Interconnected Nord-Est Innovation Ecosystem

Planning of activities

December 2022

i NEST

Introduction

The iNEST activities planning

The Spokes
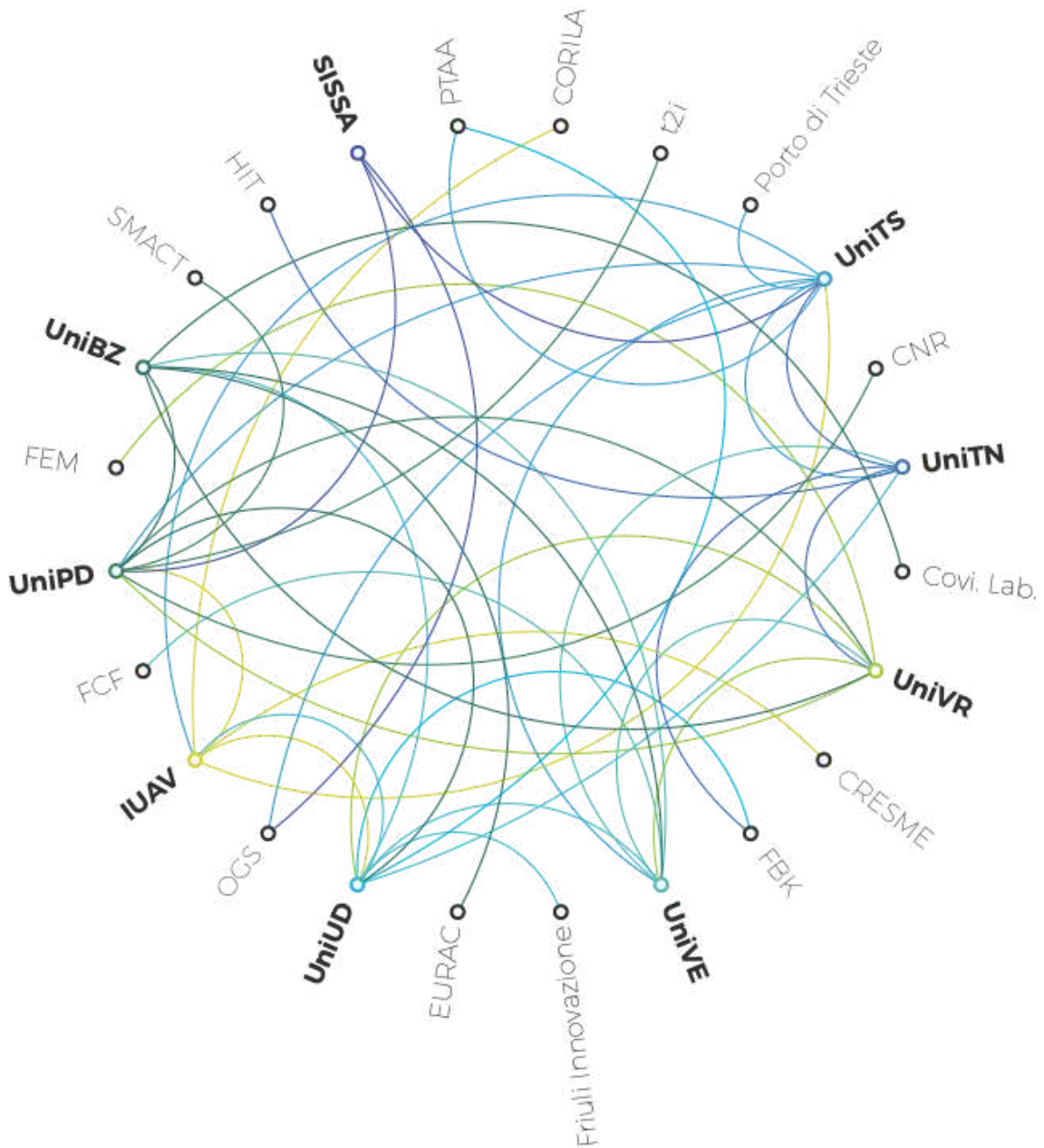
Cross-cutting activities

interactive document

Introduction

Innovation Ecosystems are networks of Universities, Public Research Institutions, Territorial Institutions and Companies. Such Ecosystems are active in technology specialization areas which are coherent with territorial industrial & research missions, and promote and strengthen cooperation among Research, Economic players and Institutions. Ecosystems add value to research outcomes, make easier technology transfer and digital transformation of companies and related processes, taking care of economic and environmental sustainability and of social impacts.

iNEST (Interconnected Nord-Est Innovation Ecosystem), financially supported in the frame of PNRR Program, is aimed at extending the beneficial effects of digitalization to the key specialization areas of "Nord-Est" (Friuli-Venezia Giulia, Veneto and Province Autonome di Trento e Bolzano): industrial and manufacturing, agriculture, marine and mountain environment, architecture and construction, tourism, culture, wellness and food are the fields addressed.
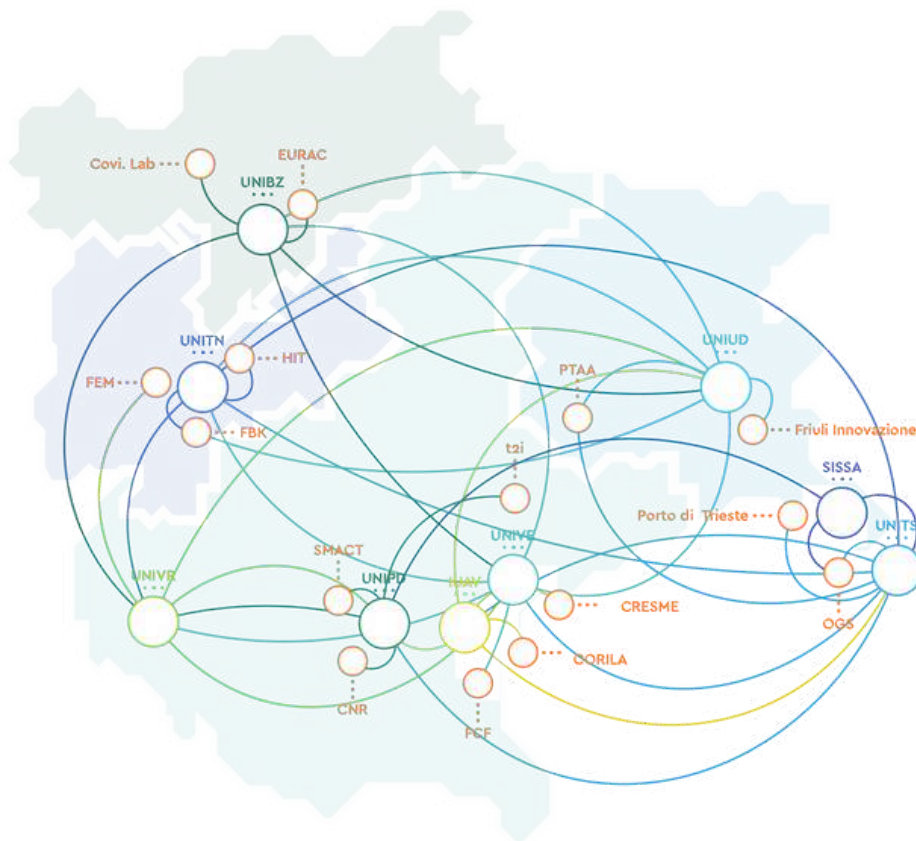
iNEST is focused at developing a common "digital vision", supporting economy and citizens, joining local Smart Specialization Strategies in a unique and shared mission for Nord-Est.

The Research and Innovation Program of iNEST is organized according to a structure consisting of 1 HUB and 9 Spokes, involving all Universities of Nord-Est as well as the main Research and Technology Transfer Organizations active in the territory.

1. ECOSYSTEMS FOR MOUNTAIN INNOVATIONS
2. HEALTH, FOOD AND LIFESTYLES
3. GREEN AND DIGITAL TRANSITION FOR ADVANCED MANUFACTURING TECHNOLOGY
4. CITY, ARCHITECTURE AND SUSTAINABLE DESIGN
5. SMART AND SUSTAINABLE ENVIRONMENTS (MANUFACTURING, WORKING, LIVING)
6. TOURISM, CULTURE AND CREATIVE INDUSTRIES
7. SMART AGRI-FOOD
8. MARITIME, MARINE, AND INLAND WATER TECHNOLOGIES: TOWARDS THE DIGITAL TWIN OF THE UPPER ADRIATIC
9. MODELS, METHODS, COMPUTING TECHNOLOGIES FOR DIGITAL TWIN

Activities of Spokes are supported and enhanced by 4 Cross-Cutting initiatives:

iNEST: Cross-cutting activities

Education, from ITS to Lifelong Learning

Creation of a network of joint strategic labs between universities and companies

Citizen engagement initiatives

Support to the generation and the development of start-ups and spin-offs

The iNEST activities planning

This document reports the detailed planning of future iNEST activities, along the path supported by PNRR Program, from 2022 to end of 2025.

During these three years, an extraordinary effort will be provided by the HUB, the 9 Spokes and the 24 Partners of iNEST,

- *involving more than 400 researchers (about 150 of them belonging to industrial & technology transfer areas),*
- *recruiting about 100 new Researchers and Research technologists,*
- *activating more than 100 Research Grants,*
- *organizing activities in 36 Research Topics (RT) and 4 Cross-Cutting initiatives (see the Table in the next page).*

The iNEST Working Plan will manage a budget of about 110 million euros, financed by PNRR, with more than 40 of them integrated in the Cascade funding mechanism and in the related Open Calls addressed to a full involvement of Companies in the Innovation process.
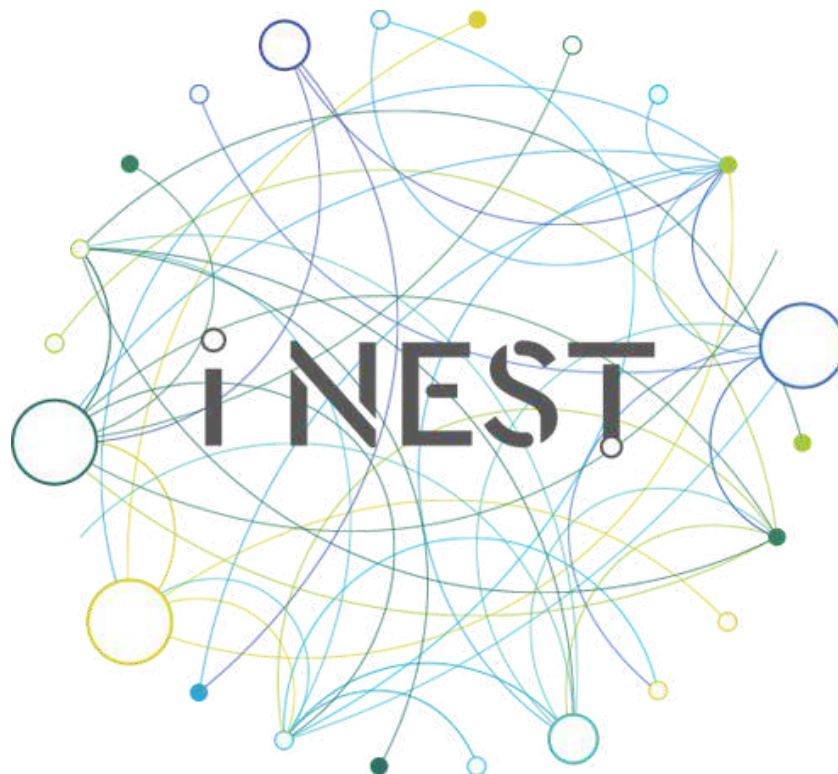
Spoke	RT	Description
1	RT1	Safety and quality of life in mountain Environments
	RT2	Resilience of Mountain production systems and supply chains
	RT3	Decentralization of mountain structures and infrastructures
2	RT1	Digital Health and Systems for the citizens
	RT2	Biotechnologies and Pharmaceutical Technologies
	RT3	Devices for Health
	RT4	Food and Health
3	RT1	Energy
	RT2	Smart Manufacturing, Mechatronics and Robotics
	RT3	Materials
	RT4	Artificial Intelligence and Data Science
	RT5	Organizational, economical and legal aspects
4	RT1	Strategic plan for the development of the construction and sustainable design sectors
	RT2	Technological solutions for the construction and sustainable design sectors
	RT3	Interaction between environments & human beings in the construction & sustainable design sectors
5	RT1	New and Emerging Technologies for Human Centric Manufacturing and other industrial working environments
	RT2	Digital Twin in Industries 5.0
	RT3	People, organization, and processes for Industry 5.0
	RT4	Personalized Assistive Technologies & Smart Environments for Inclusive Living in private & public spaces
6	RT1	New Digital Technologies
	RT2	Data Analytics
	RT3	Sustainable Business Models
	RT4	New Narratives and Communication Strategies
7	RT1	Business models for sustainable agri-food at different levels
	RT2	Process/product innovation for sustainable agri-food
	RT3	Circular economy
	RT4	Logistics, supply chain and vertical coordination
8	RT1	Biology of hydrosphere ecosystems
	RT2	Physical-chemical risks and impacts on the hydrosphere
	RT3	Sustainable waterway mobility
	RT4	Land-sea integrated maritime and spatial Planning
	RT5	North Adriatic Digital Twin
9	RT1	Mathematical, numerical and data-driven modeling
	RT2	Model Order Reduction
	RT3	Automatic learning for Digital Twins
	RT4	Applications of DT in industry, medicine, Environmental sciences, daily life

iNEST

Spoke 1

ECOSYSTEMS
FOR MOUNTAIN
INNOVATIONS

Leader: UNIBZ

Research Topics

RT1
Safety and quality of life in
mountain Environments

RT2
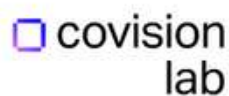Resilience of Mountain production
systems and supply chains

RT3
Decentralization of mountain
structures and infrastructures

Leader

Freie Universität Bozen
Libera Università di Bolzano
Free University of Bozen · Bolzano

Partners

800 ANNI 1222-2022 · Università degli Studi di Padova

UNIVERSITÀ di VERONA

Università Ca' Foscari Venezia

eurac research

covision lab

Spoke1　　　　　　　　　　**RT1**　　　　　　　**Leader: UNIBZ**

**Safety and quality of life
in mountain Environments**

RT Leader: UNIBZ

Participant (acronym): **UNIBZ** EURAC UNIPD UNIVR UNIUD UNIVE Covision L.
Start month: 01　**End month:** 40

Objectives

- *Identifying and implementing solutions for improving social life quality in mountain areas, fostering traditions, local cultural heritages, and communication and interconnection methods within multilingual and multicultural communities.*
- *Identifying and implementing strategies for improving the resilience and the habitat quality in mountain areas, the safety and the healthcare system, focusing on problems and risks deriving from climate change dynamics as well as on those connected to several aspects of health and safety in mountain contexts.*

Implementation strategy

Two sub-RTs are thus identified: RT1A – Mountain social life (Developing solutions for implementing Smart Villages in mountain areas) and RT1B – Mountain habitat (Developing solutions for improving the resilience in mountain areas).

