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SustAIn
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Glossary

CA	Consortium Agreement
GA	Grant Agreement
EC	European Commission
CoE	Centre of Excellence
WP	Work Package
WPL	Work Package Leader
EB	Executive Board
SB	Supervisory Board
AB	Advisory Board
PC	Project Coordinator
Portal	Funding&Tenders Portal

Deliverable description

The Research HUB map Deliverable will highlight the specific research areas of key research groups fostering multi-disciplinary collaboration to address complex research challenges. The map will provide a clear overview of the HUB's resources and spatial organization, key research focuses and resource utilization for researchers and partners.

1. Introduction

This Deliverable outlines the strategic research map for the Center of Excellence (CoE), focusing on the creation and development of four distinct Research Groups (RGs). This map serves as an important instrument for navigating the CoE's research trajectory, ensuring a focused and impactful approach. It builds upon a comprehensive analysis of partner institutions' research strengths and identified limitations, thereby optimizing collaborative potential and resource allocation. The core objective of this map is to highlight the specific research areas for each RG, fostering multi-disciplinary collaboration to address complex research challenges. This strategic structuring aims to catalyze the identification and development of innovative research projects, using the collective expertise of the CoE and its partners. Furthermore, the map ensures alignment with Lithuania's Smart Specialization Strategy (S3) priorities, guaranteeing that the CoE contributes directly to national research and innovation goals. This deliverable provides a framework for sustainable growth and impactful research outcomes, ensuring the CoE's position as a leading research entity.

Vision: To establish a leading Centre of Excellence (CoE) in Lithuania, driving sustainable innovation through AI across key sectors in Baltic region.

Mission: To establish a leading Centre of Excellence (CoE) in Lithuania, driving sustainable AI solutions across Manufacturing, Health, Transport, and Green Energy sectors through collaborative research, innovation, and ethical development.

2. Strategic Vision and Goals

2.1 The purpose of AI research HUBs

AI research hubs are important for advancing artificial intelligence, application of the innovation across sectors like smart manufacturing, health, energy, and transport. Hubs foster breakthroughs in algorithms and machine learning, developing AI applications to handle complex industry and societal issues. Research hubs are based on collaboration between researchers, businesses, and policymakers, creating ecosystems for interdisciplinary AI solution development. Furthermore, research Hubs are important for economic growth, enhancing productivity and creating new industries through AI technology. Also, they address societal issues, including climate change and healthcare disparities, while ensuring ethical AI development. To remain competitive in a rapidly evolving technological landscape, Lithuania, together with advanced partners, is establishing the AI research hub to maintain a leading position in AI research and application.

2.2 Specific research areas

The SustAInLivWork AI research hub will focus on bridging Lithuania's AI gaps and fostering sustainable growth. The hub's research areas are defined by four key sectors:

- *Innovative Manufacturing Technologies* (Manufacturing): This area will explore AI's application in optimizing industrial processes and automation.

- *Healthy Living* (Health): Research here will concentrate on AI-driven healthcare solutions, including diagnostics and personalized medicine.
- *Transport*: This sector will focus on AI applications in autonomous vehicles and intelligent transportation systems.
- *Green Energy* (Energy): The hub will investigate AI's role in developing smart energy grids and improving renewable energy efficiency.

The hub's research agenda addresses Lithuania's challenges in AI talent development, commercialization, and innovation. It aims to enhance collaboration, improve AI literacy, and navigate regulatory complexities, particularly concerning the EU AI Act. By concentrating on these four sectors, the hub will contribute to Lithuania's economic growth and sustainable development.

2.3 Desired outcomes and impact of the hub's research

The SustAInLivWork AI Research HUB will strengthen and consolidate Lithuania's AI capabilities through scientific excellence, international collaboration, and innovation. Core objectives include securing increased research funding, developing novel AI research areas, and establishing a strong AI hub. This HUB will generate societal impact by addressing critical challenges, promoting economic growth in key sectors, promoting environmental sustainability, enhancing AI literacy, and shaping policy. Regionally, it will strengthen the Baltic AI ecosystem (target countries LT, LV, EE), drive innovation, and position Lithuania as a leading AI hub focused on sustainable development. Desired outcomes and impacts of the SustAInLivWork research HUB are as follows:

1. Outcomes:
   - 1.1. *Enhanced scientific capabilities* by securing competitive research funding (EU and global) and developing new research strands in relevant AI domains.
   - 1.2. *Strengthened collaboration* by strengthening multidisciplinary and beneficial collaborations between international and Lithuanian institutions.
   - 1.3. *Enhanced innovation and integration* by strengthening innovation processes, services, and product development through the CoE Research Hub. Additionally, the Research Hub will design educational programs and service packages tailored to the needs of businesses, industry, and public sector organizations.
2. Impacts:
   - 2.1. *Societal impact* involves addressing societal challenges using AI-based solutions, improving quality of life through advancements in healthcare, transportation, and responsible application of AI-based algorithms.
   - 2.2. *Economic impact* involves innovation in key sectors (manufacturing, energy, health, transport), enhancing Lithuania’s competitiveness, attracting investments and talents, and increasing the number of patents.
   - 2.3. *Educational impact* involves improving AI literacy and skills, enhancing educational programs related to AI.

2.4 Alignment of research hub with broader organizational or societal goals

The SustAInLivWork AI Research HUB's research directly supports national and EU strategic goals by driving AI innovation in key sectors, promoting ethical AI practices, and contributing to sustainable development. It increases Lithuania's economic competitiveness, promotes social well-being by addressing societal challenges, and enhances AI literacy. The hub strengthens research capabilities through collaboration, promotes inclusivity by addressing inequalities, and advances the UN's SDGs. Enhances research via partnerships, promoting inclusivity by tackling inequalities, and contributes to the UN's Sustainable Development Goals (SDGs), aiming for a more equitable and sustainable future through its activities and outcomes. The SustAInLivWork AI Research HUB's research aligns significantly with broader organizational and social goals, primarily by addressing National and EU Strategic Priorities. The HUB will try to solve the challenges identified in Lithuania's AI Strategy and National Progress Program, focusing on enhancing AI research, innovation, and adoption across key sectors like manufacturing, health, energy, and transport. It will support the EU's agenda for AI development, including the EU AI Act, by promoting responsible and ethical AI practices.

