allocation in hybrid environments
  - Real-time event-driven service management
  - Security and privacy in cloud environments
  - Context awareness and situation management

- **Decide: from Insights to Intelligence**
  - Agentic approaches and generative AI for decision support
  - Mathematical programming, simulation and optimization
  - Multiple Criteria Decision Making
  - Personalization and recommender systems
  - Information aggregation and prediction markets

Application domains

Factories of the future	Electronic governance	Digital health and well-being	Digital innovation	Sustainable and green economy
Smart manufacturing	E-participation & e-consultation	Innovative healthcare	E-learning and knowledge management	Smart and green mobility
Supply chain management	Citizen-centric services	Mobile health management	Idea management	Digital solutions for water management
Predictive maintenance	Policy modeling	Personalised nutrition	Open innovation	ICT-enabled energy efficiency
Quality management	Citizen engagement	Secure e- health data exchange	Social creativity support	Behavioural change support

Research activities

- Since its establishment in 1997 IMU has contributed actively in **sixty (62) research and innovation projects**
  - Fifty (50) projects were completed during the 1997-2023 period
  - Ten (12) projects are active during the 2024-2027 period
- The total funding of IMU since 1997 exceeds **18,5 million euros**

- Our work is funded by these programs and institutions:

- **The European Commision research framework programs (Horizon Europe, previously Horizon 2020, FP5, FP6, FP7)**

- Research programs of the **Greek General Secretariat for Research and Innovation**

Research in human-AI decision support

- Augmenting data analytics and AI pipelines with human intelligence
  - ✓ to allow for human feedback, validation and evaluation
- (automated) machine learning & transfer learning
  - to lower the skill threshold to exploit AI benefits
- Generative AI and LLMs to facilitate data science

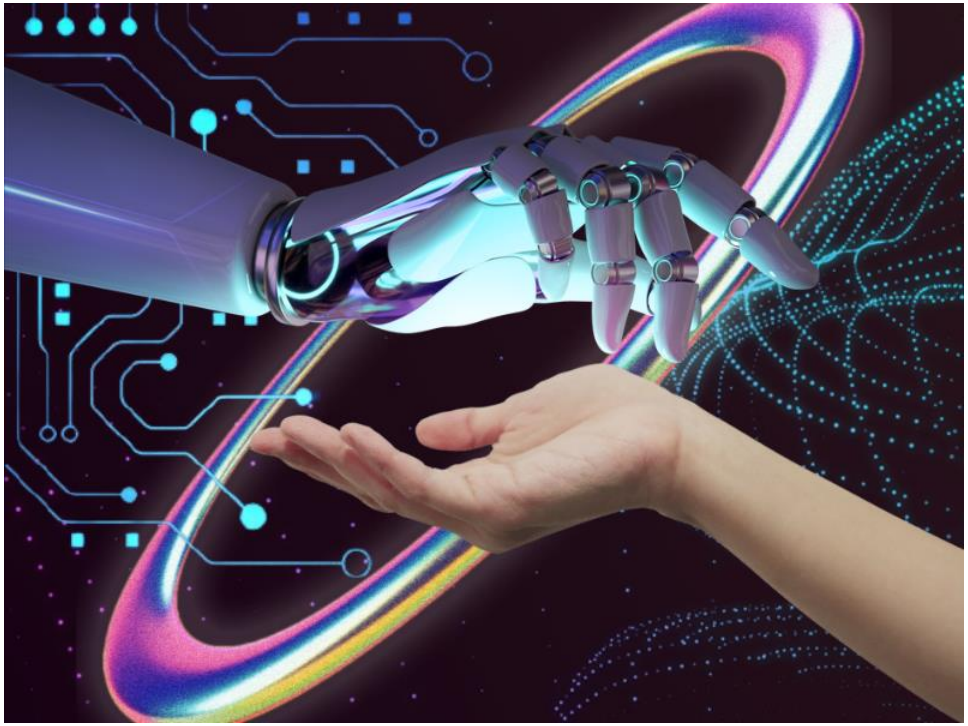
- ✓ Trustworthy AI projects THEMIS and FAITH
- ✓ AI in Manufacturing in UPTIME, COALA, WASABI and GREECE 4.0
- ✓ AI in Mining MINE.IO
- ✓ AI in EV Batteries health prognostics MARBEL
- ✓ AI in classroom learning DISCOVERY SPACE
- ✓ AI in circular water management NAIADES and AQUASPICE
- ✓ AI in future mobility projects FRONTIER and HARMONY
- ✓ AI in cross-border security METICOS

Research in the cognitive computing continuum

- Proactive adaptation and event-driven monitoring of computational resources (cloud, fog, edge)
  - ✓ across the cognitive cloud continuum in a secure way
- Context-aware ABAC-based access control
- NFT-based dataset provenance
  - ✓ across interoperable data spaces

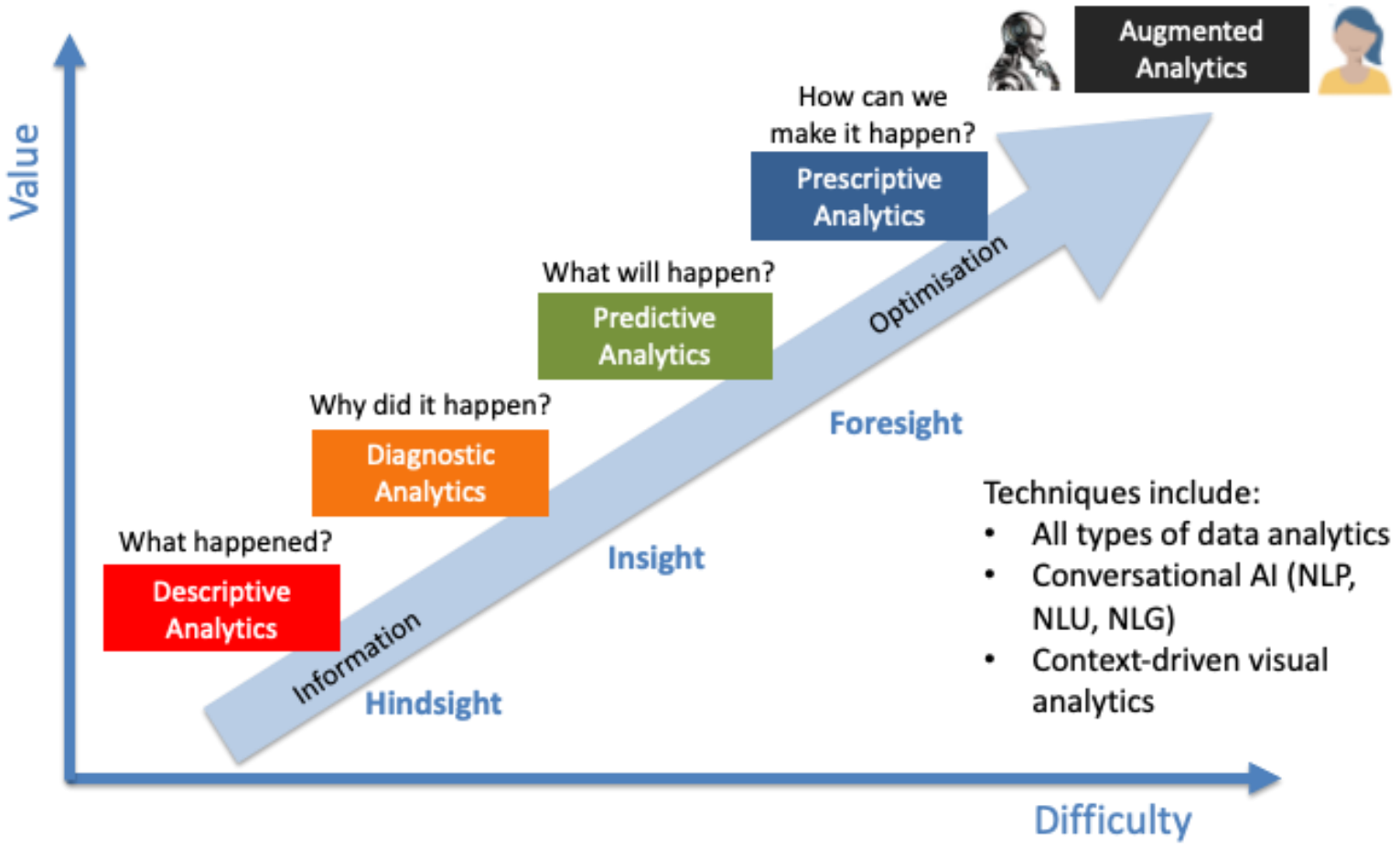
- ✓ Meta Operating System NEBULOUS
- ✓ Optimised multicloud deployment in MELODIC
- ✓ Proactive cloud service optimization MORPHEMIC
- ✓ DLT-based provenance in data analytics EXTREMEXP
- ✓ NFTs for royalty management in the project WASABI
- ✓ Decentralised orchestration & DLT-based trust in SWARMCHESTRATE