Description of Work

Task S1_RT1A.1 – Prioritization and detailed definition of the research activities related to mountain social life

Task Leader: UNIBZ (Fronza)

Duration: M01 - M04

Analysis of the psycho-socio-economic conditions of small villages in the various Alpine contexts and definition of research and development priorities. Organization of recruitment plans for new research staff. Allocation of staff (both permanent and newly recruited) to the various research priorities.

Task S1_RT1B.1 – Prioritization and detailed definition of the research activities related to mountain habitat

Task Leader: UNIBZ (Righetti)

Duration: M01 - M04

Analysis of the health-socio-environmental conditions in the various Alpine contexts. Classification of risks and definition of the ensuing research and development priorities. Organization of recruitment plans for new research staff. Assignment of personnel (both permanent and newly recruited) to the various research priorities.

Task S1_RT1A.2 – Analysis of the state of the art of Mountain Social Life and definition of innovation strategies

Task Leader: UNIBZ (Fronza)

Duration: M05 - M16

Analysis of the state of the art on aspects related to social life in mountain areas. In particular, the analysis will focus on experiences considered relevant to the social tissue of the Alpine regions and it will involve institutional actors, local communities and possibly also those private actors able to provide support services. Definition of innovation priorities, the implementation of which can then be continued through both the research activities of the Spoke 1 actors and the organization of a first round of cascade funding calls.

Task S1_RT1B.2 – Analysis of the state of the art of the several aspects of Mountain Habitat and definition of innovation strategies

Task Leader: UNIBZ (Righetti)

Duration: M05 - M16

Review of selected experiences for the monitoring, assessment and management of climatic and natural risks, as well as their effects on human health, in mountain context. In particular, the analysis will focus on experiences considered relevant for the social, civil, healthcare and productive contexts of the Alpine regions, and it will involve institutional actors, local communities and possibly also those private actors able to provide support services. Definition of innovation priorities, the implementation of which can then be continued through both the research activities of the Spoke 1 actors and the organization of a first round of cascade funding calls.

Task S1_RT1A.3 – Development of Mountain Social Life innovation strategies and preliminary evaluations

Task Leader: UNIBZ (Fronza)

Duration: M17 - M28

Development of the innovations identified in the previous Task S1_RT1A.2, together with all actions aimed at evaluating and preliminarily testing the proposed intervention strategies. Evaluations will be based on multi-decisor and multi-criteria approaches, since all the social and institutional actors will have to be involved. In parallel, organization of a second round of cascade calls.

Task S1_RT1B.3 – Development of Mountain Habitat innovation strategies and preliminary evaluations

Task Leader: UNIBZ (Righetti)

Duration: M17 - M28

Development of the innovations identified in the previous Task S1_RT1B.2, together with all actions aimed at evaluating and testing the proposed intervention strategies. Evaluations will be performed according to multi-stakeholder and multi-criteria approaches, involving all the social and institutional actors that will have to interact with the monitoring, assessment and management strategies implemented. In parallel, organization of a second round of cascade calls.

Task S1_RT1A.4 – Innovations exploitation for Mountain Social Life strategies
Task Leader: UNIBZ (Fronza)
Duration: M29 - M40
See description of Task S1_RT1B.4 below.

Task S1_RT1B.4 – Innovations exploitation for Mountain Habitat strategies
Task Leader: UNIBZ (Righetti)
Duration: M29 - M40
Assessment of the potential for commercial exploitation of the innovations developed.
Identification, definition and creation of the partnerships needed for the exploitation. Securing the necessary resources. Detailed planning of exploitations activities.

**Resilience of mountain production systems
and supply chains in mountain Environments**

RT Leader: UNIBZ

Participant (acronym): **UNIBZ** EURAC UNIPD UNIVR UNIUD UNIVE Covision L.
Start month: 01 **End month:** 40

Objectives

*Define new innovation strategies to increase the resilience of the mountain production systems and relatedsupply chains. This is achieved by working on the following topics: (a) **Extensive farm and forestry systems**; (b) **Winter and mountain industry**; (c) **Mountain crafts, construction and manufacturing processes and technologies**; (d) **Offshoring and reshoring in mountain areas**.*

Implementation strategy

Despite the variability of the application domains, the research will be articulated as parallel lines of activity within a unique task (S1_RT2).

Description of Work

Task S1_RT2.1 – Prioritization and detailed definition of the research activities related to mountain resilience
Task Leader: UNIBZ (Orzes)
Duration: M01 - M04
Preliminary analysis of the production conditions in different Alpine contexts, with particular reference to the agricultural (limited to grassland based extensive systems), forestry, manufacturing, and craft sectors. Definition of the priorities of the subsequent research and its development.
Activation of recruitment processes for new research staff and allocation of existing and newly recruited staff to the various research activities.

Task S1_RT2.2 – Analysis of the state of the art of possible mountain resilience strategies
Task Leader: UNIBZ (Orzes)
Duration: M05 - M16
State-of-the-art analysis of the production models currently in use in the various mountain sectors.
In particular, the focus will be on defining the technological requirements to make new models of mountainprimary productions competitive, on new methods of forest management, on a rationalization of the mountain industrial and manufacturing industry and craft, on the integration of transversal production chains, also considering the role of psycho-social factors in supporting innovation and its adoption. Definition of innovation priorities, the implementation of which can then be carried out both through the research activities of the Spoke 1 actors and through the organization of a first round of cascade funding calls.

Task S1_RT2.3 – Development of resilience solutions and strategies for mountain production sectors and preliminary evaluations

Task Leader: UNIBZ (Orzes)

Duration: M17 - M28

Promoting the development strategies identified in the previous Task S1_RT2.2, together with all the actions aimed at monitoring, evaluating and testing the proposed interventions. Evaluations will be based on multi-stakeholder and multi-criteria approaches, with in-depth studies of the levels of economic-financial, environmental and psycho-social sustainability. In parallel, organization of a second round of cascade calls.

Task S1_RT2.4 – Innovations exploitation for mountain resilience solutions and strategies

Task Leader: UNIBZ (Orzes)

Duration: M29 - M40

Assessment of the potential for exploitation of the resilience of production strategies developed. Identification, definition and creation of the partnerships needed for the exploitation. Securing the necessary resources. Detailed planning of exploitations activities.
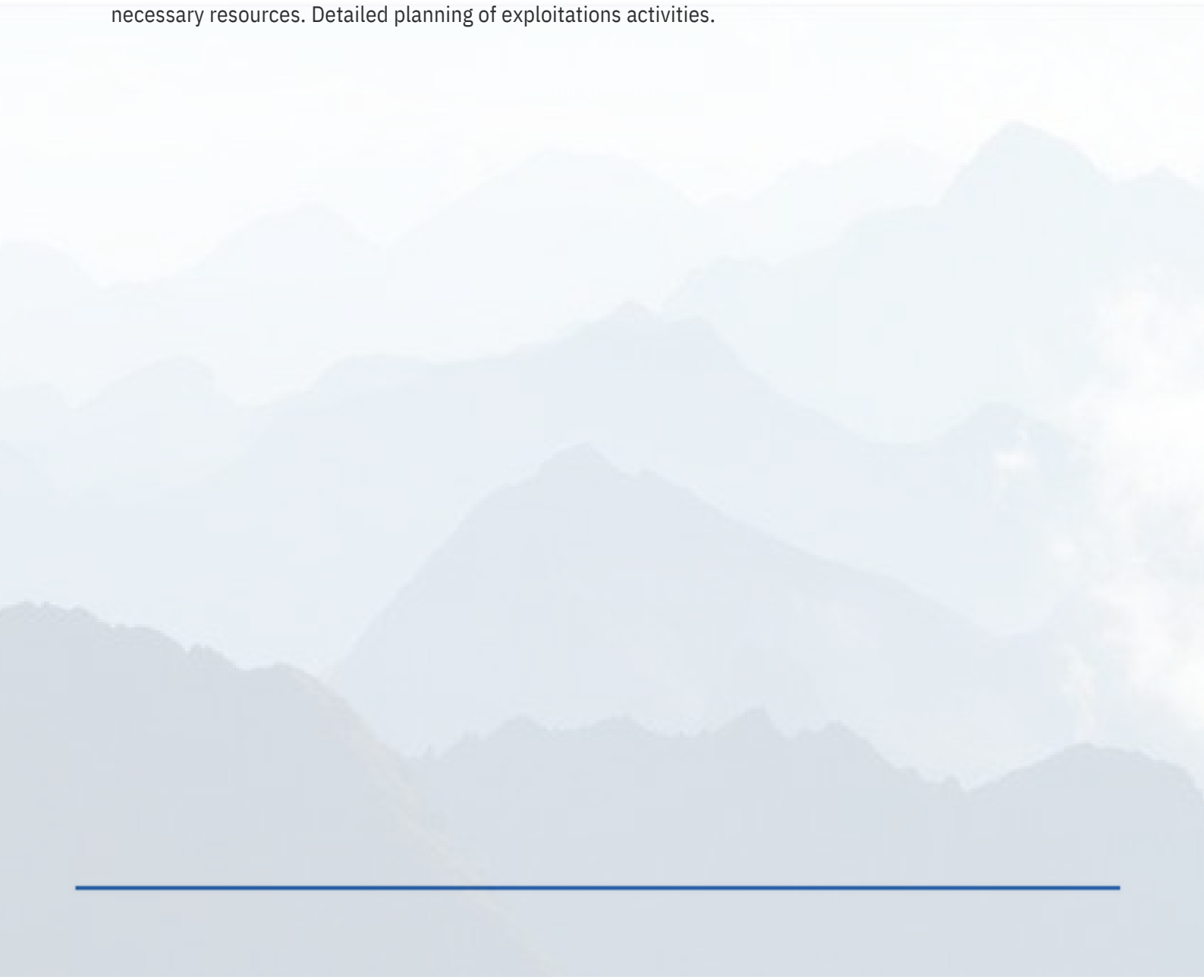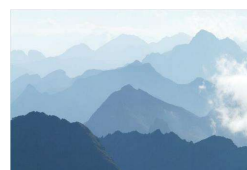
Decentralization of mountain structures and infrastructures

RT Leader: UNIBZ

Participant (acronym): **UNIBZ** EURAC UNIPD UNIVR UNIUD UNIVE Covision L.
Start month: 01   **End month:** 40

Objectives

- *Identifying and implementing solutions for improving sustainable energy strategies in mountain areas, in terms of both energy supply and energy saving solutions through energy system modelling techniques; the former, being mainly addressed on the empowerment of renewable energy sources application; the latter, being mainly focused on an efficient and sustainable use of buildings and facility structures.*
- *Identifying, studying and developing proper strategies for low-carbon mountain transport and logistics systems.*

Implementation strategy

*Two sub-RTs are thus identified: **RT3A – Energy strategies** (Developing solutions for energy supply/distribution mountain networks through the application of energy system modelling approaches and for energy saving; **RT3B – Logistics strategies** (Developing solutions for improved transport and logistics systems through energy system modelling techniques.*

Description of Work

Task S1_RT3A.1 – Prioritization and detailed definition of the research activities related to mountain energy strategies
Task Leader: UNIBZ (Baratieri)
Duration: M01 - M04
Analysis of the energy supply and distribution conditions in typical Alpine contexts, proposing possible classification keys.
Analysis of the existing building stock in the Alpine region, and local and national building performance classification systems. Definition of research and development priorities. Organization of recruitment plans for new research staff. Allocation of staff (both permanent and newly recruited) to the various research priorities.

Task S1_RT3B.1 – Prioritization and detailed definition of the research activities related to mountain logistics strategies
Task Leader: UNIBZ (Mazzetto)
Duration: M01 - M04
Analysis of the present most common transport systems at various scales (<1000 m; 1-5 km; 5-10 km) for goods and people in the various Alpine contexts. Definition of research and development priorities. Organization of recruitment plans for new research staff. Allocation of staff (both permanent and newly recruited) to the various research priorities.

Task S1_RT3A.2 – Analysis of the state of the art of mountain energy structures and definition of innovation strategies

Task Leader: UNIBZ (Baratieri)

Duration: M05 - M16

Analysis of the state of the art on aspects and experiences concerning mountain energy supply/distribution systems and building energy systems. In particular, the analysis will focus on experiences considered relevant to the social and economic tissue of the Alpine regions, with a great focus on the energy needs of the different mountain villages and communities, the different types of local enterprises and typical Alpine building stock; this will be developed involving institutional actors, local communities and enterprises together with any possible private actor able to provide support services. Definition of innovation priorities, the implementation of which can then be continued through both the research activities of the Spoke 1 actors and the organization of a first round of cascade funding calls.

Task S1_RT3B.2 – Analysis of the state of the art of mountain logistics strategies and definition of innovation strategies

Task Leader: UNIBZ (Mazzetto)

Duration: M05 - M16

Analysis of the state of the art on aspects and experiences related to already available mountain logistics facilities. In particular, the analysis will focus on experiences considered relevant for the social, civil and productive contexts of the Alpine regions, always emphasizing the differences between the transport needs for people and goods. Definition of innovation priorities, the implementation of which can then becontinued through both the research activities of the Spoke 1 actors and the organization of a first round of cascade funding calls.

Task S1_RT3A.3 – Development of mountain energy structures and energy-efficient and sustainable communities and preliminary evaluations

Task Leader: UNIBZ (Baratieri)

Duration: M17 - M28

Development of the innovations identified in the previous Task S1_RT3A.2 and related to energy production, its distribution and efficient use in high performance buildings. Evaluations will be based on multi-decisor and multi-criteria approaches, with in-depth studies on the levels of economic-financial, energy, environmental, social and economic-financial sustainability. In parallel, organization of a second round of cascade calls.

Task S1_RT3B.3 – Development of new mountain logistics strategies and preliminary evaluations
Task Leader: UNIBZ (Mazzetto)
Duration: M17 - M28
Development of the innovations identified in the previous Task S1_RT3B.2, together with all actions aimed at evaluating and testing the proposed intervention strategies and decarbonization measures on low-carbon transport systems. Evaluations will be performed according to multi-stakeholder and/or multi-criteria approaches, involving all the social and institutional actors that will have to interact with the monitoring and management strategies implemented. In parallel, organization of a second round of cascade calls.