2.5 The target audience of the research

The SustAInLivWork AI Research HUB's outputs benefit a wide range: Lithuanian research institutions gain enhanced capabilities and funding. The national AI ecosystem sees improved development and policy. Industries, especially SMEs, leverage AI solutions for growth. Policymakers and the EU benefit from informed strategies, which include different plans of actions or approaches that are based on accurate, relevant and comprehensive knowledge and understanding. The global research community gains new knowledge. Students and educational institutions access advanced programs. The target group for the HUB's research can be categorized as follows:

1. *Lithuanian Research Partners*, such as KTU, Vilnius Tech, VMU, LSMU. These institutions are central to the CoE's research activities.
2. *The broader Lithuanian AI Ecosystem* that includes AI developers, deployers, policymakers and others who are related to AI.
3. *Industry and business*, such as SMEs and larger organizations across key sectors like manufacturing, healthcare, energy and transport.
4. *Public bodies, government and agencies* responsible for forming AI strategies and regulations.
5. *International research community*.
6. *Educational institutions and students*.
7. *General Lithuanian society*.

2.6 Intra-collaboration between research groups in CoE

The SustAInLivWork CoE in Kaunas operates as a cohesive network of interconnected research hubs (Health, Manufacturing, Energy, and Transport), promoting collaboration and interdisciplinary research to achieve its overarching goals. While each hub possesses specific expertise and infrastructure tailored to its domain, mechanisms are in place to ensure synergistic interactions. Shared central resources, such as the High-Performance Computing (HPC) cluster and the secure data storage infrastructure, serve as common grounds for all hubs, enabling researchers from diverse backgrounds to collaborate on computationally intensive AI projects and share relevant datasets (while adhering to ethical and privacy standards). Regular cross-hub workshops, seminars, and networking events are organized to facilitate knowledge exchange, identify potential interdisciplinary research opportunities, and promote a shared understanding of AI advancements across different sectors. The CoE's management structure, with its emphasis on matrix and project-based approaches, further promotes inter-hub collaboration. Researchers are often involved in projects that draw upon the expertise of multiple hubs, promoting a culture of shared problem-solving and innovation. This interconnected approach ensures that the CoE leverages the diverse strengths of its constituent hubs to develop holistic and impactful AI solutions for sustainable living and working.

3. Research Focus and Capabilities

3.1 The key research questions of HUBs

The key research questions the SustAInLivWork research HUB is aiming to address:

- *Manufacturing*: How can AI optimize manufacturing processes, improve efficiency, enhance quality control, and enable predictive maintenance? How can AI contribute to the development of smart factories and automation?
- *Health*: How can AI be effectively utilized for disease diagnosis, personalized treatment and improving healthcare outcomes? What are the ethical implications of AI in healthcare?
- *Transport*: How can AI improve transportation systems, enhance traffic management, optimize logistics, and develop autonomous vehicles? How can AI contribute to safer and more sustainable transportation?
- *Energy*: How can AI optimize energy production, distribution, and consumption? How can AI facilitate the integration of renewable energy sources and improve energy efficiency?

Thematic research groups are important for tackling the outlined key research questions because they represent distinct, yet interconnected, domains where AI can have significant impact. Each RG provides a focused expertise through which specific challenges within these sectors can be addressed. AI's potential in healthcare demands specialized expertise to navigate complex medical data and ethical considerations. Optimizing industrial processes requires in-depth knowledge of production systems and automation. Developing sustainable energy solutions necessitates understanding grid management and renewable integration. Creating efficient and safe transport systems requires expertise in logistics, traffic flow, and autonomous technologies.

Key focus of smart manufacturing research group:

Integration of AI into manufacturing processes to enhance and optimize existing manufacturing workflows. Exploring AI for efficiency, productivity and precision improvement. Manufacturing research group will prioritize AI applications to promote sustainability. This involves resource optimization, waste reduction and energy efficiency. The group will work to identify and bridge gaps, such as, technological limitations, commercialization challenges and societal impacts, in research and innovation related to AI in manufacturing. Specific areas of focus:

- *Predictive Maintenance* – the development of advanced AI algorithms to analyze real-time data from sensors, industrial IoT devices, and machine logs in order to anticipate equipment degradation and detect early signs of failure. Techniques such as deep learning, anomaly detection, and time-series forecasting can be used to build models that accurately predict maintenance needs before breakdowns occur.
- *AI-Based Anomaly Detection and Quality Assurance* – the development of AI-based anomaly detection and quality assurance systems to detect irregularities in production processes in real time. This includes improving quality control using advanced computer vision, sensor fusion, and pattern recognition, as well as the development of AI techniques capable of learning from unlabeled or limited data (e.g., unsupervised and semi-supervised learning) to enable more adaptive and scalable quality monitoring.

- AI-Enhanced Collaborative Robotics - research and development of advanced AI algorithms that enable robots to learn, adapt, and operate safely in dynamic environments alongside humans. This includes exploring cutting-edge techniques in computer vision, human intention recognition, and contextual perception to enhance robot awareness, decision-making, and interaction capabilities. The focus is on developing intelligent, responsive robotic systems for flexible manufacturing and human-robot collaboration in complex industrial settings.
- *Self-Learning Process Optimization in Smart Factories* - development of adaptive AI systems that continuously learn from sensor and production data to fine-tune manufacturing parameters in real time. These systems aim to reduce material waste, energy consumption, and cycle times while improving product quality through autonomous decision-making.