Research and Innovation in Human-AI Decision Support

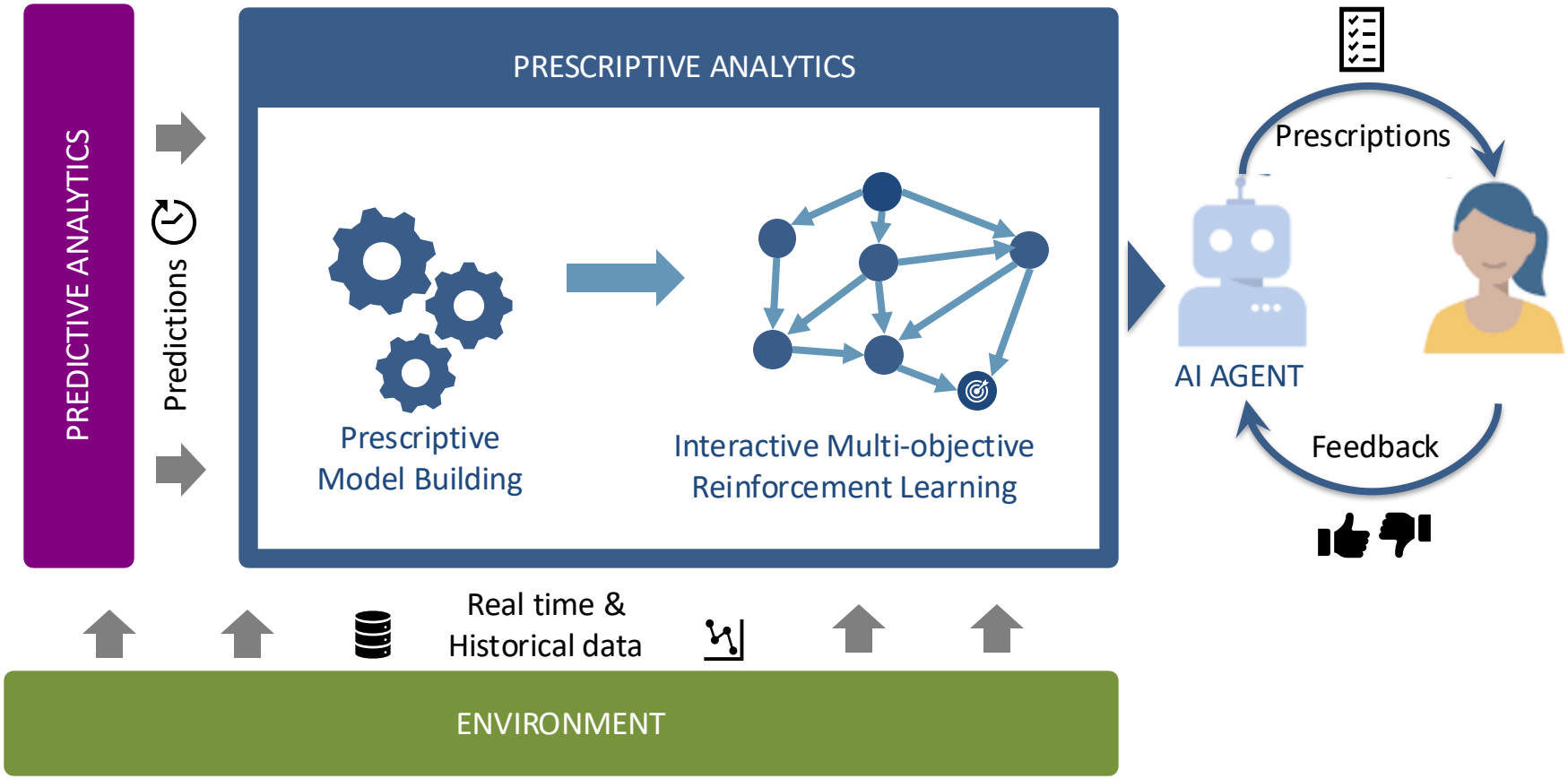


For a complete list please visit: http://imu.iccs.gr/wp/projects/

In our research we developed augmented analytics approaches that integrate human-in-the-loop with presecriptive analytics



We research human-AI collaboration by integrating human feedback and evaluation with rules and interactive reinforcement learning



Our methods have been successfully applied in various industry 4.0 use cases (cf. the UPTIME, PROASENSE and COALA projects)

Estimate Remaining Useful Life (RUL)

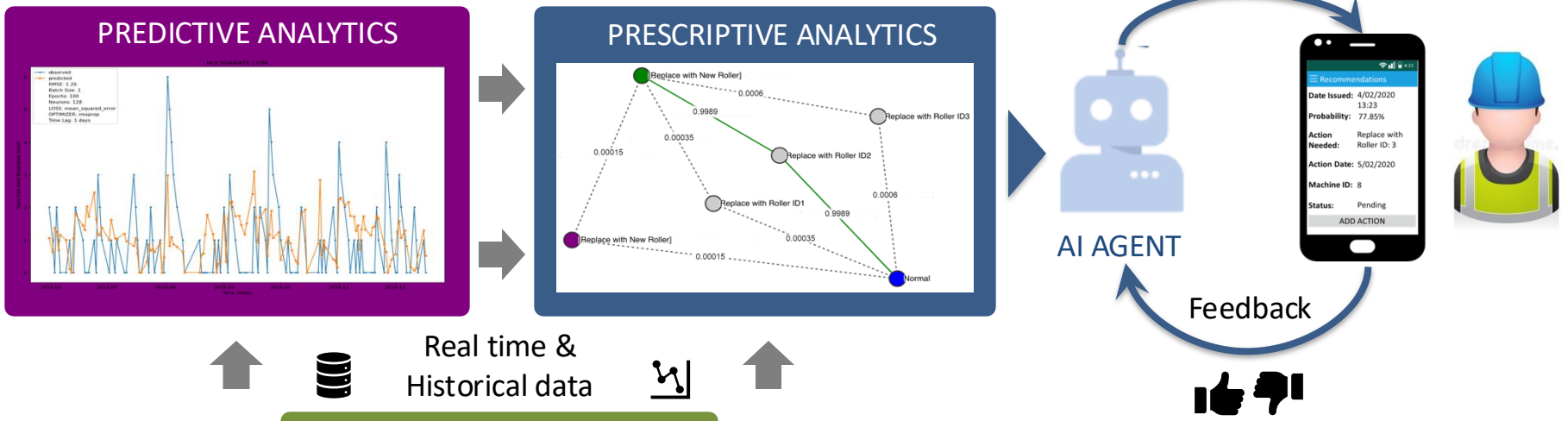
Predict future failure modes

Feature extraction
Online Bayesian changepoint detection
Weibull fitting
Long Short-Term Memory (LSTM)

Prescribe the optimal proactive actions

Provide explainable visualization

Markov Decision Process (MDP)
Reinforcement Learning
Multi-Objective Optimization