Task S1_RT3A.4 – Innovations exploitation for mountain energy strategies
Task Leader: UNIBZ (Baratieri)
Duration: M29 - M40
See description of task S1_RT3B.4 below.

Task S1_RT3B.4 – Innovations exploitation for mountain logistics strategies
Task Leader: UNIBZ (Mazzetto)
Duration: M29 - M40
Assessment of the potential for commercial exploitation of the innovations developed. Identification, definition and creation of the partnerships needed for the exploitation. Securing the necessary resources. Detailed planning of exploitations activities.

Spoke 2

HEALTH, FOOD
AND LIFESTYLES
Leader: UNITN

Research Topics

RT1
Digital Health and Systems for the citizens

RT2
Biotechnologies and Pharmaceutical Technologies

RT3
Devices for Health

RT4
Food and Health

Leader

Partners

Spoke2

RT1

Leader: UNITN

**Digital Health and Systems
for the citizens**

RT Leader: UNITN (Riccardi)

Participant (acronym): **UNITN** UNIVR FBK

Start month: 01 **End month:** 40

Objectives

- *OBJ1.1 Devices, data and experimental design*

Experimental design and clinical data acquisition of multifrequency RF-data and ultrasound data, and data labeling.

Acquisition and assessment of digital biomarkers for remote patient monitoring also using wearable technologies.

Development and testing of personalized active lifestyle for elderly people based on physical activity programs.

- *OBJ1.2 Design, Development, and Deployment of AI-enabled Solutions*

Definition of models, infrastructures, and tools to evaluate patients' fragilities and recommend assisted living tools.

Design of trustworthy strategies compliant with EU guidelines to be deployed within the digital health context.

Development and clinical validation of AI-based solutions for computer-aided lung ultrasound data analysis.

Development and evaluation of a protocol for the acquisition of interactive documents for narrative medicine.

- *OBJ1.3 Innovation for Healthcare*

Evaluation of sustainability, efficiency, and effectiveness (HTA) of a model of care in primary care with digital interventions.

Identification of needs and improvement of digital skills.

Evaluation of an innovative model of care.

Description of Work

Task S2_RT1.1 – Devices, data and experimental design

Task Leader: UNITN (Demi)

Duration: M01 - M40

Ultrasound Data: specific acquisition protocols and scoring systems will be developed for the collection and analysis of clinical ultrasound data (3 datasets obtained with multi-frequency RF data and conventional clinical ultrasound scanners in different settings).

Digital Biomarkers: extracted from individual physiological signals in clinical scenarios, to support healthcare professionals for a timely diagnostic evaluation of subjects at risk or to speed up the calibration of drug therapy.

Wearable technology for health: development and testing of personalized exercise training programs for elderly with cognitive and physical frailties.

Task S2_RT1.2 – Design, Development, and Deployment of AI-enabled Solutions

Task Leader: FBK (Dragoni)

Duration: M01 - M40

Sensing AI for Assessment and Rehabilitation: innovative technologies to allow medical doctors and therapists to collect extensive data on the patient in a safe and controlled environment, as a basis for defining patients' needs and design appropriate homecare solutions.

Trustworthy AI Solutions: trustworthy by-design solutions and AI solutions to support customized and reusable digital therapies within the various case studies and active collaborations that will be carried out within this work package.

AI for Narrative Medicine: narrative medicine holds the promise of providing a full description of the patients' state (emotions) and history (life events) to complement the analysis of lab tests and provide a breakthrough in the analysis of cause-effect relations in prevention, diagnosis, therapy calibration or outcomes.

AI for Ultrasound Diagnostics: development and clinical validation of AI-based solutions aimed at automating the analysis of clinical ultrasound data.

Task S2_RT1.3 – Innovation for Healthcare

Task Leader: UNIVR (Leardini)

Duration: M01 - M40

Need analysis and development of models for innovative care: identify the most effective organizational models and digital interventions in primary care, the services currently available, and the areas for improvement.

Development of the innovative model of care with digital interventions: services, digital interventions, and training programs for digital skills identified in the need analysis will be developed and piloted. The feasibility of the model and digital interventions developed will be evaluated with mixed-method studies.

Evaluation of the innovative model of care with digital interventions: quasi-experimental study to compare the experimental model of care with the new digital interventions to an available model of care in general practice.

**Biotechnologies and
Pharmaceutical Technologies**

RT Leader: UNITN (Biasini)

Participant (acronym):   **UNITN**   UNITS
Start month: 01   **End month:** 40

Objectives

- ***OBJ2.1. Diagnostics and precision medicine***

To develop new diagnostic tools for cancer and neurodegenerative disorders.

- ***OBJ2.2. Gene therapy***

To implement current methodologies of genome manipulation and nucleic acid delivery to define an innovative pipeline of gene therapy.

- ***OBJ2.3. Implementation of drug screening and drug delivery technologies***

To develop novel drug screening and drug delivery technologies to fight cancer.

Description of Work

Task S2_RT2.1 – Diagnostics and precision medicine
Task Leader: UNITN (Basso)
Duration: M01 – M40
This task will leverage on the competence developed at the UNITN in analyzing the qualitative and quantitative features of extracellular vehicles (EVs) as means for early diagnosis both in cancer and neurodegenerative diseases. UNITS will leverage its competence in nanoscale analysis of bile pigments in human biofluids (blood, serum, urine, CSF).

Task S2_RT2.2 – Gene therapy
Task Leader: UNITN (Cereseto)
Duration: M01 – M40
This task will generate a biotechnology pipeline for the development of novel therapeutic strategies based on nucleic acids (DNA or RNA) delivery.

Task S2_RT2.3 – Implementation of drug screening and drug delivery technologies

Task Leader: UNITN (Inga)

Duration: M01 – M40

This task will include 3 activities:

- exploit forward and reverse chemogenomics approaches through the development of new disease-relevant in vitro models and the implementation of high-throughput and high-content molecular and cellular screenings;
- build new AI-based in silico methods to study drug-target interactions and predict pharmacological behaviors;
- assess viability, cell growth and differentiation, especially to screen drug-induced liver disease (DILI) in vitro.
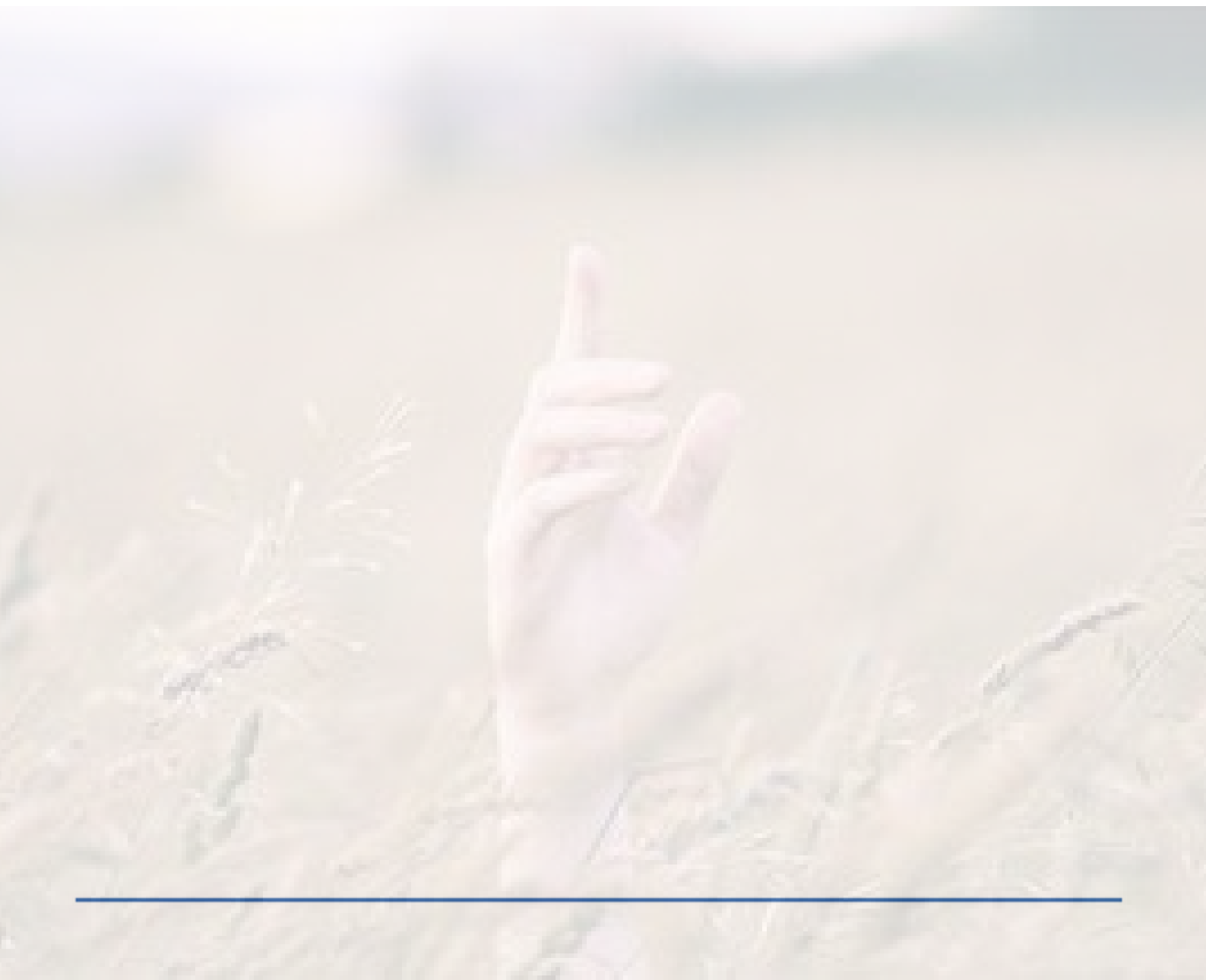
Devices for Health

RT Leader: UNITN (Nollo)

Participant (acronym):   **UNITN**   UNITS   UNIVR
Start month: 01   **End month:** 40

Objectives

- **OBJ3.1** *Citizens and workers health risk reduction and health protection, to contribute to a healthy lifestyle in safety from airborne infectious agents and pollutants.*
- **OBJ3.2** *Refinement and/or development of emerging technologies for the manufacturing of precision materials and tool for testing of metabolic and therapeutic targets*
- **OBJ3.3** *Development of technology and clinical feasibility assessment of image-guided proton radiosurgery as a new ablation treatment for life-threatening arrhythmias*
- **OBJ3.4** *Development of innovative Assistive Robotics tools able to interact with the end users taking into account their physical and cognitive (i.e., stress) status while engaging in a gamified framework through Augmented Reality and Gamification tools evaluating different real-life situations.*

Description of Work

Task S2_RT3.1 – Improve safety and health for citizens
Task Leader: UNITS (Barbieri)
Duration: M01 - M40
The task is aimed at improving safety of ambient and persons by: optimized and experimentally tested highly effective air filtration devices and antimicrobial materials in different ventilation levels; development of mathematical tool for risk prediction of infection in indoor spaces model; developing and implementing soft technologies for healthy life improvement in active life situations.

Task S2_RT3.2 – 3D Manufacturing for testing of metabolic and therapeutic targets
Task Leader: UNITN (Motta)
Duration: M01 - M40
To achieve the objective of this task, the first activity will focus on the definition of a small library of precisionmaterials, formulated using food and medical grade polymers (silk fibroin, alginate, hyaluronic acid, human elastin-like polypeptides, and their modifications) and additives. Based on precision materials properties (e.g., viscosity, stability) and their manufacturing, a selection of few will be used and optimized for the manufacturing of precision inks/scaffolds for tailored therapeutic modalities (treatment of skin conditions, bone regeneration).

Parallel to this activity, prototypes of lab-on-chip devices will be used for testing of metabolic and therapeutic targets; prototypes will be optimized to match testing requirements in food and medicine applications. Biomimicry is used to create customized biocompatible biomaterials with finely tuned properties and advanced functionality, such as Elastin-Like Polypeptides (ELPs) and Human ELPs (HELPs), retaining peculiar biophysical, biochemical, biological and properties of elastin, with huge potential as substrates for cell growth. Outputs of these tasks will be designed and validated to obtain technologies for the precise screening of metabolic and therapeutic targets.

Task S2_RT3.3 – Image-guided proton radiosurgery for life-threatening arrhythmias
Task Leader: UNITN (Ravelli)
Duration: M01 - M40
This task aims at translating high-precision radiation therapy from the oncology to the cardiovascular field to treat ventricular arrhythmias. This will include: development of pre-planning technologies for an accurate diagnosis, based on the identification of the critical regions of the heart that sustain the arrhythmias (data processing); development of 2D/3D cardiac tissue models for in-vitro planning of proton beam treatment and implementation of radiobiological studies; definition of the patient-specific target area by 3D multimodal imaging integration; in-silico planning of beam delivery.