Key focus of the health research group:

The Health Research Group will initially focus on topics related to remote health monitoring, personalized care, early detection and prediction of cancer and cardiology. Specific areas of focus:

- *AI-Driven Remote Health Monitoring* – leverages data from wearable sensors, smart home systems, and electronic health records to deliver continuous, real-time insights into a person's health. By applying machine learning to detect early signs of illness, monitor chronic conditions, and analyze behavioral or physiological trends, these systems enable timely, personalized interventions. This approach benefits a wide range of users, from older adults requiring support for independent living to patients managing long-term conditions, and even healthy individuals aiming to prevent disease.
- *AI-Powered Personalized Healthcare and Precision Medicine* – the use of AI to enable data-driven, individualized healthcare by integrating information from electronic health records, genetic profiles, wearable devices, and lifestyle data. AI algorithms analyze this multi-source input to identify risk factors, optimize treatment plans, and predict health outcomes tailored to each patient's unique profile. Core applications include a) early heart failure detection and management using echocardiography; b) supraventricular arrhythmia detection using real-time ECG analysis; c) aortic valve stenosis evaluation via AI-enhanced auscultation and echocardiography; d) retinal disease diagnostics using mobile fundus imaging; e) ischaemic heart disease diagnosis using AI-enhanced cardiovascular CT scan. These approaches align with preventive care strategies, improving outcomes and reducing hospital readmissions.
- *Early Detection and Diagnosis of Cancer* – research integrates explainable AI with multimodal data (imaging, genomics, clinical records, lifestyle factors) to enhance diagnostic accuracy and speed for cancers such as breast, lung, and colorectal. Emphasis is placed on image-based AI diagnostics (mammography, CT, MRI, histopathology) and genomic risk modeling for population screening. Explainable AI results will aid clinicians in verifying and interpreting findings.
- *Health Data Annotation, Interoperability, and Sharing* – standardized methods for annotating, storing, and sharing health data are crucial for interoperability, hindered by varying coding systems. Cross-country collaboration, like the Nordic-Baltic initiative, is key. This promotes international partnerships, accelerates research, and ensures compliance with GDPR and HIPAA while developing open-source datasets.
- *AI in Preventive Cardiology* – AI in preventive cardiology powers longitudinal health data to identify individuals at high risk of developing cardiovascular disease before clinical symptoms arise. By integrating information from wearable devices, electronic health records, lifestyle factors, etc., machine learning models can uncover complex patterns associated with early disease development. The overarching goal is to shift cardiovascular care from reactive

treatment to proactive prevention, reducing the incidence and burden of cardiovascular disease.

Key focus of the transport research group:

The Transport Research Group focuses on enhancing transportation systems using AI-based algorithms and methods. Key areas include sustainable urban planning by analyzing traffic, land use, and environmental data to design efficient, liveable, and eco-friendly cities. Research also involves AI-based optimization of routes, schedules, and operations, improving service quality. Additionally, the group aims to improve traffic monitoring using thermal imaging and image recognition. The development and application of water drones is an emerging area of research as well. Areas of focus and activities:

- *Sustainable Urban Planning* – the application of AI algorithms to analyze urban data (traffic, land, environment) to design efficient, liveable, and eco-friendly cities with optimized transport and EV infrastructure. Moreover, RG is planning to apply thermal imaging techniques for advanced traffic monitoring.
- *AI-Driven Services for Smarter, Inclusive Public Transport* – AI-based optimization of public transport routes, schedules, and operations, improving service and reducing costs. Real-time information, multilingual support, smart ticketing, and dynamic pricing enhance user experience and accessibility.
- *Predictive Maintenance for Transport Infrastructure and Vehicles* – maintenance prediction of transport infrastructure and vehicles by analyzing diverse data, reducing downtime, and improving safety. Real-time monitoring and AI-based tools enable proactive interventions and optimize resource allocation for enhanced reliability and efficiency. Exploring the development and applications of drones operating on and under water
- *Bio-Behavioral Monitoring for Smart and Safe Driving* – Bio-behavioral monitoring uses AI to assess driver alertness, stress levels, and vital signs, supporting proactive safety interventions. Real-time analysis of behavior patterns and biometric signals enables adaptive vehicle responses, reducing the risks of accidents and enhancing user trust. AI-driven insights foster smoother human-machine collaboration in both autonomous and semi-autonomous driving environments.

Key focus of the energy research group:

The Energy Research Group within the Center of Excellence (CoE) aims to harness AI to drive innovation and sustainability in the energy sector, especially targeting the expansion and integration of renewable energy sources and storage technologies on micro and macro grid scales. The group will align with Lithuania's Smart Specialization (S3) priorities, leveraging existing national strengths and addressing current limitations. The creation of the Energy research group will enable specific multi-disciplinary collaborative research projects to be identified and developed. Areas of focus and activities:

- *AI for Renewable Energy Forecasting* – the development of advanced AI models to accurately forecast solar and wind energy generation by leveraging historical data, weather patterns, satellite imagery, and real-time sensor inputs. This includes the adaptation and enhancement of existing machine learning and deep learning techniques, such as spatiotemporal modeling and ensemble learning, to improve prediction accuracy across different timescales and geographic locations.

- *Smart Grid Optimization* – AI-based load forecasting, dynamic demand response systems and improving grid stability. AI learning models for predicting consumption patterns, optimizing energy allocation, and automated real-time response to grid conditions. Integrating decentralized energy sources and storage with the aim of creating more resilient, efficient and adaptive energy systems, considering changing demand and the intermittency of renewable energy.
- *Digital Twins for Sustainable Energy Systems* - development of high-fidelity, AI-powered digital twins for energy assets and infrastructure encompassing generation, distribution. These twins integrate real-time sensor data, physics-based modeling, and ML to simulate, predict, and optimize energy system performance.
- *Energy Storage Management* by using machine learning to optimize battery (for example Li, Na ion, NiMH, flow batteries technologies) and hydrogen energy storage systems (based on water electrolysis and low (PEMC) and high (SOFC) hydrogen fuel cells technologies), degradation predictions performance and storage resources scheduling.
- *Cognitive Energy Efficiency Systems for Built and Industrial Environments* - development of AI-based cognitive control systems capable of real-time energy profiling, occupant-aware consumption optimization, early anomaly detection, and lifecycle-based predictive maintenance in buildings and energy-intensive industrial settings, leveraging IoT and edge-AI for decentralized intelligence.