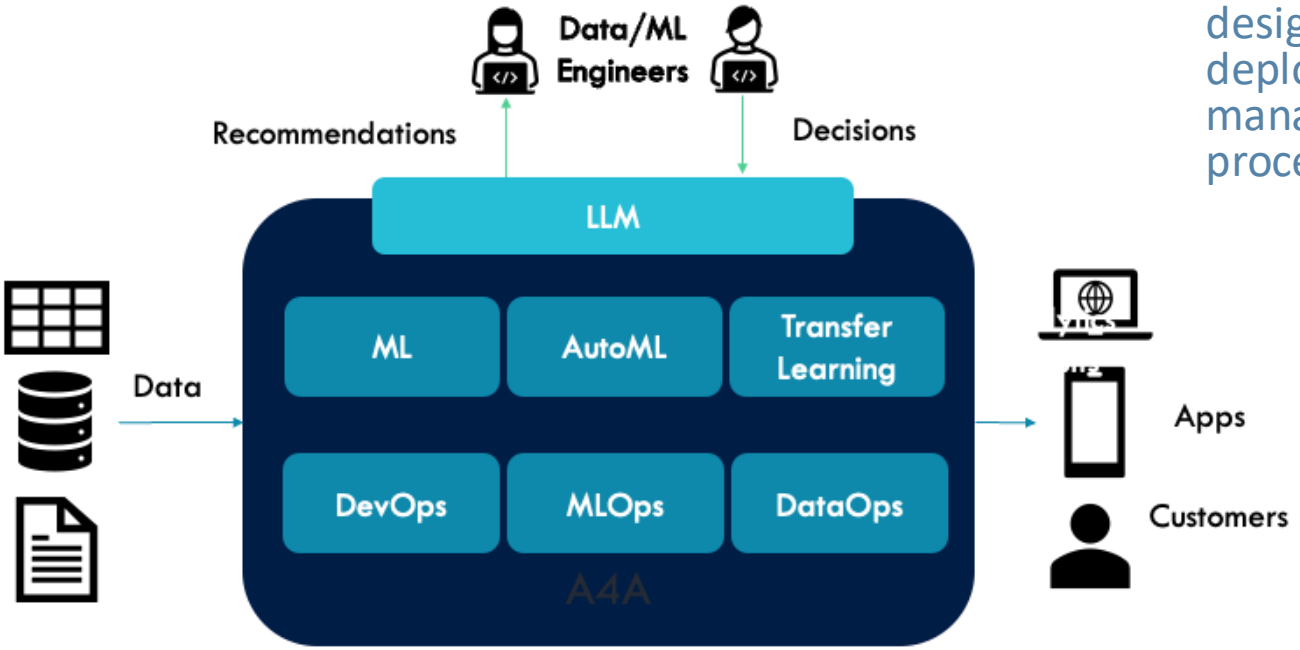


Real-time data
Accelerometers
Tachometer

Enterprise data
CMMS
ERP

… and also in water management (cf. the AquaSPICE project) and battery prognostics (cf. the MARBEL project)

Within our data analytics research we developed A4A, a framework that offers a flexible approach for building data-driven applications



- Facilitates and automates the design, implementation, deployment and management of the analytics process
  - One single tool - instead of the orchestration of multiple tools
  - All steps implemented with the bootstrapped functionalities and tools of the platform
  - Various implementations for each step that can support the customization of the analytics process, in order to meet the specific problem's requirements
- Has been validated in five industrial use cases

We developed a prescriptive process and an agentic KG-based toolkit for operationalising the assessment and improvement of trustworthy AI

TRUSTWORTHY AI CARDS

We developed a structured documentation approach for assessing and improving trustworthy AI

TRUST-AI-PROCESS

Socio-technical, risk-based process that supports assessing, measuring and enhancing AI trustworthiness

Knowledge-graph based agentic toolkit that supports trustworthy AI design and development

TRUSTPROOFER

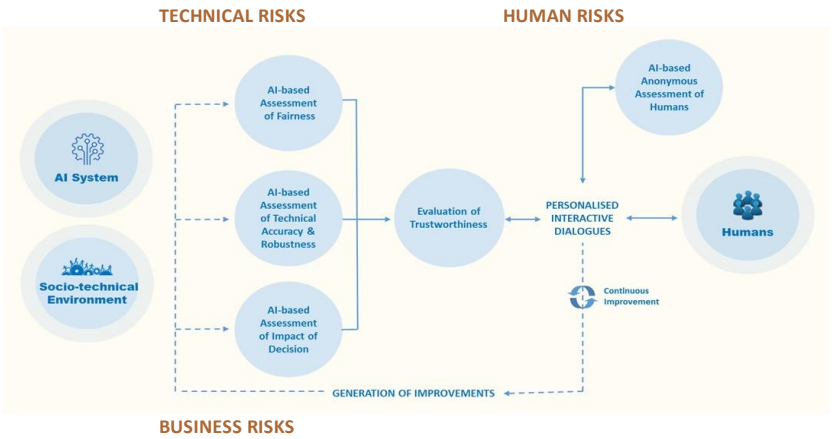
Guidebook to assist in implementing the Trustworthy AI process

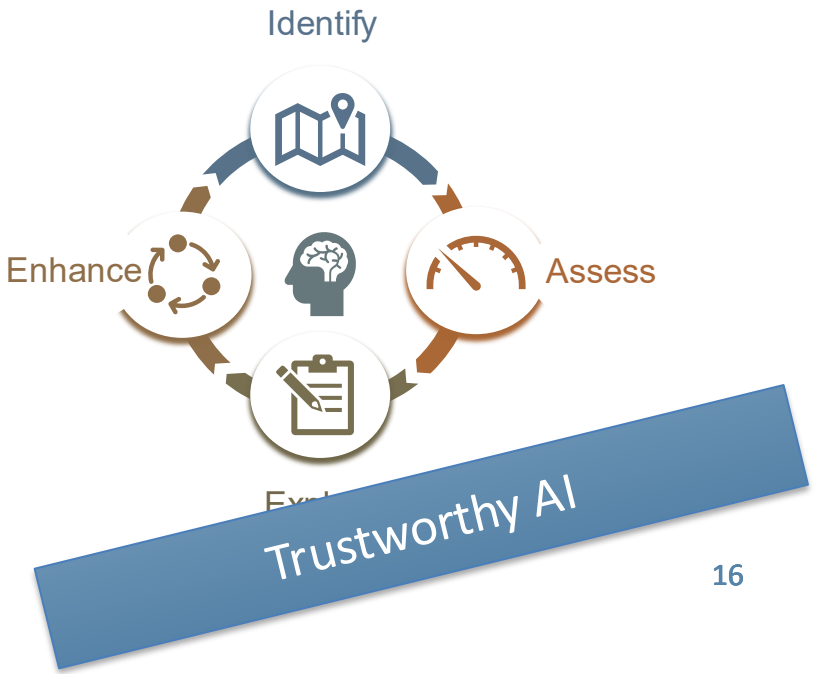
GUIDEBOOK

THEMIS 5.0
Human-centered Trustworthiness Optimisation in Hybrid Decision Support

THEMIS 5.0 is developing an AI trustworthiness optimization framework to assist all AI System stakeholders to enforce trust and mitigate potential risks.

- **Socio-technical environment:** Trustworthiness is not limited to only the technical perspective of the AI System, but incorporates also societal, business, legal, and ethical aspects of its environment
- **Trustworthiness Optimization Process (TOP):** A key innovation of the project is the TOP where all the perspectives of the AI System and the dimensions of trustworthiness are combined to support trust
- **Human-in-the-center:** AI Trustworthiness is approached as a set of risks toward the human that need to be assessed and mitigated.

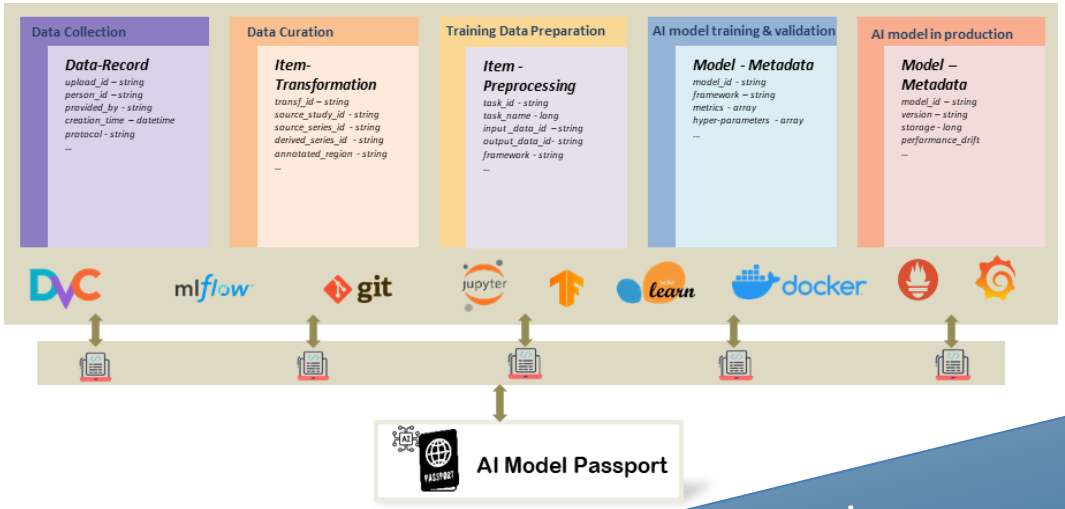




- From 01/9/2023 to 30/09/2026
- url: https://www.themis-trust.eu

Fostering Artificial Intelligence Trust for Humans towards the optimization of trustworthiness through large-scale pilots in critical domains