Task S2_RT3.4 – Collaborative Robots for Restoring Human Walking
Task Leader: UNITN (De Cecco)
Duration: M01 - M40
This task will focus on techniques and technologies to develop a collaborative robot able to enhance/restore human walking capability. The robotic system will be equipped with shared autonomy capabilities and increased human-robot interface based on automatic estimation of patient's feedback and interactive mixed reality.
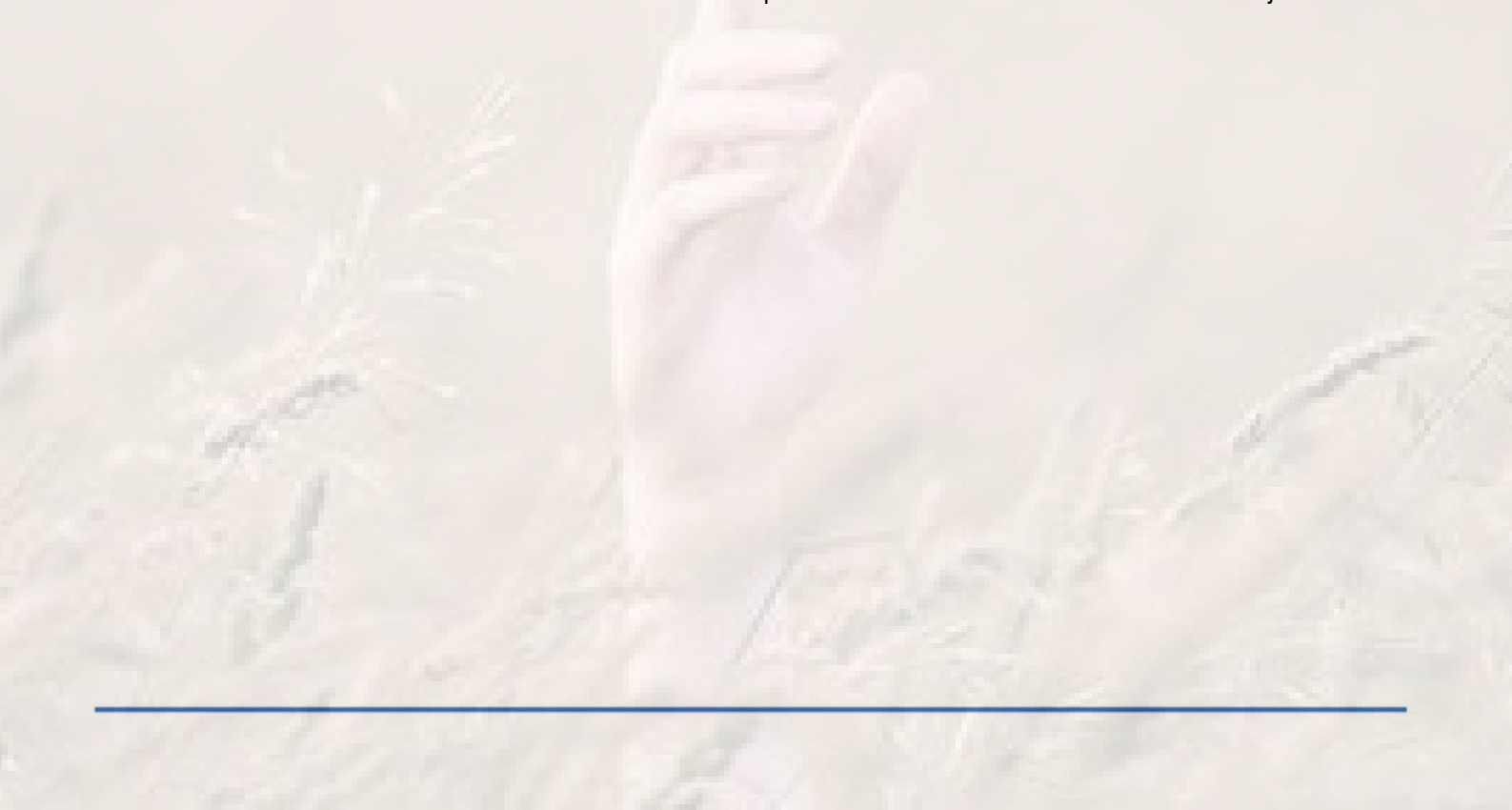
Food for Health

RT Leader: UNITN (Perazzolli)

Participant (acronym): **UNITN** UNITS UNIVR
Start month: 01   **End month:** 40

Objectives

- ***OBJ4.1*** *To characterize the human microbiome under different nutritional strategies.*
- ***OBJ4.2*** *To investigate the metabolomic profiles of nutritional biomarkers from microbiota and host metabolism interaction.*
- ***OBJ4.3*** *To elucidate the association of human microbiota sensory-related profiles with individual dietary patterns.*
- ***OBJ4.4*** *To understand the effects of healthy nutritional strategies on human biomarkers and to develop nanocarriers and nutraceuticals.*
- ***OBJ4.5*** *To characterize the nutrigenomic of healthy food models and to develop healthy nutritional strategies.*

Description of Work

Task S2_RT4.1 – Metagenomic characterization of human gut and oral microbiome under healthy nutritional strategies

Task Leader: UNITN (Gasperi)

Duration: M01 - M40

This task will include 2 activities:

– Metagenomic characterization of human microbiome under healthy nutritional strategies, involving cohorts of healthy volunteers with available cardiometabolic markers and accurate dietary information, and adopting a standardized experimental and computational framework for the generation of microbiome data.

– Linking human microbiota sensory-related profiles to food choices and healthy dietary styles, by means of an experimental activity carried out within a study on healthy young volunteers focusing on the efficacy of a free trial food intervention with bioactive-enriched snacks increasing the adherence to the Mediterranean diet.

Task S2_RT4.2 – Metabolomic characterization of human biofluids in biochemical and clinical studies under different nutritional strategies

Task Leader: UNITS (Passamonti)

Duration: M01 - M40

This task will include 2 activities:

– Metabolomic investigation of the nutritional biomarkers from microbiota and host metabolism interaction: will investigate the role of the microbiome in shaping the profile of host metabolic biomarkers of nutritional status, and vice versa, by exploiting cohorts of healthy volunteers with available dietary data, blood metabolic markers and gut metagenome data.

– Effects of healthy nutritional strategies on human biomarkers: will be based on a cross- sectional analysis aiming at identifying subgroups of pediatric subjects with obesity exposed to cardiovascular risk who can be targeted in the cascade calls phase for clinical trials of personalized nutrition using nanocarriers.

Task S2_RT4.3 – Characterization of nutraceuticals, nanocarriers, personalized nutrition and therapeutic interventions

Task Leader: UNIVR (Maffeis)

Duration: M01 - M40

This task will include 2 activities:

– Development of nanocarriers and nutraceuticals, where different nutraceutical plant extracts will be considered as sources of bioactive molecules to be encapsulated, based on their biological activity, environmental and economical sustainability, and ease of manipulation.

– Nutrigenomic characterization of healthy food models and development of healthy nutritional strategies, based on a sample of children and adolescents with obesity, and including a detailed phenotypic characterization, a dietary assessment, and study of biomarkers of oxidative stress and cardiovascular risk.

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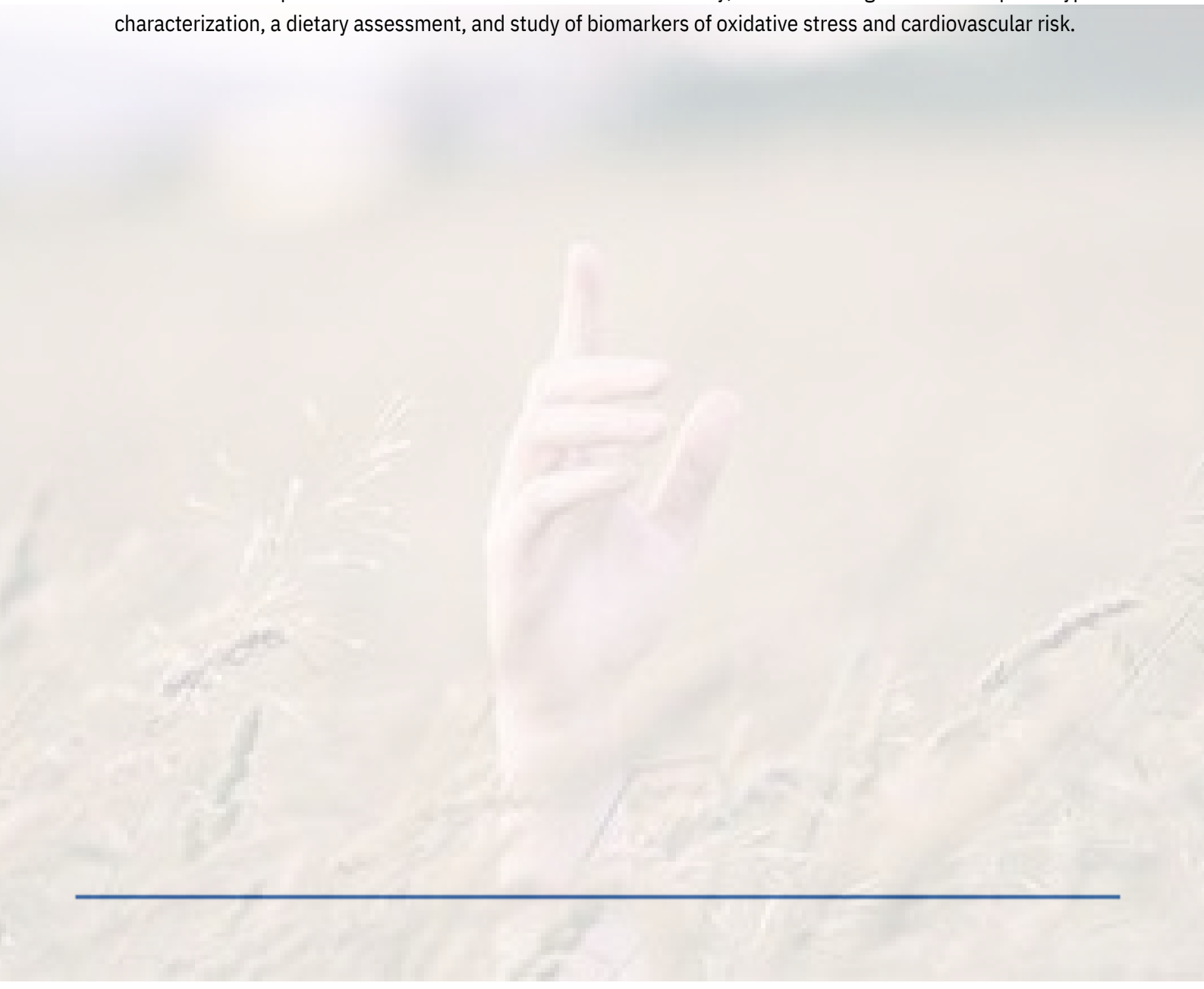
Spoke 3
GREEN AND DIGITAL
TRANSITION FOR
ADVANCED MANUFACTURING
TECHNOLOGY
Leader: UNIUD

Research Topics

RT1
Energy

RT2
Smart Manufacturing, Mechatronics and Robotics

RT3
Materials

RT4
Artificial Intelligence and Data Science

RT5
Organizational, economical and legal aspects

Leader

UNIVERSITÀ
DEGLI STUDI
DI UDINE
hic sunt futura

Partners

FREIE UNIVERSITÄT BOZEN
LIBERA UNIVERSITÀ DI BOLZANO
FREE UNIVERSITY OF BOZEN - BOLZANO

UNIVERSITÀ
DI TRENTO

Università
Ca'Foscari
Venezia

Università Iuav di Venezia

Autorità di Sistema Portuale
del Mare Adriatico Orientale
Porti di Trieste e Monfalcone

FONDAZIONE
BRUNO KESSLER
FUTURE BUILT
ON KNOWLEDGE

RT Leader: UNIUD (Trovarelli)

Participant (acronym):   **UNIUD**   UNITN   UNIBZ   UNIVE
Start month: 01   **End month:** 40

Objectives

– *Energy conversion equipment for biomass, industrial and urban waste energy recovery, and CO2 in chemicals and in green energy (hydrogen, methane) for a circular economy.*
– *Energy efficiency, storage, transport, and distribution, decarbonization and industrial symbiosis in energy-intensive sectors, efficiency in water-energy nexus.*
– *Energy and environmental monitoring of industrial manufacturing processes.*
– *Sustainable energy supply chains, multi-energy systems, and smart-energy grids.*
– *Renewable energy penetration and energy efficient management of operations and logistics*.

Description of Work

Task S3_RT1.1 – Waste conversion for a circular economy

Task Leader: UNIVE (Signoretto)

Duration: M01 - M40

The aim of the task is to investigate possible routes for valorization of CO2 and biomasses through integrated thermal, photothermal, photocatalytic and thermocatalytic methods following a circular economy approach and paying attention to integration of technologies.

Task S3_RT1.2 – Integration of renewable energy sources, alternative fuel/vector production and energy efficient management in industrial and logistic systems

Task Leader: UNIUD (Meneghetti)

Duration: M01 - M40

The overarching aim of the task is supporting an efficient integration of renewable/alternative energy sources within industrial and logistic facilities and systems. Energy recovery and storage, symbiotic exchanges and demand side management will be investigated to enhance the exploitation of local resources, while increasing the flexibility of the energy service and reducing the impact of pollutant emissions in production, material handling and distribution.

**MISSIONE 4
ISTRUZIONE
RICERCA**

Task S3_RT1.3 – Smart sensors, data-driven models and sustainable strategies for improved energy management and power quality in smart grids and smart industrial energy communities
Task Leader: UNIBZ (Renzi)
Duration: M05 - M40
The task aims at identifying and overcoming the main challenges to increase the share of renewable energies in the industrial environment and to solve the related power quality issues deriving from the extensive electrification of the plant processes. Novel approaches for the optimal real-time energy management of the future industrial energy communities will be developed, also relying on big data analysis tools based on data collected from smart interconnected sensors.
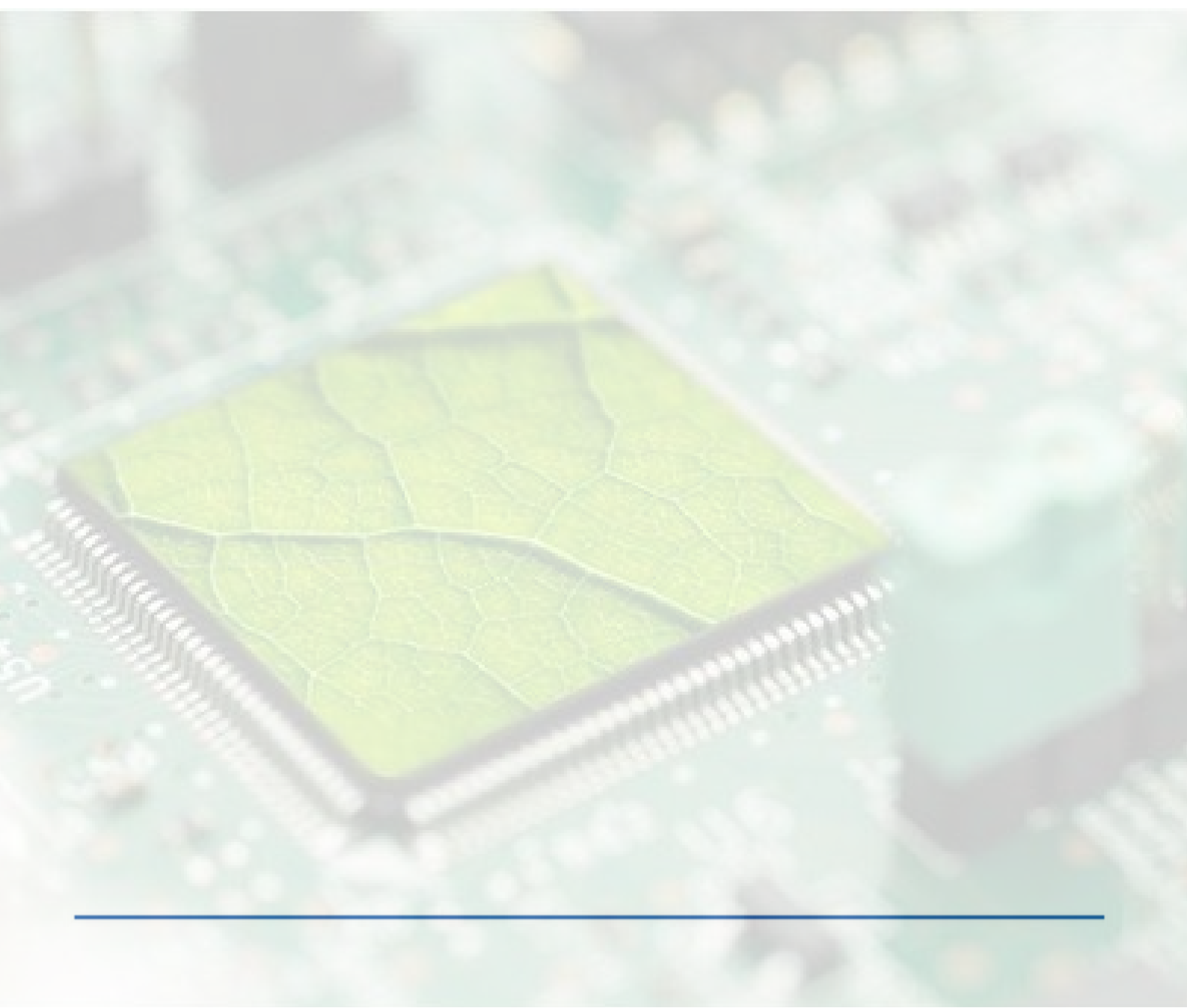
Smart Manufacturing, Mechatronics and Robotics