3.2 Unique capabilities and expertise

The SustAInLivWork research HUB will offer unique capabilities and expertise by integrating AI into four critical sectors: Health, Manufacturing, Energy, and Transport. Each thematic group brings specialized knowledge to address sector-specific challenges, fostering interdisciplinary collaboration. Manufacturing RG will focus on optimizing processes, enhancing sustainability through resource optimization, and developing AI-based predictive maintenance, anomaly detection, robotics, and quality assurance. Energy RG will leverage AI to integrate renewable sources, optimize smart grids, manage energy storage (batteries and hydrogen), and improve energy efficiency in buildings and industry, aligning with Lithuania's Smart Specialization priorities. Health RG will concentrate on AI-based medical image analysis and diagnostics, focusing on cardiology initially and expanding to other clinical domains like ophthalmology and dermatology. This includes developing AI tools for automated disease diagnosis and personalized treatment evaluation. The Transport Research Group excels in AI-based transport solutions, including sustainable urban planning, public transport optimization, and predictive maintenance. Unique expertise lies in applying AI to thermal traffic monitoring and exploring innovative water drone development and driver action analysis. These specialized groups will provide a unique platform for AI innovation and application, driving advancements across diverse sectors.

3.3 Requirements for resources and infrastructure

The robust infrastructure and a range of resources are needed to support the diverse research activities of the SustAInLivWork HUB across health, manufacturing, energy, and transport RG. Computing infrastructure, including high-performance computing (HPC) capabilities for processing large datasets and training complex artificial intelligence models, as outlined in the Common HPC Resource, is essential. Specialized equipment tailored to each thematic area is crucial, such as advanced medical imaging devices for health research, industrial IoT sensors and robotic platforms for manufacturing, smart grid testing facilities for energy, and simulation software for transport modeling. Data Resources are fundamental, requiring access to relevant datasets in each sector, including medical images, manufacturing sensor data, energy consumption records, and transportation data. This includes establishing secure data storage, sharing platforms, and data management frameworks.

The CoE will have common infrastructure needs, including a powerful HPC cluster with GPUs for training complex AI models across all thematic areas (Energy, Transportation, Health, and Manufacturing). A secure and scalable data storage and management infrastructure will store diverse datasets from these sectors, with investments in data anonymization and privacy protection. The CoE will also provide access to leading AI software tools (TensorFlow, PyTorch) and data digitization, annotation, and visualization tools to support researchers across all thematic groups. Access will be provided to all teaming partners and interested parties after signing dedicated agreements. More details about research equipment are available in "SustAInLivWork CoE Infrastructure development" document.

<u>Resources and infrastructure of the smart manufacturing research group</u>:

The Manufacturing Research Group is planning to acquire a range of advanced robotic and vision equipment to enhance its research capabilities. This includes the Youibot AT-IPR-200, an autonomous mobile robot intended for navigation and interaction within manufacturing environments. RG also plans to acquire the UR16e, a collaborative robot arm designed for safe human-robot interaction in shared workspaces. Furthermore, the group intends to integrate these mobile and static robots into mobile manipulators, requiring the necessary components and control systems. A Cambrian Robotics Machine Vision System is planned for implementation, enabling vision-guided robotics applications. To enhance robotic manipulation capabilities, RG aims to acquire the SCHUNK SVH5, an advanced robotic gripper for interacting with various materials. The potential acquisition of the Neura Robotics MAV-1500, allows it to focus on advanced mobile automation within manufacturing settings.

To effectively utilize its planned equipment, the manufacturing research group needs a multi-faceted infrastructure. Dedicated zones for autonomous mobile robots (like the Youibot AT-IPR-200) are crucial, requiring navigable spaces and charging facilities. Workcells designed for collaborative robots (UR16e) must prioritize human-robot safety and include appropriate fixtures. Integrating mobile bases and robot arms into mobile manipulators demands space and control system integration capabilities. Furthermore, implementing the Cambrian Robotics Machine Vision System necessitates controlled lighting and camera mounting setups. Finally, physical workstations allowing the SCHUNK SVH5 gripper to interact with diverse manufacturing materials are essential. The potential addition of the Neura Robotics MAV-1500 AMR underscores the need for environments conducive to autonomous navigation.

Mobile robots, such as Youibot AT-IPR-200, Neura Robotics MAV-1500, collaborative robot UR16e, and specialized gripping mechanism SCHUNK SVH5 will be extensively used for AI-enhanced navigation and interaction within manufacturing environments, autonomous order handling, sorting, and picking in a collaborative manner. Additionally, mobile robots will be equipped with sensors to collect data for AI-based predictive maintenance and anomaly detection research. The Cambrian Robotics Machine Vision System will be used for quality assurance research. AI-based system for robot arms to perform tasks like pick and place, bin picking, and real-time defect detection (quality assurance).

<u>Resources and infrastructure of the health research group:</u>

The Health Research Group (Health HUB) plans to acquire several pieces of specialized equipment, primarily focusing on social robotics and advanced medical diagnostics. The group intends to acquire mobile home care social robots (SomCare Temi) and mobile social care robots (SomCare Misty).

These robots are designed to assist individuals at home by providing reminders, facilitating communication, offering mental stimulation, and monitoring well-being. Furthermore, RG plans to acquire Pepper, a social humanoid robot capable of interacting with people through speech, facial recognition, and touch. Pepper can be programmed for various tasks in healthcare settings. For surgical applications research, the Health RG aims to acquire the KUKA LBR Med lightweight robot, a seven-axis robot certified for medical device integration, intended to assist surgeons in various procedures. In the area of advanced diagnostics, the group plans to acquire the FT-Raman Bruker MultiRam spectrometer for analyzing the molecular composition of biological samples. Additionally, RG intends to acquire the PHILIPS EPIQ CVx, a high-end ultrasound system specifically designed for cardiology with advanced imaging capabilities.