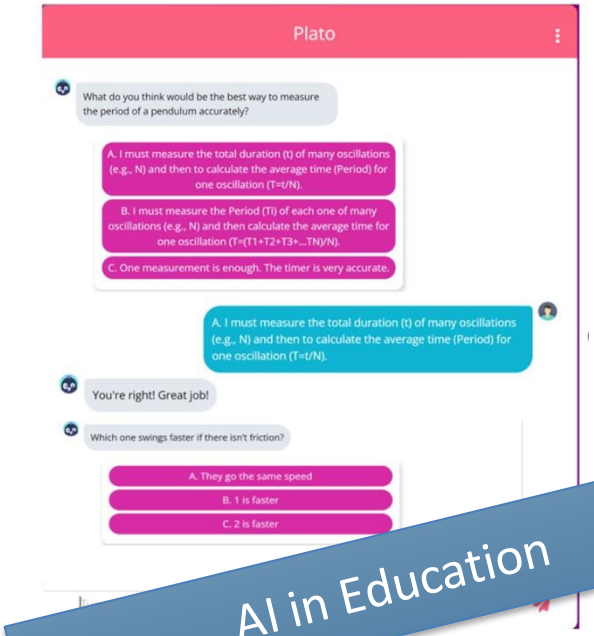
- Faith aims to provide the practitioners and stakeholders of AI systems a playbook for how to **assess and build trustworthy AI systems** and how to continuously measure their trustworthiness.
- Seven (7) Large Scale Pilot activities in critical domains (robotics, education, media, transportation, healthcare, active ageing, and industry) validate the **FAITH holistic estimation of trustworthiness** of selected sectoral AI systems



- From 01/01/2024 to 31/12/2027
- url: https://faith-ec-project.eu/

Discovery Space: An AI-Enhanced Classroom for Deeper Learning in STEM

- Discovery Space develops a roadmap for the AI-Enhanced Classroom for Deeper Learning in STEM.
- Discovery Space implements AI mechanisms and data analytics to enhance inquiry-based learning, foster curiosity, and support lab simulations.
- Discovery Space introduces AI-driven learning companions and VR/AR interfaces to support the student and enhance the learning experience.

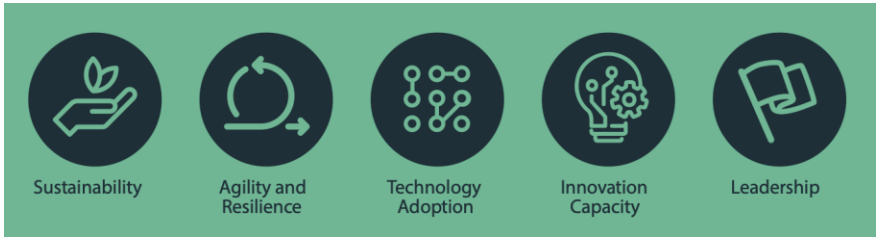


- From 01/01/2023 to 31/12/2025
- url: https://discoveryspace.eu/

AI in Education

White-Label Shop For Digital Intelligent Assistance And Human-AI Collaboration In Manufacturing

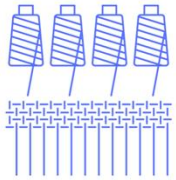
- WASABI focuses on **digital intelligent assistance** solutions, based on **human-AI collaboration**, applied to the manufacturing domain.
- The key technology in WASABI's solution portfolio is the digital intelligent assistant (DIA) – an anthropomorphic, task-oriented AI with a conversational interface.
  - The WASABI solution **increases the cognitive abilities of workers** and accelerates the acquisition and transfer of knowledge **for the upskilling of the existing workforce**.
  - IMU is responsible for the creation of **predictive analytics** skills of and an **NFT-based royalty management** system.



- From 01/03/2023 to 30/02/2027
- url: https://wasabiproject.eu/

Cognitive Assisted Agile manufacturing for a labor force supported by trustworthy Artificial Intelligence

- COALA provides a solution for **cognitive assistance that consists of a composition of trustworthy AI components with a voice-enabled digital intelligent assistant as an interface**.
  - The COALA solution will transform how workers perform their jobs and
  - it allows companies to maintain or increase the quality of their production processes and their products



Textile Production

On-the-job training of new machine operators

White Goods Production

Quality inspection during Zero Hour Testing

Detergent Packaging

On-job training of new and temporary line managers, change over, issue handling

- From 01/10/2020 to 30/09/2023
- url: https://www.coala-h2020.eu

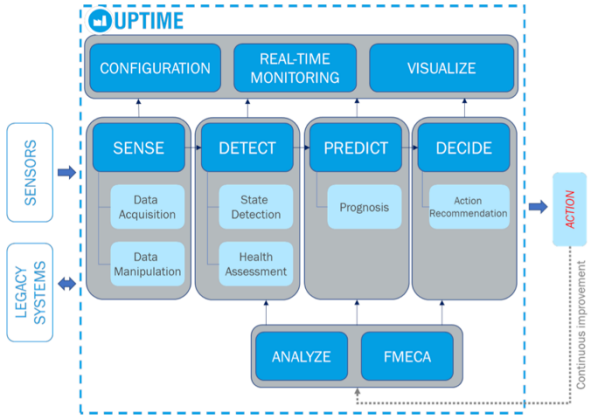
AI in Industry 4.0

Unified Predictive Maintenance System

UPTIME

- UPTIME provides a unified predictive maintenance framework and an associated unified information system in order to enable predictive maintenance strategy in manufacturing firms
  - Validation in 3 industrial cases: (a) White Goods - Home appliances (b) Steel Industry - Cold rolling (c) Aviation Industry

- From 01/09/2017 to 31/08/2020
- url: https://www.uptime-h2020.eu and https://www.uptime-predictive-maintenance.com

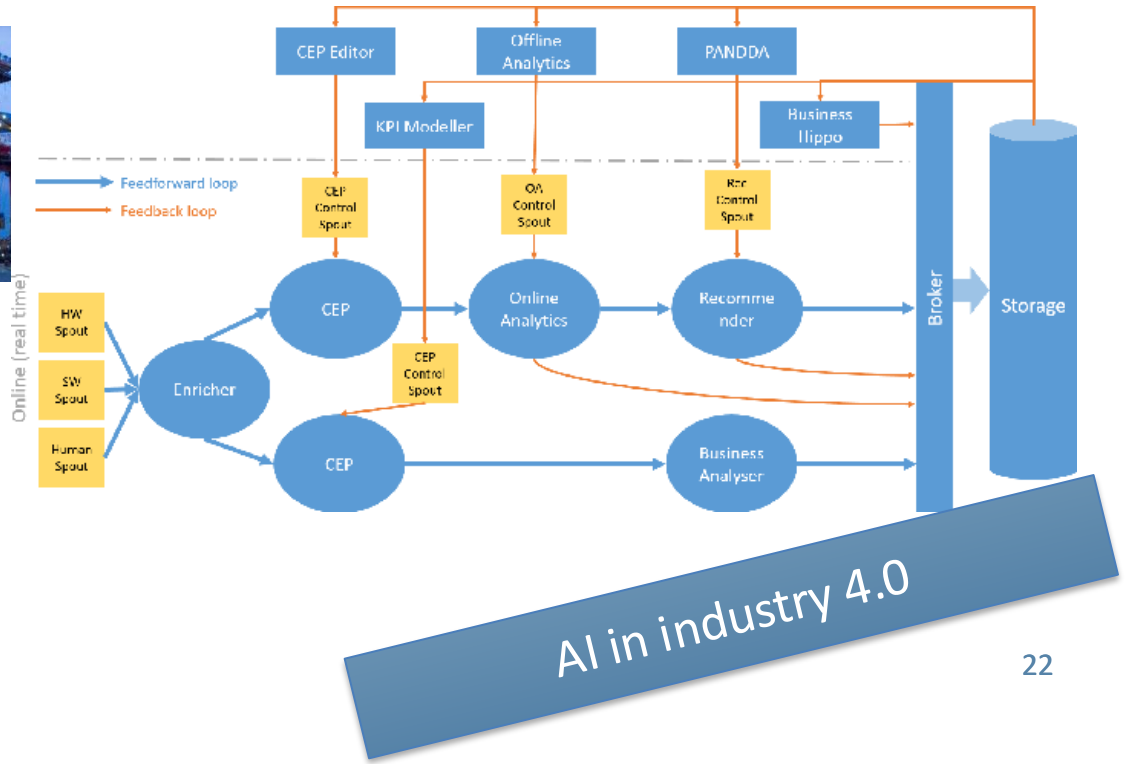


AI in Industry 4.0

The Proactive Sensing Enterprise

- The vision of ProaSense is a new class of **proactive enterprises** that will be continuously aware of that **what "might happen"** in the relevant business context
  - and will optimize their behaviour to achieve **what "should be the best action"**

- ProaSense's core goal is to pave the way for an **efficient transmission from Sensing into Proactive enterprises**.