RT Leader: UNIUD (Sortino)

Participant (acronym): **UNIUD** FINN UNIBZ UNITN UNIVE FBK

Start month: 01 **End month:** 40

Objectives

– *Industrial sensors systems, real-time monitoring, and advanced automation of machine tools.*

– *Development of sensorized equipment, tools, and tool holders.*

– *Architectures for advanced IoT and edge computing.*

– *Analysis of the dynamics of production systems.*

– *Simulation of production processes and digital manufacturing.*

– *Additive manufacturing of plastics and metals (with a focus on the production of prosthesis).*

– *Dynamic modeling and trajectory planning for mechatronic and robotic systems.*

– *AI-driven robots (continuous and transfer learning, neuromorphic robots).*

– *Specification and validation of functional and security requirements of robotic software.*

Description of Work

Task S3_RT2.1 – Industrial sensors systems, real-time monitoring, advanced automation of machine tools, development of sensorized equipment, tools, and tool holders and architectures for advanced IoT and edge computing

Task Leader: UNIUD (Sortino)

Duration: M01 - M40

Methodologies for real-time monitoring, advanced automation of machine tools, sensorized industrial equipment, tiny machine learning, online learning and supervised and semi-supervised AI techniques will be under investigation. The activities will include the development of industrial cases and demonstration applications.

Task S3_RT2.2 – Analysis and simulation of production systems and processes and digital manufacturing

Task Leader: UNIBZ (Rauch)

Duration: M01 - M40

Drivers, enablers and barriers for digital twins in manufacturing, new digital manufacturing techniques and production process simulation will be under investigation. The activities will include the development of industrial cases and demonstration applications.

Task S3_RT2.3 – Additive manufacturing of plastics and metals

Task Leader: FINN (Valan)

Duration: M01 - M40

Additive Manufacturing (AM) of plastics and metals, investigating materials, technologies and applications will be under investigation. The activities will include the development of industrial cases and demonstration applications.

Task S3_RT2.4 – Dynamic modeling and trajectory planning for mechatronic and robotic systems, AI-driven robots (continuous and transfer learning, neuromorphic robots), specification and validation of functional and security requirements of robotic software

Task Leader: UNIVE (Ferrara)

Duration: M01 - M40

Dynamic modeling and trajectory planning for mechatronics and robotic systems, AI-driven robots and security requirements of robotic software will be under investigation. The activities will include the development of industrial cases and demonstration applications.
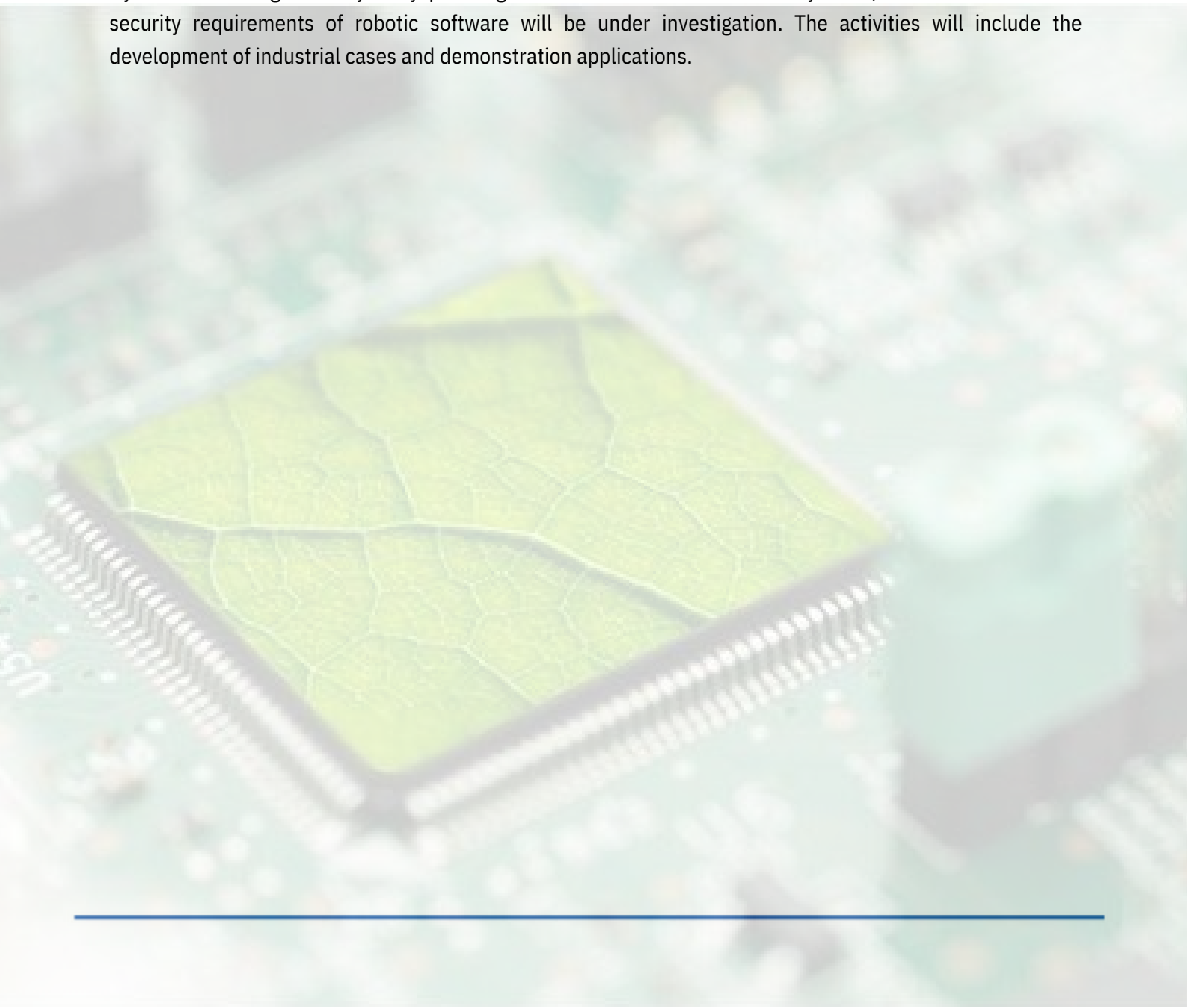
Materials

RT Leader: UNIUD (Fedrizzi)

Participant (acronym):   **UNIUD**   FINN   UNIBZ   UNITN   IUAV
Start month: 01   **End month:** 40

Objectives

– Analysis of secondary raw materials for environmental sustainability and circularity.
– Operational protocols for wood production and processing.
– Analysis of hybrid or traditional materials for hydrogen storage.
– New materials (metal, polymer and ceramic) for additive manufacturing.
– New metallurgical environmentally-friendly products.

Description of Work

Task S3_RT3.1 – Analysis of secondary raw materials for environmental sustainability and circularity
Task Leader: UNITN (Zanella)
Duration: M01 - M40
Availability of secondary raw materials and existing good practices on a global scale will be analyzed. Processability and durability studies will be carried out. The LCA tool will be used to assess circularity and sustainability impact of the new secondary raw material including materials from green sources.

Task S3_RT3.2 – Operational protocols for wood production and processing
Task Leader**:** UNIUD (Riavis)
Duration: M01 - M40
State of the art on operational protocols of wood production and processing will be analyzed. New technologies of wood production, treatment, assembly and finishing depending on the use and integration with other materials will be considered. New techniques for the recovery, reuse and recycling of wood material, to encourage sustainability and avoid waste will be applied.

Task S3_RT3.3 – Analysis of hybrid or traditional materials for hydrogen storage
Task Leader: UNIUD (Fedrizzi)
Duration**:** M01 - M40
Degradation mechanisms related to the contact of hydrogen with the container materials will be analyzed. Suitable materials to withstand the types of degradation established will be studied.
Possible recyclability of innovative materials will be assessed. The study and development of coatings, including nano-structured ones, that can mitigate degradation is envisaged.

Task S3_RT3.4 – New materials (metal, polymer and ceramic) for additive manufacturing

Task Leader**:** UNIUD (Fedrizzi)

Duration: M01 - M40

State of art on materials used in manufacturing processes including polymer, biopolymers as well as metals will be analyzed and new metals and polymers for additive manufacturing will be considered. Small protypes will be developed by additive manufacturing for biomedical and industrial applications.

Task S3_RT3.5 – New metallurgical environmentally-friendly products

Task Leader**:** UNIUD (Fedrizzi), UNIBZ (van Bezooijen)

Duration: M12 - M40

Two main strategies will be adopted:

1. Analysis on biocompatible metals for transient electronic devices (such as Zn, Mg, Mn, etc.) and evaluation of possible deposition of thin-films on natural substrates using PVD technologies.

2. New metallurgical processes will be designed with the collaboration of industrial partners and new products will be realized and characterized to evaluate existence of proper functional properties.
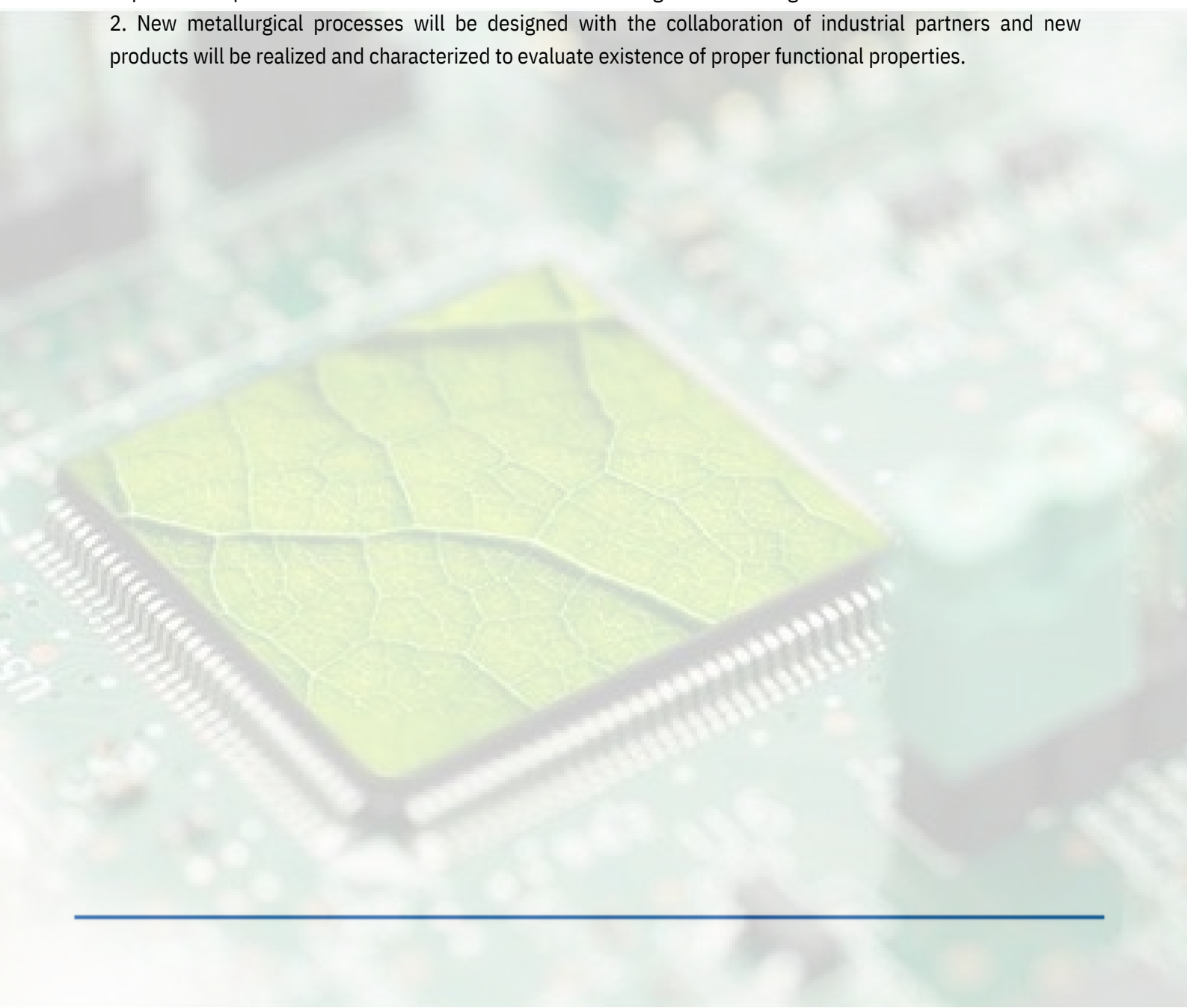
**Artificial Intelligence
and Data Science**

RT Leader: UNIUD (Montanari)

Participant (acronym): **UNIUD** UNIBZ UNITN UNIVE FBK IUAV
Start month: 01   **End month:** 40

Objectives

– *Automated planning and scheduling for production and distribution.*
– *Real-time data analytics and automatic quality control for industrial processes.*
– *Continuous learning of industrial processes.*
– *Efficiency and interpretability of learning models in industry.*
– *Deep learning for object counting and intruder recognition.*
– *Integration of runtime verification and machine learning.*
– *Interaction, visual and digital storytelling for design, service and sharing.*

Description of Work

Task S3_RT4.1 – Automated planning and scheduling

Task Leader: FBK (Micheli)

Duration: M01 - M40

This task will develop automated planning and scheduling technologies tailored to the north-east industrial needs. Automated planning and scheduling are needed to organize the activities in the factories as well as to optimize the use of resources for realizing a certain product. We will investigate approaches based on SMT and gray-box formulations as well as tailor the techniques to properly support human-robot collaboration.