The Health Research Group requires a dedicated research laboratory within CoE, equipped for AI integration. This lab needs space for housing and operating social robots like SomCare Temi, SomCare Misty, and Pepper, facilitating human-robot interaction studies. Furthermore, dedicated areas are needed for advanced diagnostic equipment such as the FT-Raman Bruker MultiRam spectrometer and the PHILIPS EPIQ CVx ultrasound system, ensuring controlled environments for accurate measurements and analysis. The lab should also support the KUKA LBR Med lightweight robot for surgical robotics research, potentially requiring specialized setups and safety measures.

The Health Research Group's equipment acquisitions support its focus on remote health monitoring, early cancer detection, and surgical applications, underpinned by robust data management. Social robots (SomCare Temi, Misty, Pepper) facilitate remote care and personalized support. The PHILIPS EPIQ CVx ultrasound aids in both remote monitoring and cancer diagnostics. The FT-Raman spectrometer contributes to early cancer detection through molecular analysis. The KUKA LBR Med robot enables research in AI-assisted surgery. A dedicated AI-integrated lab supports health data annotation and sharing, crucial for advancing research across all these interconnected areas.

Resources and infrastructure of the transport research group:

The Transport Research Group plans to acquire several types of unmanned aerial vehicles (UAVs) or drones to support its research objectives in transportation. RG intends to acquire the DJI Matrice 300 RTK drone equipped with the Zenmuse H20N camera. This combination offers a robust aerial imaging platform suitable for various tasks due to its weather resistance, long flight time, and advanced positioning system. The group also plans to acquire the DJI Mavic 3 Thermal drone, which features a dual imaging system including a standard photo/video camera and a thermal camera. This capability is valuable for applications like infrastructure inspection and potentially search and rescue operations within the transportation domain. Finally, Transport RG intends to acquire the Leica Geosystems BLK2FLY 3D autonomous drone-mounted laser scanner. This advanced equipment will enable the group to perform detailed 3D scanning of infrastructure and environments relevant to transportation, potentially for digital twin creation and inspection purposes.

The Transport Research Group's equipment acquisition focuses on aerial data collection for various transportation challenges. High-resolution and thermal imaging drones (DJI Matrice 300 RTK & Mavic 3 Thermal) will support sustainable urban planning and advanced traffic monitoring. The Leica BLK2FLY 3D scanner will enable predictive maintenance through detailed infrastructure scanning. While not directly addressed by the drones, driver action monitoring and water drone technology are also key research interests, suggesting potential future equipment needs. Data gathered will provide inputs to AI algorithms for public transport optimization and other applications.

Resources and infrastructure of energy research group:

The Energy Research Group requires several key resources to effectively conduct its work. Firstly, it needs open-source advanced energy simulation platforms for modeling and analyzing energy systems. Secondly, it requires testbeds for real-time AI deployment in smart grid environments, necessitating collaboration with national energy companies (like Ignitis). Finally, the group requires access to real-world datasets from utilities and buildings to validate and refine its AI models.

The Energy Research Group plans to acquire special equipment for advanced energy research. This includes the Opal-RT real-time simulator for testing complex energy systems like power grids and renewable integration. For environmental monitoring, RG will acquire a HOBO RX3000 Remote Weather Station Starter Kit and a Building Performance Monitoring Set with various sensors for temperature, humidity, light, CO2, energy consumption, and occupancy. To facilitate smart grid research, RG plans to acquire WattNode kWh Transducer Sensors, Accurate Z-Wave Smart Energy Meters, and HOBOlink Remote Monitoring Software. For hands-on experimentation and control, the group will acquire Arduino PLC Starter Kits, a Portenta Max Carrier, Arduino Sensor Kits, a Gravity Sensor Set, Arduino Explore IoT Kits, an Arduino Tiny Machine Learning Kit, and an Arduino GIGA Display Shield, providing platforms for developing and testing AI-driven energy management solutions.

The Energy Research Group's equipment and research focus are aligned across five key areas. Renewable energy forecasting utilizes weather stations and utility datasets. Smart grid optimization employs real-time simulators, energy meters, monitoring software, and testbeds with industry partners, alongside Arduino platforms for control algorithm development. Energy storage management leverages simulators and building performance data, with Arduino kits for control strategy testing and access to real-world datasets. Finally, AI-based energy efficiency in buildings and industry relies on comprehensive building monitoring sensors, smaller-scale Arduino development kits, real-world data, and simulation platforms for analysis and strategy testing.

3.4 Collaboration and interdisciplinary research

Collaboration and interdisciplinary research within the SustAInLivWork CoE will be promoted through a multi-directional strategy. The hybrid management structure, combining matrix and project-based approaches, inherently encourages interaction across thematic areas. Researchers, while anchored in their core expertise (Health, Manufacturing, Energy, Transport), will be actively involved in projects that necessitate diverse skill sets. Shared resources, such as the central High-Performance Computing (HPC) cluster and data storage infrastructure, will act as common grounds, facilitating interaction and knowledge exchange. Regular workshops, seminars, and networking events will be organized to bring together experts from different disciplines, promoting dialogue and the identification of synergistic research opportunities.

4. Operational and Organizational Structure

4.1 Management structure of the hub

SustAInLivWork research hub will be structured with a hybrid management approach, combining elements of both matrix and project-based structures. Matrix Structure Elements consist of four functional departments that focus on four general thematic areas. Four distinct thematic areas include health, manufacturing, energy and transport. Each area has its own PI (Principal Investigator) and experts with specialized knowledge (AI, Transport, Health, Energy, Manufacturing). The resources and expertise in departments are grouped by function. The equipment and HPC resources are shared across different thematic areas. This is a common characteristic of matrix structures, where resources are allocated based on project needs rather than being confined to specific departments. Experts in one area may collaborate with and report to PIs in other areas for interdisciplinary projects. Project-based management organizes work around distinct projects with specific goals, timelines, and resources. Teams are formed for each project, disbanding upon completion. This approach prioritizes project delivery, focus, and flexibility, contrasting with traditional functional departments.