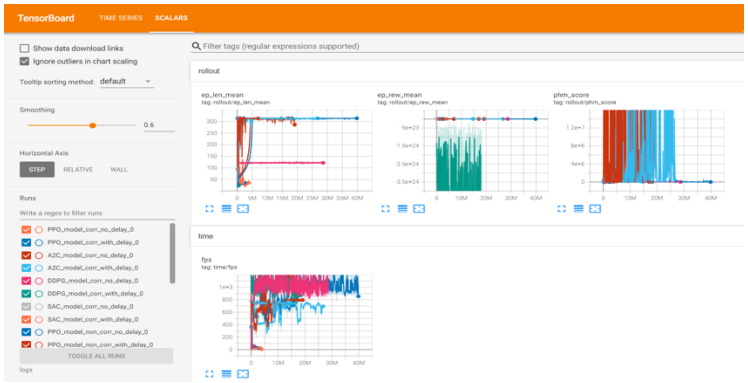


- From 01/11/2013 to 31/01/2017
- url: http://www.proasense.eu/

AI in industry 4.0

Network of Excellence for the Development, Dissemination and Application of Digital Transformation Technologies in the Greek Manufacturing Industry

- The Greece4.0 project aims to assist the **digital transformation of Greek manufacturing industry** providing the required infrastructure and knowledge for the development, testing, and validation of services, such as Digital Twins, Artificial Intelligence, Internet of Things, Robotics.
  - IMU is responsible for the development of a **predictive analytics** system which adopts an **Autonomous Analytics As A Service** approach
    - and incorporates **(deep) Machine Learning, Reinforcement Learning**, and **Automated Machine Learning (AutoML)** algorithms for Industry 4.0.



- From 15/05/2023 to 15/09/2025
- url: https://greece40.gr/

AI in Industry 4.0

Manufacturing and Assembly of Modular and Re-usable EV Battery for Environment-friendly and Lightweight Mobility

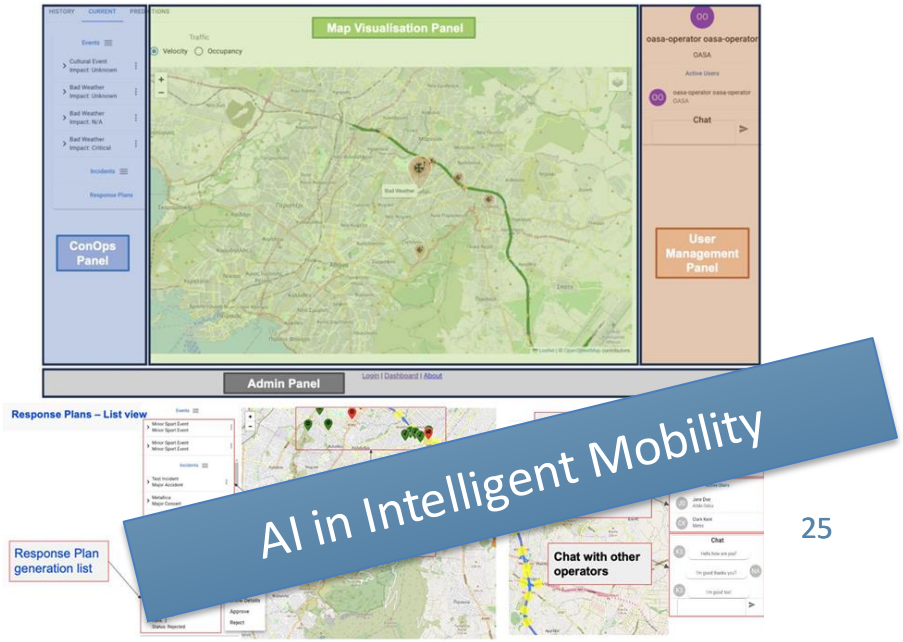
- The MARBEL project aims to design and develop an **innovative and competitive lightweight battery** with increased energy density and shorter recharging times
  - IMU is responsible for the data analytics tasks, the computation of SoX (State of Charge, State of Health, etc.) variables and
  - the development of an AI-based system with early failure detection functionality.

- From 01/01/2021 to 30/06/2024
- url: https://marbel-project.eu

AI in Battery Management

Next generation traffic management for empowering CAVs integration, cross-stakeholders collaboration and proactive multi-modal network optimization

- FRONTIER aims to provide new **integrated traffic management strategies** and resilient **multimodal autonomous mobility** by facilitating collaboration in **multi-stakeholder** environments.
  - A platform has been developed to streamline communication among operators, ease congestion and facilitate decision-making.
- The platform functionalities include **incident and congestion detection** and **recommendation of the generated response plans** by offering **situational awareness**
  - supported by visual dashboards for operators, a mobile app for commuters and AI-based services that predict traffic and incidents.



- From 01/05/2021 to 30/04/2024
- Url: https://www.frontier-project.eu

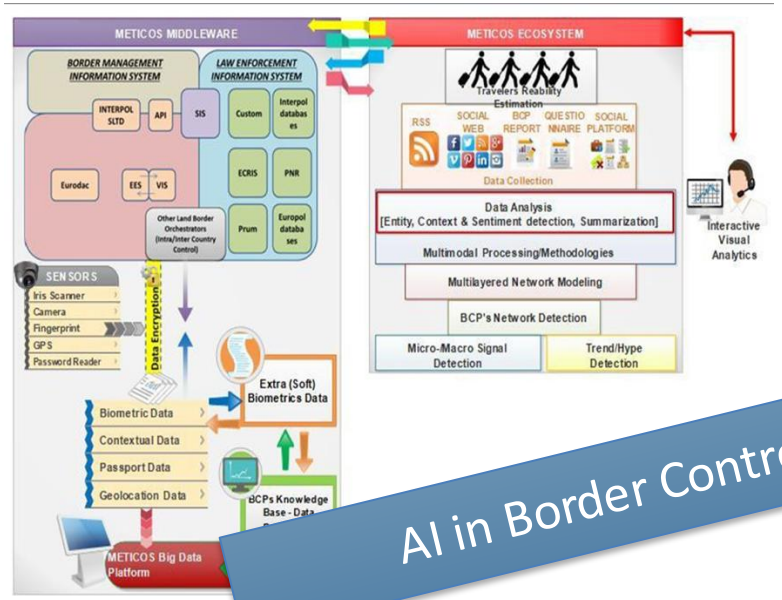
Mine.IO - A Holistic Digital Mine 4.0 Ecosystem

- A Holistic Digital Mine 4.0 Ecosystem is a project focused on industrialization, informatization and sustainable development of the mining sector.
- Mine.IO aims to provide solutions that will build a **novel mining digital ecosystem** and a systemic structure for the implementation of Industry 4.0 in mining industrial environments.
  - IMU is responsible for the **predictive maintenance module** which will use Automated Machine Learning and Transfer Learning in order to detect anomalies, predict the future health state, and support decision making about maintenance plans of drilling equipment.

- From 01/01/2023 to 31/12/2025
- url: https://www.mineio-horizon.eu

A Platform for Monitoring and Prediction of Social Impact and Acceptability of Modern Border Control Technology

- METICOS aims to address the need for more **effective and efficient Smart Borders** in addition to the need for gaining the travellers' societal and political **acceptance and satisfaction** on the use of these technologies.
- METICOS developed a platform that integrates various heterogenous data sources to evaluate:
  1. the **effectiveness and efficiency** of Smart Border technologies and
- 2. the travellers' satisfaction and **acceptability** on the employment of those technologies.
  - IMU is responsible for developing the METICOS data model, data analytics pipelines for structured & unstructured data and bias identification and a visualisation dashboard for displaying the results



- From 01/09/2020 to 31/08/2023
- Url: https://meticos-project.eu/

AI in Border Control

Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

- For the vast majority of industries, water is used during some stages of the production process.
  - It is estimated that 20% of all fresh water consumption globally is used by industry and this share is increased to 50% in industrialised countries
- AquaSPICE aims at realising **circular water use in the European Process Industries**
  - fostering awareness in resource-efficiency and delivering compact solutions for industrial applications.