Task S3_RT4.2 – Data Quality and Basic Data Analytics

Task Leader: UNIBZ (Gamper)

Duration: M01 - M16

The usage and analysis of data is key to a more green and sustainable production in manufacturing.

A particular problem in industrial environments is often data quality, which heavily impacts advanced downstream analysis tasks. In this context, the activities of research task S3_RT4.2 focus on data quality issues and basic analytics with the aim to transform raw data into high quality data, which is amenable for advanced analysis tasks such as ML, prediction and interpretation (cf. Task S3_RT4.3).

Task S3_RT4.3 – Machine Learning, Prediction, Interpretation

Task Leader: UNIUD (Foresti)

Duration: M17 - M40

Machine/deep learning techniques allow companies to both quickly create and deploy product models and improve their production processes, thereby reducing the time to bring new products or services to the market. The task will design and develop machine/deep learning techniques with continuous learning capabilities for real-time predictive maintenance and visual inspection applied to the company's production cycle. Example applications will include real-time data analytics, data prediction and interpretation in industrial processes for object counting, anomaly identification, predictive maintenance and intruder detection in complex networks as well as action, plan and intention recognition in human-robot collaboration. Experimental evaluation and test of the developed approaches will be carried on business cases proposed by manufacturing companies that will cooperate with the project.

Task S3_RT4.4 – Integration of runtime verification (monitoring, diagnosis, ..) and machine learning

Task Leader: UNIUD (Montanari)

Duration: M01 - M40

The goal of the task is to design, develop, implement, and experimentally evaluate a framework that pairs lightweight runtime verification techniques with machine/deep learning methods, in order to automatically derive relevant properties related to bad behaviors of the considered system that can be used to early detect anomalies and to predict future failures.

Task S3_RT4.5 – Interaction, visual and digital storytelling for design, service and sharing

Task Leader: IUAV (Fagnoni)

Duration: M01 - M40

The task investigates the issues of interaction processes, visual and digital storytelling with regard to companies and users. Project aims are of two-fold interrelated nature:

1) reconstruct a multi-faceted narrative of the experience of collective and organized labor in the contexts of industrial production;

2) conceive and experiment with the role of data science in shaping novel transitional processes and rethinking forms of AI-based user experiences.

**Organizational, economical
and legal aspects**

RT Leader: UNIUD (Chiarvesio)

Participant (acronym): **UNIUD** UNIVE FINN PTAA IUAV
Start month: 01   **End month:** 40

Objectives

– *Business model innovation, organizational transformation, and performance implications related to advanced manufacturing.*
– *Resources and capabilities enabling green and digital transition.*
– *Digital transition and sustainability: assessment of company needs.*
– *Legal aspects of advanced logistics and sustainable transport systems.*
– *Impact of advanced manufacturing on jobs composition and development of resilient and sustainable value chains.*
– *Definition of a roadmap of possible development actions for digital transition towards customization and on-demand production.*
– *Valorization of territorial and enterprise system capital: technological platform, market experience, managerial expertise, historical and corporate culture, implicit knowledge, and other intellectual capital.*

Description of Work

Task S3_RT5.1 – Literature review, best practice and methods

Task Leader: UNIUD (Chiarvesio)

Duration: M01 - M16

The first part of the project is aimed at identifying the existing knowledge and practices related to the different subjects objective of the RT5 (state of the art, methodologies, case studies and best practices), such as strategic, organizational and performance implications of Industry 4.0, business model innovation, new international production organization due to digital transformation, legal implications of advanced logistics, implications for territories and local communities.

Task S3_RT5.2 – Data collection

Task Leader: UNIVE (Corò)

Duration: M17 - M28

The second task of the project is focused on the collection of data and experiences related to green and digital transition processes of companies. Hence qualitative and quantitative data (surveys, interviews, workshops) will be collected and analyzed based on the methodologies previously depicted and involving stakeholders that operate within the local and regional socio-economic system. An Active Learning Lab involving students and researchers from the University network and a selected pool of SMEs will also be organized.

MISSIONE 4
ISTRUZIONE
RICERCA

Task S3_RT5.3 – Systematizing results, disseminations
Task Leader: FINN (Di Benedetto)
Duration: M29 - M40
The last part of the project is particularly oriented to the: a) systematization of the results (review of results, methodologies, reports, set up of implementation guidelines and discussion on piloting strategies) of the research and sharing with the other RT groups involved in the project; and b) dissemination of results and experiences among the scientific community as well as public and private stakeholders.
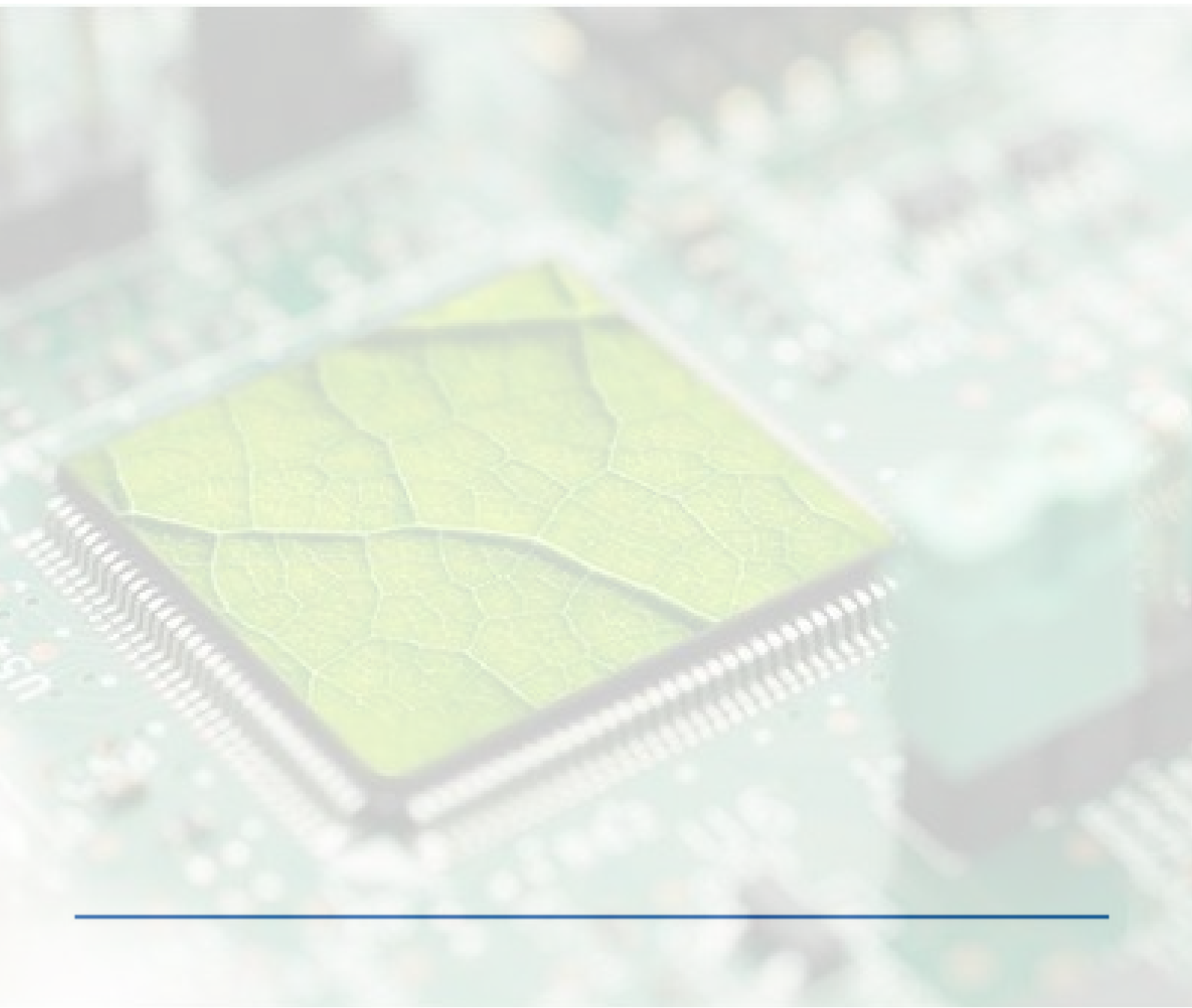
Spoke 4

CITY, ARCHITECTURE AND SUSTAINABLE DESIGN

Leader: IUAV

Research Topics

RT1
Strategic plan for the development of the construction and sustainable design sectors

RT2
Technological solutions for the construction and sustainable design ectors

RT3
Interaction between environments and human beings in the construction and sustainable design sectors

Leader

Università Iuav di Venezia

Partners

Strategic plan for the development
of the construction and sustainable design sectors

RT Leader: IUAV (Fabian)

Participant (acronym): **IUAV** UNIPD UNITS UNIUD CRESME CORILA
Start month: 01   **End month:** 40

Objectives

RT1 anticipates and supports the paths of applied research and technology transfer. RT1 will develop an analysis of the built environment to define the main sustainability goals to be applied to the next building phase in Italy. The disciplinary tools activated will be the scenario and the strategic plan.

Through a scenario process, RT1 will determine the main expected criticalities. The research will have common applied design case studies.

Description of Work

Task S4_RT1.1 – Environmental, energy and mobility problems

Task Leader: UNITS (Marchigiani)

Duration: M01 - M16

Survey of the main expected vulnerabilities on the green, blue and mobility networks and the role of buildings. The task will make it possible to develop conceptual insights into the ecological and sustainable transition of local systems in the North-East and in Venice case on the basis of principles of redundancy and self-subsistence, determining the current limits of a transition so oriented.

Task S4_RT1.2 – Critical issues in the building sector

Task Leader: CRESME (Bellicini)

Duration: M01 - M16

The task will research the main criticalities of the North-East construction sector (supply chains and supply structure, organizational models, productivity, technological diffusion) identifying the nodes to be addressed on a building scale for the definition of the hypothesized transition model.

Task S4_RT1.3 – Identification of innovative technologies and operating methodologies

Task Leader: UNIUD (Sdegno)

Duration: M05 - M16

The objective is the identification of technologies and methodologies capable of fostering the evolution of the construction sector towards the solution of the critical issues identified. The task will operate by outlining supply chains and paths of reproducibility of these technologies and methodologies for each of the four networks recognized as key to the transition. Details of the models developed in the case study.

Task S4_RT1.4 – Scenarios

Task Leader: IUAV (Fabian)

Duration: M04 - M28

Recognition on demand and settlement problems in the Northeast region and in Venice case study. Data collection on constraints to the development of urban and architectural sustainable projects. Clustering of the main urban and territorial criticalities at different levels. Data collection on constraints to the development of urban and architectural sustainable projects in the case study. Clustering of the main urban and territorial criticalities in the case study.

Task S4_RT1.5 – Construction of the strategic plan

Task Leader: IUAV (Fabian)

Duration: M29 - M40

The strategic plan must guide the transfer of innovations and methodologies to the sector's supply chains. It has to provide a proposal of data collected in RT1. It will gather the outcomes and products of RT2 and RT3 and dialogue with the terminal phase of these two. The output will be a strategic master plan design for the development of sustainable projects in the North-East and particularly in the case study.
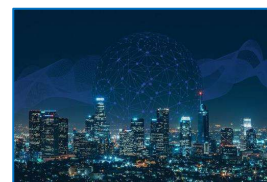
**Technological solutions for the construction
and sustainable design sectors**

RT Leader: IUAV (Fabian)

Participant (acronym): **IUAV** UNIPD UNITS UNIUD CRESME CORILA
Start month: 05   **End month:** 40

Objectives

RT2 is dedicated to the operative applied research and related technology transfer activities. It consists of 6 actions, each dedicated to one of the 5 core business themes of the spoke, plus one dedicated to the pilot. The development of the five tasks will make it possible to detail the transition plan for the construction sector in the specific complexities and needs of the North-East area and in the case of Venice.

Description of Work

Task S4_RT2.1 – New materials

Task Leader: UNIUD (Sdegno)

Duration: M17 - M28

The first issue to be developed concerns transition materials, both in buildings as well as in networks and nodes. Building and furnishing materials will have to meet sustainability and replicability criteria, based on the principles of the circular economy and green building, and be designed for user well-being.

Task S4_RT2.2 – Smart networks: energy, mobility, water, green

Task Leader: UNITS (Marchigiani)

Duration: M17 - 28

The task will work on the recognition of integrated smart city management systems to ensure sustainable mobility, accessibility, monitoring of energy consumption, and redundancy of utility sources.

Task S4_RT2.3 – Heritage, recovery, conservation

Task Leader: CORILA (Campostrini)

Duration: M17 - M28

It is necessary to determine the role of buildings, thresholds and the relationships between them in order to help overcome an inaccessible, high-impact building and mobility system. The task will delve into this question in order to define solutions and processes for overcoming conflicts of livability in the urban fabric of the case studies.

Task S4_RT2.4 – Living, usability, accessibility

Task Leader: UNIPD (Gamberini)

Duration: M29 - M40

The role of buildings in the transition of urban systems in the North-East is central to transition processes (supply chains and structure of the offer, organizational models, productivity, technological diffusion). The different types of fabric and consolidation of anthropic spaces must be investigated in the identification of the most appropriate conservation and replacement processes.

Task S4_RT2.5 – Increasing the resilience of territories and cities

Task Leader: IUAV (Fabian)

Duration: M29 - M40

The task will work on the standardization of post-event restoring and repair models, to overcome a concept of the event as a crash that immobilizes the system, towards a conception of the event as a part of the continuous evolution of the system. The task will take models of resilience in reconstruction, rather than defense robustness, to propose restorable or evolvable solutions dealing with the impact.