A hybrid management structure is joining matrix and project-based approaches. The matrix structure establishes the foundational framework, organizing specialists and assets into thematic areas. This facilitates resource optimization and knowledge dissemination throughout the organization. Within these thematic areas, a project-based approach is implemented for individual research projects, training initiatives, and postdoctoral work. This allows for concentrated effort, clearly defined responsibilities, and on-time project completion. Essentially, the matrix structure provides the "what" and "who," while the project-based structure dictates the "how" and "when." This combination allows for both broad organizational efficiency and focused project execution, adapting to the dynamic needs of the SustAInLivWork research hub.

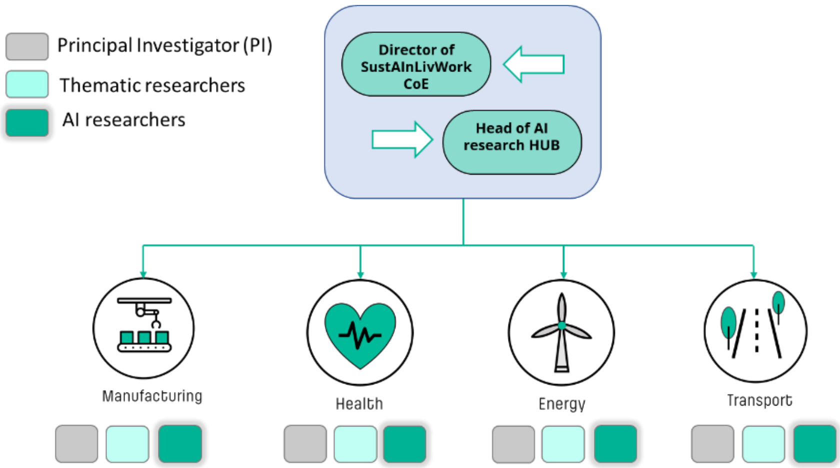

Figure 1. Functional diagram of the hybrid management structure of the research HUB

The hybrid approach allows for significant flexibility for AI experts. Instead of being rigidly assigned to a single department, AI experts can contribute their skills to various projects across different thematic areas (Health, Manufacturing, Energy, Transport). This cross-sharing of expertise promotes innovation and encourages a broader understanding of AI applications within the hub. For example, an AI expert specializing in natural language processing could contribute to a health project by developing a chatbot for mental health support, while also collaborating with the energy team on an AI-powered predictive maintenance system for renewable energy sources. This flexibility not only enriches the research outcomes but also encourages professional growth and a deeper understanding of the diverse applications of AI.

The proposed management structure promotes RG collaboration, ensuring experts aren't confined to their thematic areas. While the matrix structure groups experts by core competencies, the project-based approach allows for flexible team formation. When a project within, for example, the "Health" department requires AI expertise, an AI specialist from the "Manufacturing" or "Energy" departments can be readily integrated. This interdisciplinary collaboration fosters innovation, leveraging diverse perspectives and skills. Experts across all thematic areas can access and utilize shared HPC resources, facilitating collaborative data analysis and computation.

Figure 2 illustrates the hierarchical and collaborative structure of a thematic research group within a hybrid management approach, specifically focusing on the relationship between project-based and matrix elements. The Principal Investigator (PI) oversees the thematic experts (AI, domain-specific), forming the matrix core, ensuring alignment with CoE goals. Project-based elements are introduced via a Project Leader and experts from other departments, integrated for specific projects. Solid lines denote direct management, while dotted lines indicate collaborative project interactions. This setup balances thematic specialization with project flexibility. The PI maintains thematic focus, while project-specific roles facilitate efficient execution. The hybrid approach enables resource optimization, knowledge sharing, and adaptability, leveraging the strengths of both matrix and project-based structures. This ensures both thematic depth and project-driven agility within the research hub.

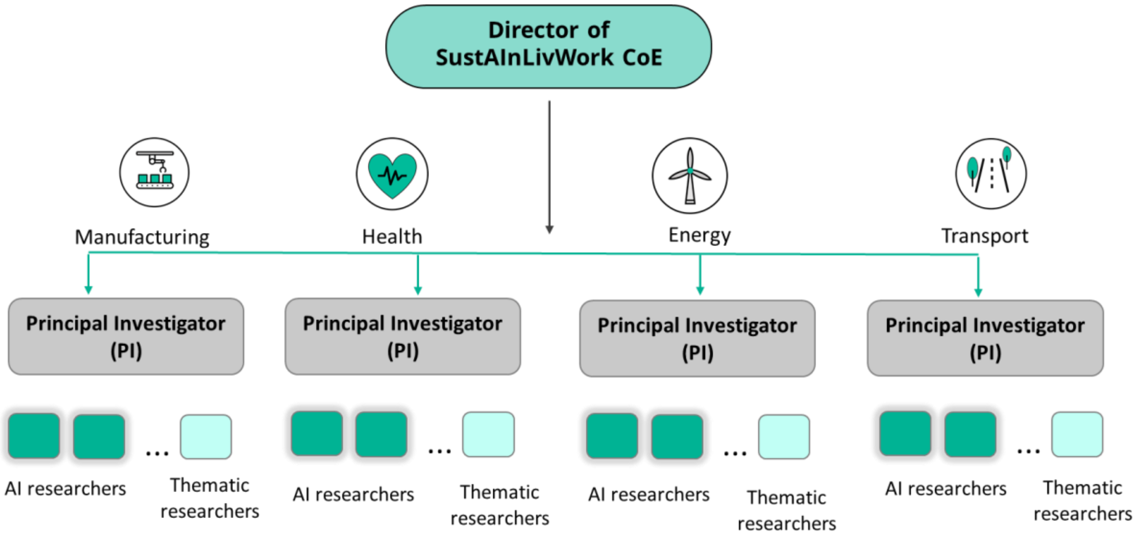

Figure 2. Functional diagram of the management structure of the thematic research group

Decision-making within the SustAInLivWork CoE will be based on a multi-tiered approach. Strategic direction and overall priorities will be set by the CoE Director, potentially in consultation with an Advisory or Supervisory Board, ensuring alignment with project goals and national strategies. Operational decisions related to specific thematic research groups will be led by the respective Principal Investigators, considering the expertise of their teams. Project-level decisions, particularly for interdisciplinary initiatives, will involve collaboration between Project Leaders and relevant experts. Shared resource allocation (e.g., HPC time) will be managed through a central coordination mechanism to ensure equitable access and efficient utilization across the CoE's activities.