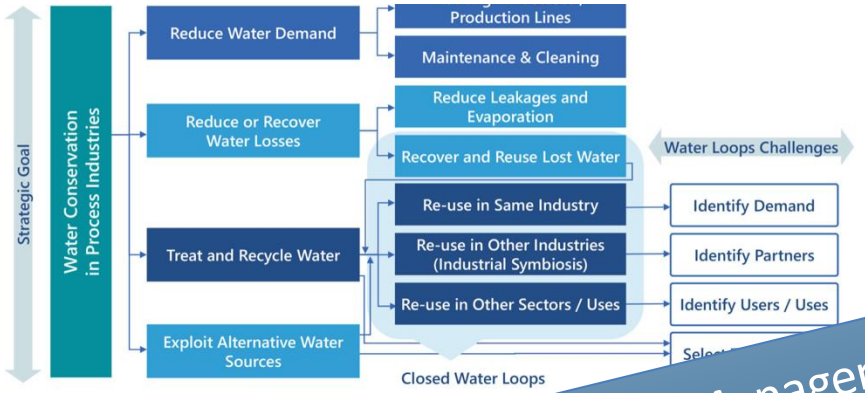
Reduce water demand

Reduce or recover water losses

Treat and recycle water

Exploit alternative water sources

- From 01/12/2020 to 31/05/2024
- url: https://aquaspice.eu



AI in Water Management

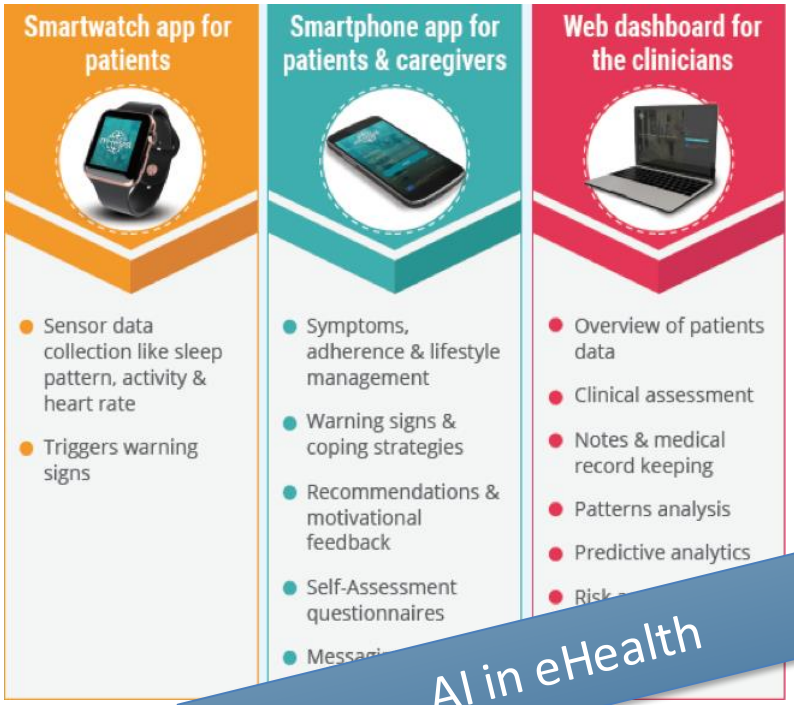
A holistic water ecosystem for digitization of urban water sector

- NAIADES supports the modernization and digitization of the water sector by providing a holistic solution for the control and management of water ecosystems.
- The project aims to address the increased need for **sustainable and eco-friendly water methodologies by defining a new ICT framework**, with a wider scope than a sole technical proposition.
  - Driven by the need to yield an end-to-end, uniform approach, NAIADES redefines water management by taking into consideration issues pertaining to cost, safety, complexity, vulnerability, societal acceptance, user behaviour and ethics.

- From 01/06/2019 to 31/05/2022
- url: https://naiades-project.eu

Mobile Therapeutic Attention for Patients with Treatment Resistant Schizophrenia

- M-Resist helps **predict patient's behaviour** and allows the establishment of a **reaction alert system**, as well as to draw up protocols and recommendations to give **doctors support in the clinical decisions**.
  - During the m-resist project, a model of analysis was implemented, in order to move forward in **understanding resistant schizophrenia**.



- From 01/01/2015 to 31/12/2017
- url: http://www.mresist.eu

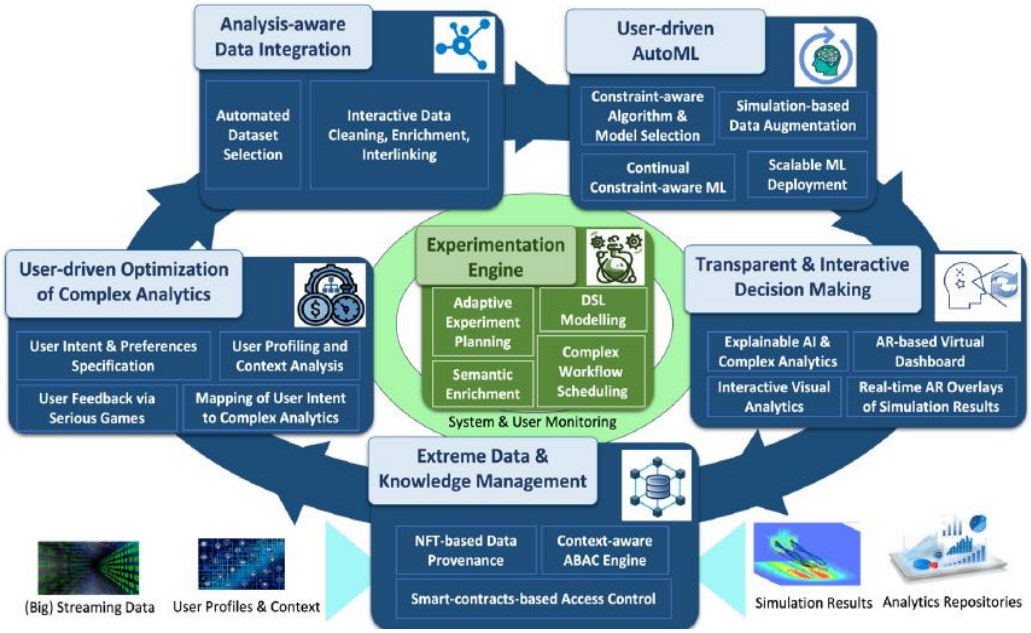
AI in eHealth

ExtremeXP

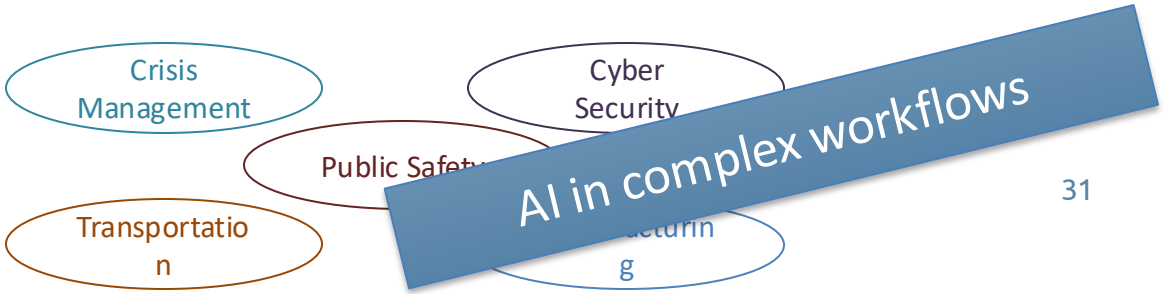
Experiment Driven and User Experience Oriented Analytics for Extremely Precise Outcomes and Decisions

ExtremeXP supports the development and operation of **complex analytics workflows** that are used for taking **data-driven decisions** in different application domains.

- "**Fully-generated**" and "**Intent-based**" experiments specification
- **Human in the loop** of the execution of experiments
- **Attribute** Based Access Control Authorization
- **Decentralized** Data & Knowledge Management
- **NFT** based Data Provenance

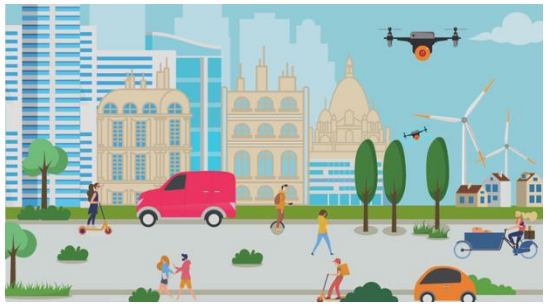


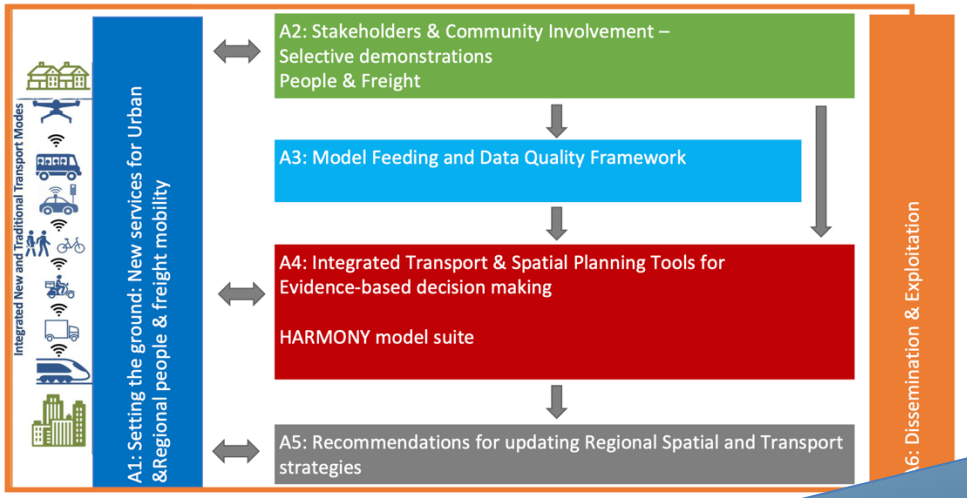
- From 01/01/2023 to 31/12/2025
- url: https://extremexp.eu