Task S4_RT2.6 – Pilot project

Task Leader: IUAV (Fabian)

Duration: M05 - M40

The pilot project task serves as a pivot between the whole project and its testing. It is the only task in the project that lasts three years. In the first year, the task will be responsible for recognizing the target territories for testing. In the second and third year, the task will maintain a dialogue between the winners of the cascade calls and the research teams involved in the active tasks. The second year will be dedicated to testing the objects, During the third year, the task will test the interactions.
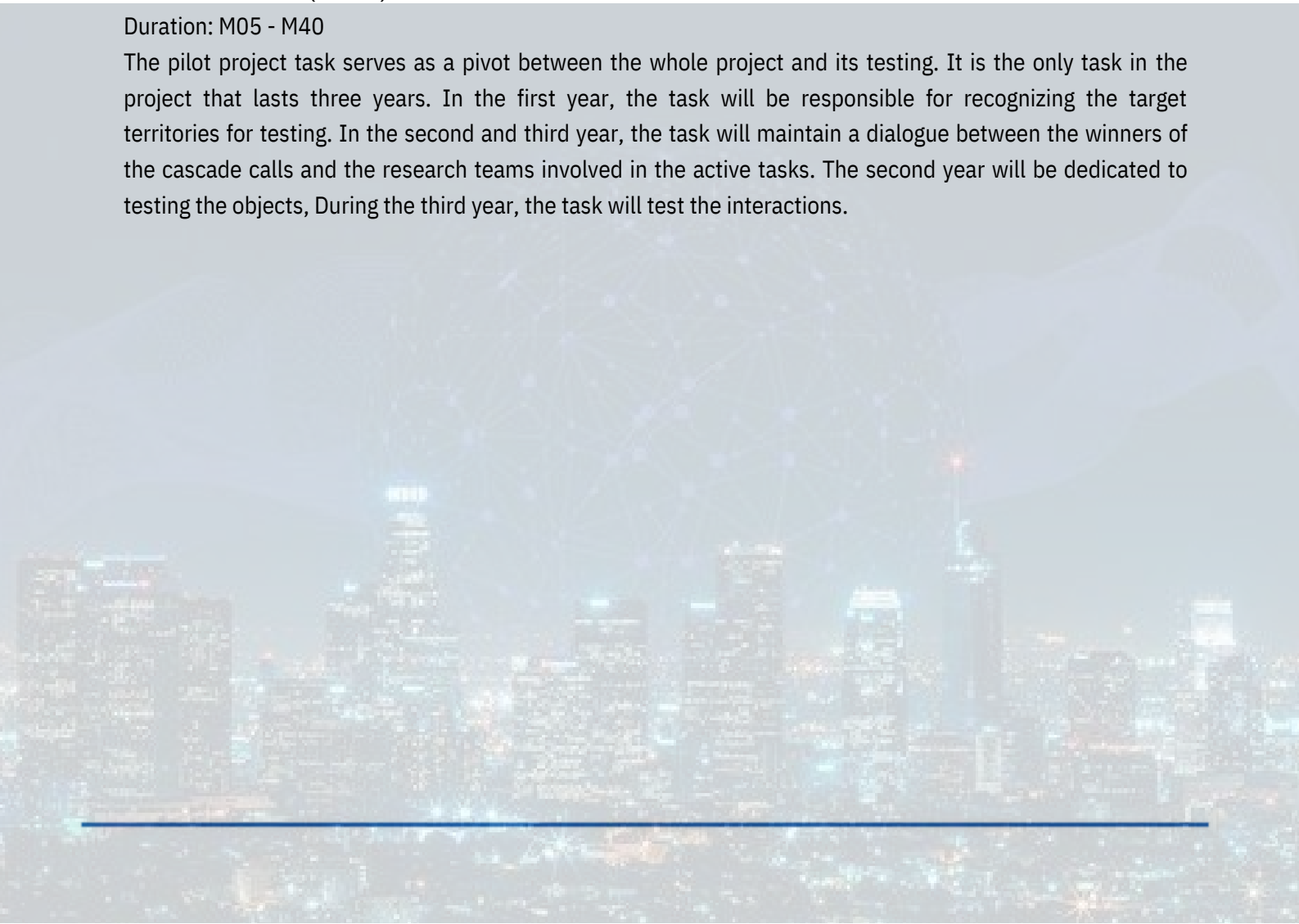
Interaction between environments and human beings in the construction and sustainable design sectors

RT Leader: IUAV (Fabian)

Participant (acronym) IUAV UNIPD UNITS UNIUD CRESME CORILA
Start month 17 **End month** 40

Objectives

RT3 is an interdisciplinary research and knowledge transfer activity dedicated to social innovation supporting the resilience enhancement. The RT focuses on the interaction between natural/built/virtual environments and the way in which humans think and act and how places shape us as individuals and communities. RT3 also aims to invest its scientific outcome in informing the design and development of new socially inclusive, sustainable, accessible spaces and interior design products. The RT consists of two annuities. The first year will be devoted to the objects to be innovated, at all scales of the project. The second year will be devoted to the interactions to be innovated, at all project scales.

Description of Work

Task S4_RT3.1 – The interaction between individuals and their environment
Task Leader: UNIPD (Pazzaglia)
Duration: M17 - M28
The first aspect of habitability considered by the RT is the interaction between individuals and environments. The task is aimed at highlighting the design forms most capable of fostering inclusive and interpretable interactions by individuals. The support of the knowledge of environmental psychology will make it possible to precisely identify the most advantageous solutions from the point of view of the individual, in order to challenge them with the actors selected by the cascading calls.

Task S4_RT3.2 – The role of the environment in mediating human behavior and emotions
Task Leader: UNIPD (Pazzaglia)
Duration: M17 - M28
The environment is not only the setting in which relationships take place, but it can have significant effects in promoting inclusive or exclusive behavior, and in fostering well-being or states of dissatisfaction. The task is to problematize current research in RT2 in search of settings and indicators to move towards environments that are conducive to well-being and inclusiveness.

Task S4_RT3.3 – The social use of space

Task Leader: UNIUD (Sdegno)

Duration: M29 - M40

The design of space is always, consciously or unconsciously, a design of interactions in space. A transition of anthropic spaces towards adaptation and complexity is a project aimed at making space for interpretation. The task will investigate advisable models of interaction in space to foster processes of sustainability and design for all tailored for the North-East and detailed for the City of Venice.

Task S4_RT3.4 – Solutions to improve the well-being and quality of life of fragile groups

Task Leader: UNITS (Marchigiani)

Duration: M29 - M40

Starting from a census of the most exposed fragile categories in relation to the urban fabric of the North-East, the task will produce a system of proposals for reducing the exposure of fragile people through a redesign of the built environment.

Spoke 5
SMART AND SUSTAINABLE ENVIRONMENTS (MANUFACTURING, WORKING, LIVING)

Leader: UNIPD

Research Topics

RT1

New and Emerging Technologies for Human Centric Manufacturing and other industrial working environments

RT2

Digital Twin in Industries 5.0

RT3

People, organization, and processes for Industry 5.0

RT4

Personalized Assistive Technologies and Smart Environments for Inclusive Living in private and public spaces

Leader

Partners

Spoke5   **RT1**   **Leader: UNIPD**

New and Emerging Technologies for Human Centric Manufacturing and other industrial working environments

RT Leader: UNIPD

Participant (acronym): CNR   SMACT   **UNIPD**
Start month: 01   **End month:** 40

Objectives

The Spoke's shared goal is the development of innovative, smart, sustainable, digitally-driven working and living environments within a human-centric design framework. The global scenario in which the Spoke moves its steps is the transition from the so-called 4.0 revolution to the new 5.0 paradigm. Its socio-technical vision considers sustainability, quality of life, inclusion and psychological well-being as indispensable outcomes.

A main focus of the research in RT1 will be the transition from 4.0 to 5.0 scenario in manufacturing.

Topic to be addressed include advanced tools for 5.0 manufacturing, interpretable machine learning for innovative decision support systems, methods and tools for predictive manufacturing, smart and innovative production systems and materials, intelligent and sustainable automation and mechatronics, control of Human-in-the-Loop systems, human-robot interaction, ergonomics, adaptive and personalized workplaces and working tools, hybridization (physical-digital) and remotization of work environments.

Description of Work

Task S5_RT1.1 – Technologies for the 5.0: State of the Art

Task Leader: UNIPD (Susto)

Duration: M01 - M04

The aim of task S5_RT1.1 will be that of providing a thorough yet compact overview of the state of the art of 5.0 technologies and methodologies as related to the very broad spectrum of research areas characterizing RT1, that span from AI-based tools for manufacturing to innovative materials. Special focus will be given to highlighting the most significative and challenging aspects that have to be dealt with to enable the 4.0 to 5.0 transition in advanced manufacturing.

Task S5_RT1.2 – Designing methods and tools for resilient, sustainable and human-centric industries

Task Leader: UNIPD (Susto)

Duration: M05 - M16

Research activities carried out in Task S5_RT1.2 will be focused on the design of methods and tools for 5.0 industries. With respect to 4.0 technologies, the most relevant shift concerns the human-centric approach, but sustainability and resilience are considered as well, although in a new light that brings in quality of life and well-being.

Activities will then be performed to design technologies and methods fitting the new paradigm in a systematic multidisciplinary approach, comprising full exploitation of new classes of engineering materials for industrial applications, development and application of Artificial Intelligence tools for process and equipment design, optimization and control, the integration of smart sensors and actuators for intelligent monitoring and control of the different production steps. Specific focus will be given to the study and realization of collaborative mechatronic and robotic systems achieving new ergonomic standards by considering human factors by design, to drive the transition towards human-centric and sustainable assembly and production workspaces. Finally, activities will be performed to sync the research outputs with the issuing of the first Open Call, to select industrial partners supporting the development and implementation of selected solutions.

Task S5_RT1.3 – Implementing and prototyping human-centric solutions for 5.0 tools, machines, and production systems
Task Leader: UNIPD (Susto)
Duration: M17 - M28
The output of Task S5_RT1.2 will be used to select the most promising methodologies and solutions to be further developed and brought to a prototypal stage, also leveraging the contribution of industrial partners selected via the Open Calls. It is clearly expected that further methodological research will be needed to improve the solutions and tools on the basis of the outcomes of the implementation and prototyping activities.

Task S5_RT1.4 – Technical Validation and Human Factors evaluations of iNEST 5.0 solutions
Task Leader: UNIPD (Susto)
Duration: M29 - M40
Task S5_RT1.4 will be dedicated to the validation and evaluation of the methods and solutions developed in the Tasks S5_RT1.1-3. Emphasis will be given on analyzing the results in a human factors perspective. For those solutions that have reached an implementation/prototyping stage, the analysis will be done on the basis of experimental results, simulations and other forms of lab/virtual testing studies will instead be used to validate promising technologies and solutions that have not been selected for implementation and prototyping.

Digital Twin in Industries 5.0

RT Leader: UNIVR

Participant (acronym) SMACT UNIPD **UNIVR**
Start month 01 **End month** 40

Objectives

In the Industry 5.0 scenario, more and more the Digital Twin (DT) plays a central role, not only for monitoring the status of its physical counterpart, but also for actively interacting with its components, orchestrating their execution and integrating the human behavior to implement smart human-machine cooperative strategies.

In this framework, the research will address the design automation of smart factories by defining methods and tools for the identification, customization and integration of components, the definition and implementation of real-time and distributed software for intelligent containerization, orchestration and verification of mixed criticality systems, and the programming and the reconfiguration of the overall production line.

As the human role is completely integrated, the research will focus also on the definition of methods and tools for video analytics, augmented reality, gesture recognition and machine learning for mixed human-machine working environments, human/robots localization and positioning, modelling of human-machine co-habitation dynamics, DNN-based human motion analysis, human-robot collision prediction, and collaborative edge-cloud deep inference.

The outcome of the studies will be finally showcased and exploited in a real production line, in cooperation with industrial stakeholders, at the Industrial Computer engineering Lab (ICE Lab).

Description of Work

Task S5_RT2.1 – Design and integration of Digital Twin components

Task Leader: UNIVR (Fummi)

Duration: M01 - M04

The concept of Digital Twin (DT) can be exploited in many directions that depend on the side technologies used to create the twin. The Task S5_RT2.1 has the twofold aim to (i) identify the core technologies for the development of DTs for smart manufacturing, and (ii) to develop methods and tools for the identification, customization and integration of smart components. To this end, in RT2.1, a comprehensive literature review will be conducted.

Task S5_RT2.2 – Architecture deployment and orchestration of the physical counterpart

Task Leader: UNIVR (Fummi)

Duration: M05 - M16

The aim of Task S5_RT2 is to develop methods and tools for the deployment and orchestration of software tasks and related verification environments in the physical counterpart of a smart production line. In particular, the main activities related to the task will concern the definition and implementation of (i) a platform that extends the de-facto reference standard for container orchestration, Kubernetes, to schedule tasks with mixed-criticality requirements, (ii) smart scheduling of processes to take care of the robot-human interaction, (iii) an assertion-based verification (ABV) framework for the runtime verification of multi-domain software applications.

Task S5_RT2.3 – Industrial application of X-Realities based DT

Task Leader: UNIPD (Gamberini)

Duration: M05 - M28

Industry 5.0 brings the concept of Digital Twin to the next level by removing the perceived boundary of a manufacturing environment and allowing humans to interact with machines in a fluid-tight manner, also remotely. To this sake, human factors, cognitive and usability aspects need to entangle with the machine intelligence. In RT2.3 we aim at 1) developing an interaction model where the behavior of the human is formally described and predicted, so that the robot can "understand" the human, and 2) developing novel interaction solutions for controlling robotic systems in MR/VR/AR.

Task S5_RT2.4 – Digital Twins Case Studies

Task Leader: UNIVR (Fummi)

Duration: M17 - M40

All methods and tools developed and experimented in the previous tasks will be applied to actual case studies mainly provided by companies through the financial instrument of cascade fundings. In addition, the methods and tools will be also applied to the production line of the Industrial Computer Engineering Lab (ICE Lab), which has already proved to be an effective environment to test technologies and to boost technology transfer.

**People, organization, and processes
for Industry 5.0**

RT Leader: UNIPD

Participant (acronym):   SMACT   **UNIPD**   t2i
Start month: 01   **End month:** 40

Objectives

Smart and sustainable environments will permit the creation of many new digital and soft-skilled work positions. In this perspective, training, new skills creation, re-skilling and up-skilling, and the acquisition of research competencies also need to be considered as critical elements of the 5.0 transition process. Activities will be dedicated to promoting, supporting, and generating innovative educational and training initiatives. The specific focus will be on the impact of IoT on job characteristics and on the study of proactive behaviors of workers, cognitive models and workers' behaviors in manufacturing firms.