4.2 Funding of the research Hub

Initial funding is secured through the ongoing SustAInLivWork Project. However, sustained operation will necessitate attracting additional resources from various sources. The CoE will actively seek competitive research funding opportunities within the European Union and globally, proposing the enhanced scientific capabilities of its Lithuanian partners. Partnerships with industry will be important for commercializing research outcomes and securing private sector investment. Developing a strong brand and reputation as a leading AI excellence center will attract further funding and collaborations. The CoE's service package, adjusted to businesses, industry organizations, and public bodies, will generate revenue. Exploring opportunities for intellectual property generation and licensing can also contribute to financial sustainability.

4.3 Attraction and retention of talented researchers

Recruiting and retaining talented researchers at the CoE will involve a multi-directional approach focusing on attraction, development, and a supportive environment. To attract talent, the Hubs of CoE will promote international collaborations with advanced partners like Tampere University and

Hamburg University of Technology, offering opportunities for joint research projects and knowledge exchange. The competitive research funding secured by the CoE will enable attractive salaries and research resources. The establishment of new PhD programs in AI will cultivate local talent and attract promising early-career researchers. Furthermore, the CoE will actively promote its research achievements and impact to enhance its visibility and appeal to top researchers globally.

Retention strategies will focus on promoting a stimulating and supportive research environment. This includes providing access to cutting-edge infrastructure like the HPC cluster and specialized equipment. Opportunities for professional development through training programs and international collaborations will be offered. Additionally, the CoE's hubs will provide career advancement opportunities and recognize research contributions to ensure the long-term engagement of its talented researchers. The location in Kaunas, Lithuania, while potentially offering a lower cost of living compared to some Western European hubs, will need to be complemented by competitive compensation packages and a vibrant research community.

4.4 Management of intellectual property and knowledge transfer

Intellectual property (IP) generated at the SustAInLivWork CoE will be managed through clear policies outlining ownership, protection, and commercialization strategies, potentially involving legal expertise and technology transfer offices. Knowledge transfer will be facilitated through publications, presentations, workshops, and the development of the CoE's service package for industry and public bodies.

4.5 Hub's performance measures and evaluation

The performance of the Research Groups (RGs) within the SustAInLivWork CoE will be measured and evaluated through a combination of quantitative and qualitative methods. Key Performance Indicators (KPIs) will form a central part of this assessment, focusing on outputs such as the number of publications and their citations, the number of patents filed, the volume of research projects undertaken (including applications prepared for funding), and the extent of collaborations established with industry partners. These metrics provide a quantifiable measure of research productivity and engagement.

Complementing the KPIs will be Peer Reviews, involving regular assessments of research projects and publications by experts in the respective fields. Impact Assessment will focus on the broader societal and economic benefits of the research, tracking the adoption of newly developed technologies, measuring tangible economic benefits for industry partners and Lithuania, and evaluating the environmental impacts of the AI solutions developed. Finally, Feedback Loops will be implemented to gather insights from researchers within the RGs, industry collaborators, and other relevant stakeholders. This qualitative feedback will provide valuable context for understanding the challenges, successes, and areas for improvement within each RG, contributing to a more holistic and adaptive evaluation process.

The list of performance measures and evaluations for the Research Groups (RGs) within the SustAInLivWork CoE:

- *Number of Publications*: The total count of scientific articles, conference papers, and other scholarly outputs produced by the RG;
- *Number of Citations*: The total number of times the RG's publications have been cited by other researchers, indicating the impact and influence of their work;

- *Number of Patents*: The number of patents filed or granted based on the RG's research findings, reflecting the potential for technological innovation and commercialization;
- *Number of Projects*: The total number of active research projects being conducted by the RG;
- *Number of Applications Prepared*: The number of proposals submitted for external research funding (e.g., EU grants, national funding);
- *Number of Industry Collaborations*: The number of formal partnerships or collaborative projects established with industry partners;
- *Adoption of New Technologies*: Tracking the extent to which the RG's research outputs and developed technologies are adopted and utilized by industry or other relevant sectors;
- *Feedback from Researchers*: Gathering input from researchers within the RG regarding their experiences, challenges, and suggestions for improvement.
- *Feedback from Industry Partners*: Collecting feedback from industry collaborators on the relevance, impact, and effectiveness of their partnerships with the RG;
- *Feedback from Other Stakeholders*: Gathering input from other relevant parties, such as policymakers or end-users, on the RG's contributions and impact.

5. Collaboration and Partnerships

5.1 Key stakeholders and potential partners

The key stakeholders and potential partners of the Research Groups (RGs) within the SustAInLivWork CoE encompass a wide range of actors crucial for the hub's success and impact.