Holistic Approach for Providing Spatial & Transport Planning Tools and Evidence to Lead a Sustainable Transition to a New Mobility Era

- Harmony's vision is to enable metropolitan area authorities to lead a **sustainable transition to a low-carbon new mobility era**.
- Our spatial and multimodal transport planning tools will update the Sustainable Urban Mobility Plans of the future.
  - HARMONY is demonstrating electric AVs and drones in real-life conditions integrating them with the traditional transport modes to understand the requirements, reactions, barriers and collect real-world data.



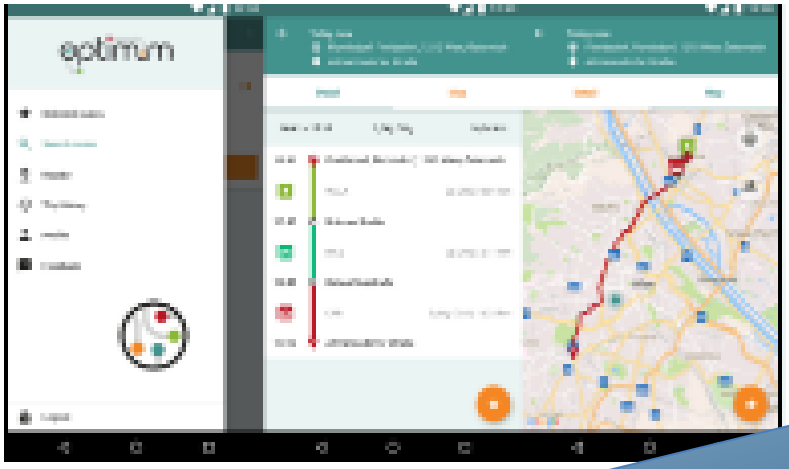


- From 01/06/2019 to 31/05/2022
- url: https://harmony-h2020.eu

AI in Smart Mobility

Multi-source Big Data Fusion Driven Proactivity for Intelligent Mobility

- OPTIMUM aims to unveil state-of-the-art solutions to improve transit, freight transportation and traffic connectivity throughout Europe.
- OPTIMUM established a scalable distributed architecture for the management and processing of multi-source big data, enabling monitoring of transportation system needs and proposing proactive decisions and actions in a (semi-)automatic way.
  - OPTIMUM follows a cognitive approach based on the Observe–Orient–Decide–Act loop of the big data supply chain for continuous situational awareness.



- From 01/05/2015 to 30/04/2018
- Url: http://www.optimumproject.eu

AI in Smart Mobility

Research and Innovation
in the Cognitive Computing Continuum

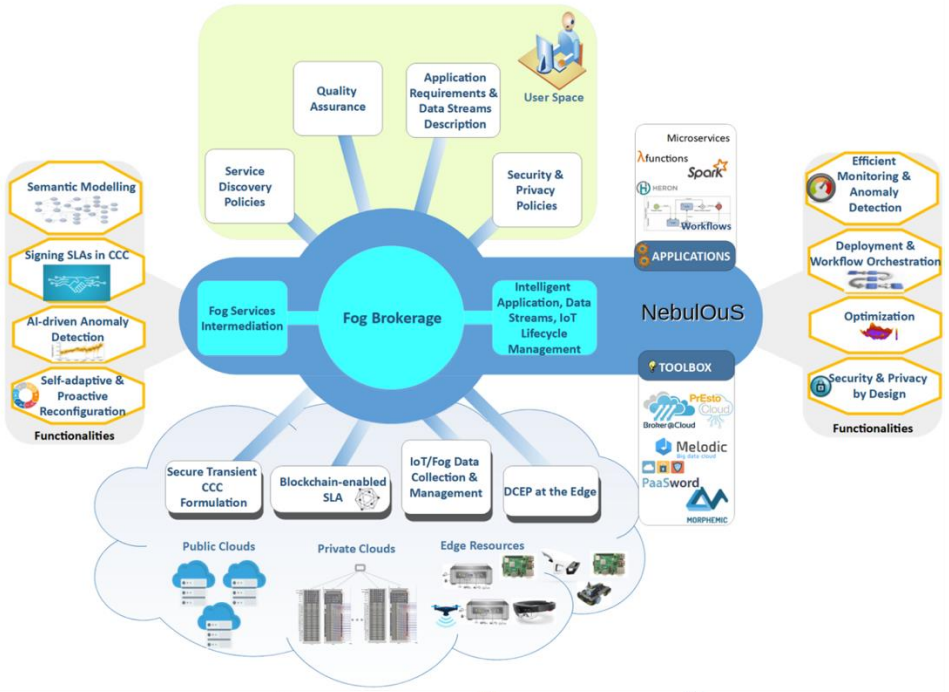
For a complete list please visit: http://imu.iccs.gr/wp/projects/

A meta operating system for brokering hyper-distributed applications on cloud computing continuums

NebulOuS develops a novel **Meta Operating System** and platform that seamlessly exploit **edge and fog nodes**, in conjunction with **multi-cloud resources**

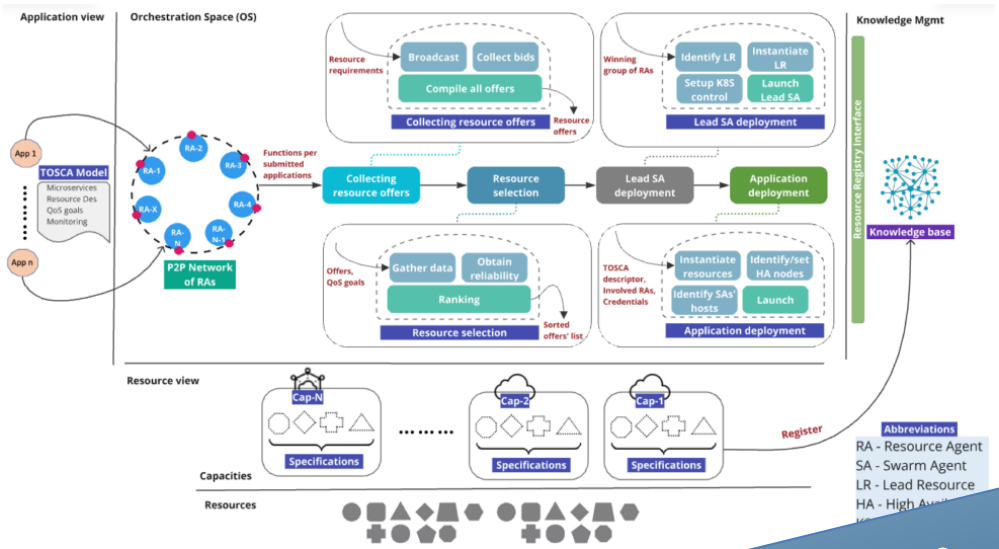
- **Tools for modelling** application topologies, requirements and data streams
- **Multi-criteria resource brokerage**
- **Smart-contract** backed non-repudiable **service level agreement** monitoring
- **Reactive & proactive reconfiguration**
- Unified **security for cloud computing continuums**
- 5 application domains

- From 01/09/2022 to 31/08/2025
- url: https://nebulouscloud.eu/



Application-level Swarm-based Orchestration Across the Cloud-to-Edge Continuum

- **Swarmchestrate** is a novel decentralised application-level orchestrator of self-organised interdependent swarms
- **Decentralized Orchestration**: Introduces a novel decentralized application-level orchestrator for managing and monitoring microservices through self-organized interdependent swarms.
- **Distributed Knowledge & Security**: Utilizes blockchain-based solutions with Self-Sovereign Identities (SSI) and Distributed Identifiers (DID) to ensure trust and validity of Swarmchestrates' agents, resources and application's components.



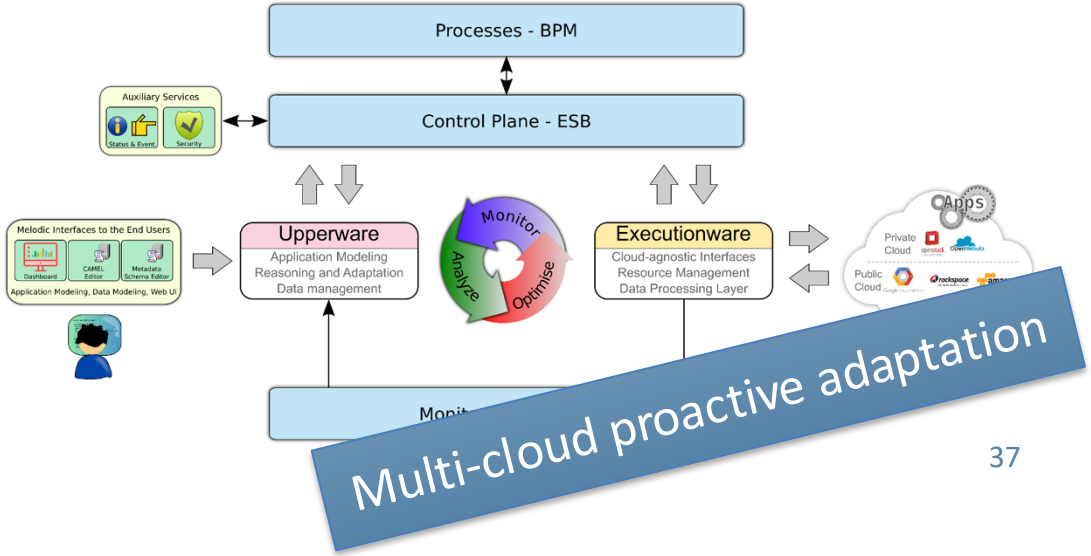
Swarm-based orhestration

- From 01/01/2024 to 31/12/2026
- https://www.swarmchestrate.eu/

Modelling and Orchestrating heterogeneous Resources and Polymorphic applications for Holistic Execution and adaptation of Models In the Cloud

- MORPHEMIC is a **unique way of adapting and optimizing Cloud computing applications**.
  - The project is an extension of MELODIC which is a multi-cloud platform.
  - This open source platform is extended to MORPHEMIC with 2 main innovative pillars:
    - **Polymorphing architecture**: when a component can run in different technical forms, i.e. in a Virtual Machine (VM), in a container, as a big data job, or as serverless components.
    - **Proactive adaptation**: aims to forecast future resource needs and possible deployment configurations -adaptation can be done effectively and seamlessly for the users of the application.

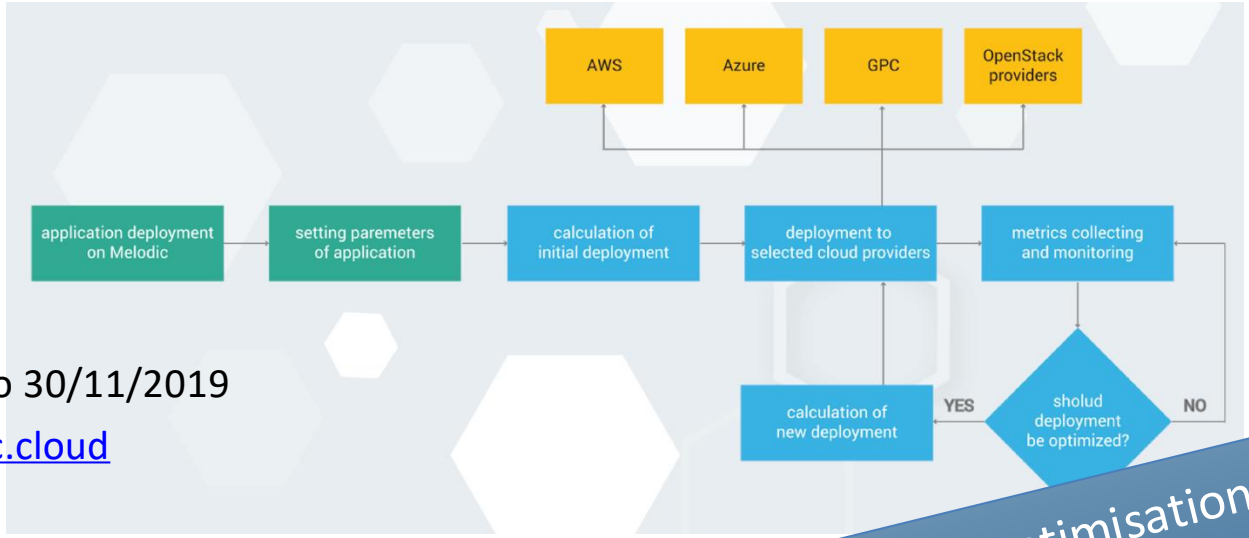
- From 01/01/2020 to 31/12/2022
- Url: https://www.morphemic.cloud



Melodic
optimized multicloud

Multi-cloud Execution-ware for Large-scale Optimized Data-Intensive Computing

- MELODIC is a **multicloud optimization platform and automatic deployment solution** of the application to different cloud providers without changing configuration – full cloud agnostic approach.
  - The selection of cloud providers and cloud resources is fully optimized, instead of prices, performance, reliability instead of other factors.
  - After the initial deployment the application is continuously monitored for checking the business goals fulfilment and appropriately reconfigured to always maintain the optimal operation.

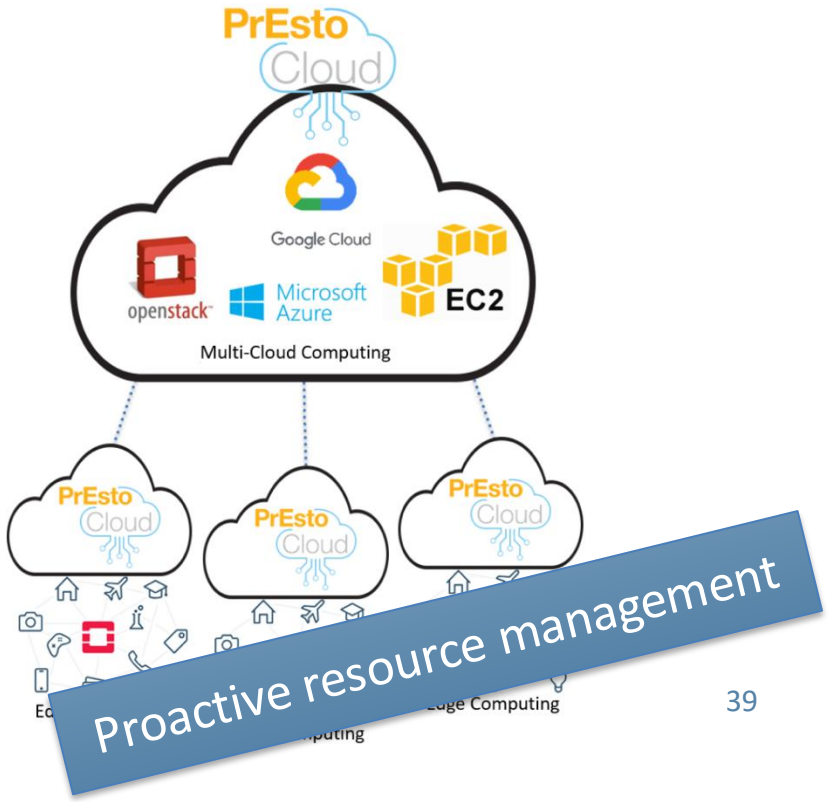


- From 01/12/2016 to 30/11/2019
- Url: https://melodic.cloud

Proactive Cloud Resources Management at the Edge for efficient Real-Time Big Data Processing

- PrEstoCloud targets a dynamic and distributed software architecture that **manages proactively cloud and fog resources**, while reaching the extreme edge of the network for an efficient real-time Big Data processing.
  - Three use cases demonstrate pro-activeness, self-adaptation, orchestration of distributed processing nodes and processing on the edge: (a) vehicle fleet management (b) media prosumer platform (c) surveillance solution

- From 01/01/2017 to 31/12/2019
- url: http://prestocloud-project.eu



For more information and to contact us…

VISIT OUR SITE

http://imu.iccs.gr

Connect with us on LinkedIn

https://www.linkedin.com/company/2929404/

Follow us on X

https://x.com/imu_ntua

Watch Us On YouTube

https://www.youtube.com/channel/UCenUYJveI5WHb92x-jiH8Zg