Academic and Research Institutions are primary stakeholders, including the CoE's partner universities (KTU, VILNIUS TECH, VMU, LSMU, TAU, TUHH) and other national and international research organizations. These partnerships facilitate knowledge exchange, collaborative projects, and access to diverse expertise and infrastructure. Industry Partners are vital for translating research into practical applications and ensuring real-world impact. These include companies in the manufacturing, energy, health, and transport sectors, ranging from large corporations to SMEs and startups. Government and Public Sector Bodies are key stakeholders, including national ministries (e.g., Economy and Innovation, Health, Energy), regional development agencies, and municipalities. Healthcare Providers (hospitals, clinics) are important partners for the Health RG, enabling access to medical data, clinical expertise, and real-world testing environments. Energy Utilities (e.g., Ignitis) are primary partners for the Energy RG, providing access to real-world grid data and testbeds for AI deployment. Technology Providers (AI software companies, hardware manufacturers) can offer valuable tools, platforms, and expertise to support the RGs' research activities. Finally, the local community and citizens are important stakeholders, as the ultimate beneficiaries of AI solutions for sustainable living and working.

5.2 Knowledge sharing and dissemination

Internally, regular workshops, seminars, and cross-thematic meetings will promote the exchange of research findings, methodologies, and best practices among the different Research Groups. A centralized digital platform or repository will store publications, datasets (where appropriate and ethical), and project updates, ensuring easy access for all CoE members.

Externally, the CoE will actively engage in disseminating its research outputs through publications in high-impact scientific journals and presentations at international conferences. Public outreach activities, such as public lectures, workshops, and online content, will aim to raise awareness and understanding of AI and its applications for sustainable living and working among the wider community in Kaunas, Lithuania, and beyond. Collaborations with industry partners will inherently involve knowledge transfer through joint projects, technology demonstrations, and potential licensing agreements. The development of a service package for businesses and public bodies will also serve as a key mechanism for disseminating expertise and practical AI solutions.

5.3 The broader community engagement

The CoE's hubs will organize public lectures, workshops, and demonstrations showcasing the potential of AI for sustainable living and working. These events will be designed to be accessible and engaging for a diverse audience, including students, local businesses, and the general public. The CoE will also develop online platforms and social media to disseminate information about its research activities, achievements, and the benefits of AI. Collaborations with local media outlets will help to raise public awareness and address any potential misconceptions about AI. Educational initiatives targeting schools and community groups will aim to improve AI literacy and inspire the next generation of AI specialists. Furthermore, the CoE will actively seek feedback from the community on its research directions and the ethical implications of AI, ensuring that its work aligns with societal values and needs in Kaunas and beyond.

6. Risk Assessment and Mitigation

6.1 The potential risks and challenges

The SustAInLivWork CoE research HUB faces challenges in coordinating its research due to a fragmented AI ecosystem and broad strategic priorities. Educational gaps, including low AI literacy and gender imbalances, disturb progress. Innovation is hampered by limited resources, data quality issues, and a lack of central leadership. Regulatory uncertainties, particularly concerning the EU AI Act, create compliance hurdles. Achieving long-term sustainability and translating research into practical applications pose further difficulties, alongside addressing sectoral innovation gaps. The potential risks and challenges associated with the SustAInLivWork CoE's research HUB are:

1. *Collaboration and coordination challenges* that involve a fragmented AI ecosystem, a lack of awareness of strategic AI priorities, the risk of inconsistencies in AI regulations, and multi-disciplinary partnerships;
2. *Educational and talent development challenges* involve low average AI literacy, lack of talents and R&D investments;
3. *Innovation and resource challenges* involve insufficient financial resources, poor-quality private data and insufficient state data resources, and low R&D spending;
4. *Regulatory and ethical challenges* include a shortage of accredited institutions and information, unclear principles for ensuring transparency and bias prevention, and uncertainty regarding practical organizational alignment with AI regulations.
5. *Implementation and impact challenges* include long-term self-sustainability, the gap between research and practical application.

6.2 Mitigation of the risks

The risks and challenges, which are faced by the SustAInLivWork CoE research HUB are mitigated by addressing each area systematically:

1. *Mitigation of risks associated with collaboration and coordination*: Collaboration issues are addressed by establishing a central AI platform, hosting networking events, workshops, seminars and creating an environment with shared resources. A regulatory group will be formed that will monitor AI regulations, develop compliance guidelines, and engage with policymakers. These actions aim to unify the fragmented ecosystem, clarify strategic goals, ensure regulatory alignment, and promote interdisciplinary cooperation.
2. *Mitigation of risks related to education and talent development*: The public education material and awareness campaigns will be created in order to increase AI literacy. The scholarships, partnering with universities and the execution of impactful research projects will cultivate new talents and attract existing ones.
3. *Mitigation of risks associated with innovation and limitation in resources*: Research HUB will diversify funding through EU programs, grants, and other investments, ensuring a sustainable financial model. HUB will prioritize high-impact research to maximize returns. Investments in data infrastructure will be made to create a data sharing platform.
4. *Mitigation of risks associated with regulation and ethics*: The central information and AI certification functions will be created in CoE. The XAI will be promoted, development guide for ethical AI solutions will be created that will help to reach ethical standards. We will offer consulting services and open-source compliance tools that help to align with regulatory formalities.
5. *Mitigation of risks related to implementation and impact*: The CoE is planning to secure varied funding, engage industry to commercialize findings, and establish a solid reputation in order to achieve lasting sustainability. To close the research-to-practice divide, technology transfer offices, pilot projects, and startup incubators are essential. Strong industry ties are important and necessary.

6.3 Adaptation to changing research landscapes and priorities

Adapting to the evolving research landscape requires the SustAInLivWork CoE research HUB to implement dynamic strategies. Firstly, continuous monitoring of global AI trends and regulatory changes, particularly regarding the EU AI Act, is very important. Regular updates and dialogue with policymakers will ensure alignment with current standards. Secondly, the CoE should foster interdisciplinary collaboration through workshops and shared research platforms, promoting knowledge exchange among partners and external stakeholders. Thirdly, a flexible R&I agenda, with periodic reviews every 12 months, will allow for adjustments based on emerging technologies and societal needs. Fourthly, investing in talent development through AI literacy programs and international collaborations will ensure a skilled workforce. Lastly, establishing strong industry connections and technology transfer offices will facilitate the practical application of research, ensuring its relevance and impact on society, economy, and environment.