Description of Work

Task S5_RT3.1 – State of the Art in 5.0 Organization and Workers

Task Leader: UNIPD (Furlan)

Duration: M01 - M04

The aim of S5_TR3.1 is to build a comprehensive understanding of the relationship between the worker and technology in the context of Industry 5.0. To this end a systematic literature review will be conducted addressing aspects related to user experience, technology acceptance, social acceptability, factors fostering the introduction, and safety concerns.

Task S5_RT3.2 – Organizational aspect in smart and sustainable manufacturing

Task Leader: UNIPD (Furlan)

Duration: M05 - M16

The aim of Task S5_RT3.2 is to investigate how the organizational aspects in manufacturing firms are affected and need to be transformed at the introduction of advanced technologies and how the role-breath efficacy and proactivity of workers become prominent.

Task S5_RT3.3 – Technologies and Innovative Methods for training to 5.0

Task Leader: UNIPD (Furlan), t2i

Duration: M05 - M28

The aim of Task S5_RT3.3 covers aspects related to active learning and e-learning (including mobile-learning), to clarify relationships between the adoption of new technologies and the development of professional soft and hard skills such as technological competences, critical self-awareness, collaboration and information skills.

Task S5_RT3.4 – Organizational learning in 5.0 scenarios: case studies

Task Leader: UNIPD (Furlan)

Duration: M17 - M40

The task S5_RT3.4 aims at investigating whether and how the introduction of advanced and adaptive technologies affects organizational learning in real case studies. More specifically, the task will explore (i) to what extent the knowledge generated by machines is acquired by individuals and (ii) whether the knowledge generated by the interaction between the person and the technology is actually transferred into the organizational routines.

Personalized Assistive Technologies and Smart Environments for Inclusive Living in private and public spaces

RT Leader: UNIPD

Participant (acronym): SMACT **UNIPD** UNIVR t2i

Start month: 01 **End month:** 40

Objectives

The overall aim of the RT4 is to advance the knowledge of human behavior and find new best practices to take care of the adoption of intelligent technologies for sustainability and inclusiveness of different living environments. The research will focus on the cognitive and social side of the digital transformation of working and living environments. By exploring how the hybridization of spaces influences human behaviors, we aim to find new methods and design guidelines to drive digital transformation that positively affects our lives. The research aims to find priority and new ideas for designing and developing socially sustainable and inclusive solutions for living and working spaces, promoting quality of life and well-being. Case studies will be oriented to learning environments (e.g., schools, universities), active ageing and enhancing social equality and participation at any level.

Description of Work

Task S4_RT4.1 – Space and Place. A socio-technical framework for the next generation living environments

Task Leader: UNIPD

Duration: M01 - M04

This task is a literature review aiming to define the state of art in understanding how the transformation of traditional working and living spaces in new hybrid environments influences and changes human behaviors.

Task S4_RT4.2 – Inclusion and Independent living in Smart homes

Task Leader: UNIPD (Gamberini, Arfe, Milani, Buodo), UNIVR (Cristani)

Duration: M05 - M16

Task S4_RT4.4 aims to identify the most suitable technological solutions for developing smart assistive homes, to bring individuals with disabilities and older adults to live more independently. Elderly and impaired users and their formal and informal caregivers will be involved in evaluating emerging technologies for assistive smart homes. Particular emphasis will be devoted to technology acceptance, usability and UX, inclusiveness, perceived autonomy, well-being and quality of life.

Task S4_RT4.3 – Teaching and Learning in emerging hybrid schools

Task Leader: UNIPD (Arfè, Milani, Gamberini, Buodo), UNIVR (Giacchetti)

Duration: M05 - M28

Digital technologies play an increasingly central role in learning across various levels of education. Indeed, their flexibility allows teachers to adapt novel learning tools to the skills and abilities of students. Moreover, they extend learning beyond traditional environments, e.g., through virtual reality-based learning, and enable ubiquitous learning, thanks to mobile devices. This task will investigate the adoption of digital teaching technologies at school and synergically involve teachers and students. S4_RT4.3 will also explore how environmental factors (e.g., noise) can impact educational activities and students' learning outcomes, with a particular focus on fragility cases. A mixed-method approach will be adopted, combining quantitative and qualitative data collection and analysis.

Task S4_RT4.4 – Cognitive and Behavioral aspects for healthy and socially sustainable 5.0 workplaces

Task Leader: UNIPD (Gamberini, Buodo), UNIVR (Giacchetti)

Duration: M17 - M40

By adopting a human-centric perspective, Task S5_RT3.2 aims to investigate how the human cognitive and behavioral aspects can benefit from introducing advanced technologies at work.

Besides directly involving end-users (i.e., manufacturing sector workers), particular emphasis will be given to laboratory-based experiments on mental workload, fatigue, stress, and human performance on a 5.0 collaborative-robotic assembly workstation. A mixed-method approach will characterize the investigation. Mainly, we will adopt advanced wearable technologies to collect psychophysiological and neurocognitive biodata and advanced techniques of computerized video analysis to analyze human activities.

Spoke 6

TOURISM, CULTURE AND CREATIVE INDUSTRIES

Leader: UNIVE

Research Topics

RT1
New Digital Technologies

RT2
Data Analytics

RT3
Sustainable Business Models

RT4
New Narratives and Communication Strategies

Leader

Università Ca'Foscari Venezia

Partners

Freie Universität Bozen
Libera Università di Bolzano
Free University of Bozen - Bolzano

UNIVERSITÀ DI TRENTO

UNIVERSITÀ di VERONA

Fondazione Università Ca'Foscari

Spoke6	**RT1**	**Leader: UNIVE**

New Digital Technologies

RT Leader: UNIVE (Albarelli)

Participant (acronym): **UNIVE** UNIVR UNITN UNIBZ
Start month: 01 **End month:** 40

Objectives

– Design of emotionally engaging digital interactions to enhance the experience of cultural tourism sites.
– Develop customer-centric digital applications based on user empathy and the visitor's emotional attachment of the learning experience.
– Collection, integration and storage of spatio-temporal data describing tourism phenomena.
– Analysis and production of contextual recommendations and development of forecast models of tourist flow.
– Construction of big-data confederations in the iNEST ecosystem to reinforce the smart destination concept.
– Legal support for data management and governance in the data ecosystem.

Description of Work

Task S6_RT1.1 – Augmented & virtual reality and gamification for interactive user experiences of cultural tourism
Task Leader: UNIBZ (Luigini)
Duration: M01 - M40
The task investigates how new digital technologies can benefit cultural tourism by enhancing visitor experiences with innovations ranging from virtual enhancements to re-live historical sites and events, engage with content in museums, or to visit remote destinations in virtual environments. The research will develop specific value propositions that can be realized through meaningful design AR, VR and gaming applications based on proper understanding of tourists needs and wants. Having this deeper level of understanding will allow AR/VR designers to build emotionally engaging layers to enhance the experience of cultural tourism sites.

Task 6_RT1.2 – User-generated content, big data and machine learning for a smarter tourism industry
Task Leader: UNIVR (Belussi)
Duration: M01 - M40
The task is focused on the collection, integration, and storage in big data systems of spatial-temporal data describing tourism phenomena. Hence, based on big data, this task aims at studying and developing techniques, based on the machine learning approach, for the analysis and production of contextual recommendations and the development of forecast models of tourist flows.

In addition to this, further solutions to manage tourism information and related flows will be conducted via blockchain technology by exploiting data shared by users to obtain a transparent and aware management of tourist flows. This will also allow to provide ad hoc tools and guidelines to promote cultural heritage information by exploiting approaches based on non-fungible tokens.

Task S6_RT1.3 – Integrated data platforms to support strategic decision-making and empower travelers and visitors
Task Leader: UNIVE (Albarelli)
Duration: M01 - M40
The task aims at facilitating the emergence and consolidation of new vertical services, mainly based on machine-learning, deployed by innovative enterprises and startups, aimed at offering new experiences to travelers and visitors, beyond simple sales of accommodations and transfers. Current infrastructures, such as the regional DMS and the national Digital Tourism Hub will be the starting point towards a big data confederation. The ultimate goal is to make available in the ecosystem aggregated information about tourists/customers, who interact with data-based services to prepare the trip/experience, during the experience and also afterwards, with certified feedbacks.
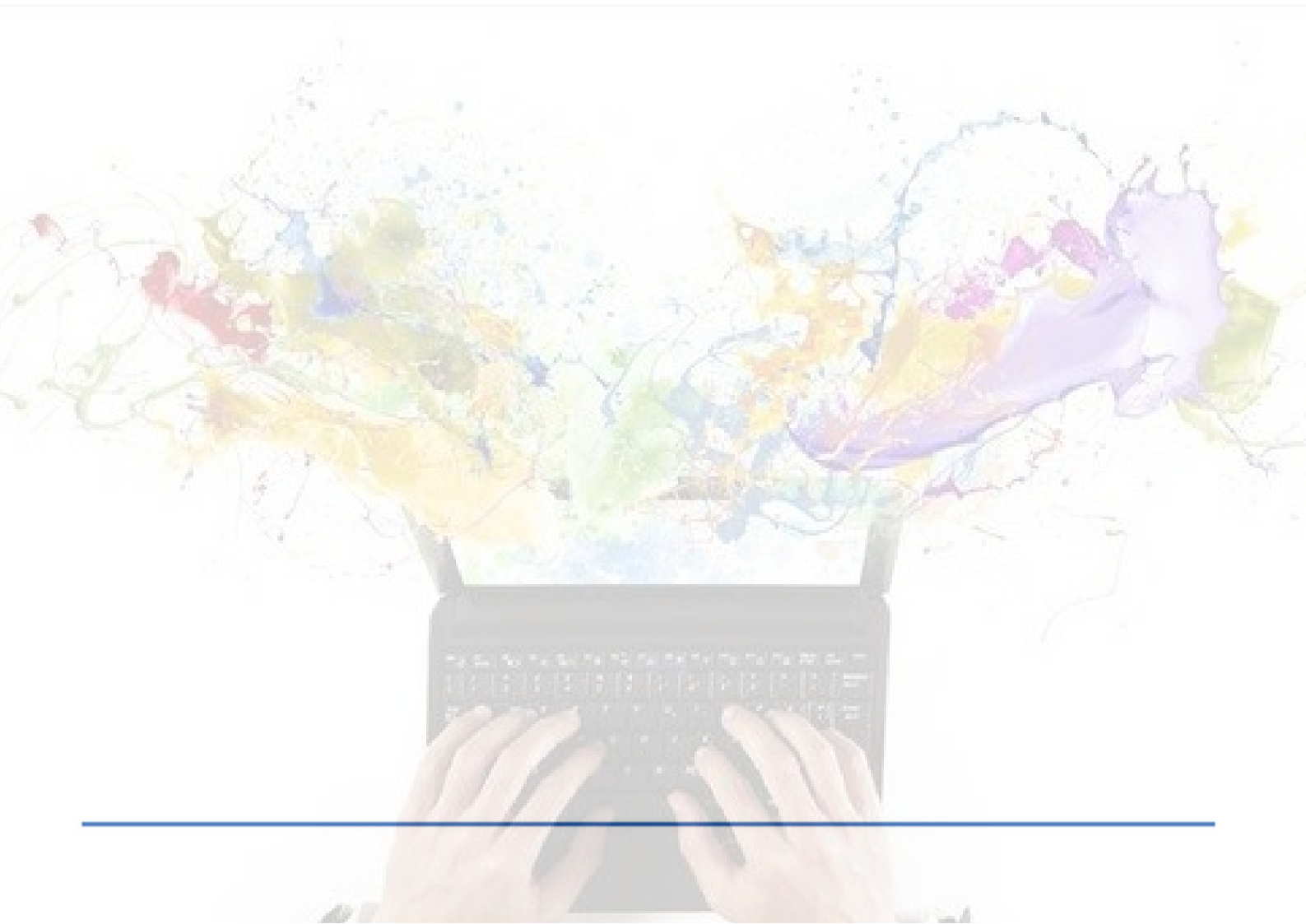
Data Analytics

RT Leader: UNIVR (Confente)

Participant (acronym):   UNIVE   **UNIVR**   UNITN   UNIBZ
Start month: 01   **End month:** 40

Objectives

– *Understand and monitor visitor behaviors and patterns of mobility within tourist destinations.*
– *Design of quantitative indicators for the creation of a monitoring system for the governance of tourism ecosystems.*
– *Model tourist flows based on optimization objectives of the impacts of tourism, particularly in overtourism contexts*
– *Understand tourists' perceptions and sentiments regarding specific destinations with a particular focus on sustainability issues.*
– *Develop destination marketing strategies based on integrated information from online and offline content analysis.*
– *Provide robust empirical foundation for the governance of cultural tourism with a taxonomy of the forms of cultural tourism in the iNEST ecosystem.*

Description of Work

Task S6_RT2.1 – Creation of dashboards of indicators for the governance and regulation of smart places tourist ecosystems
Task Leader: UNIVE (Camatti)
Duration: M01 - M40
The task focuses on the design of quantitative indicators for the creation of a monitoring system for the governance of tourism ecosystems, as well as the modeling of tourist flows based on optimization objectives of the impacts of tourism, particularly in overtourism contexts. Such indicators will have to be measured at the local level (city and municipal) and, when feasible, using higher spatial aggregations. Official administrative data, survey findings, alternative sources, and big data will be used to feed the indicators.

Task S6_RT2.2 – Destination marketing strategies based on big data analytics and online and offline content analysis
Task Leader: UNIVR (Confente)
Duration: M01 - M40
The task builds on data elaborated in RT1.2. to improve destination marketing strategies, destination branding and imaging, and multiple territory brand architecture in the iNEST ecosystem. Data analytics and content analysis are proposed as a key asset in destination smartness, in particular to make 'smarter' decisions in several areas such as:

a) understand tourists perceptions and sentiments regarding specific destinations with a particular focus on sustainability issues;

b) develop marketing strategies for destinations affected either by over or under tourism;

c) recommend destination activities and tailored packages based on ad hoc tourist segmentation analysis;

d) provide individual business and destination managers with solutions to extract more value from user-generated content feedback and requests.

Task S6_RT2.3 – Mapping cultural and creative resources to support evidence-based tourism policies and strategies

Task Leader: UNIVR (Vigolo)

Duration: M01 - M40

The task aims at providing a reliable representation of the most relevant resources in the iNEST ecosystem and their current status as tourist attractions with particular reference to both the points of massive interest and those with poorly valued assets. Attention will be devoted to both material and immaterial cultural heritage and contemporary productions, with mapping exercises including archeological sites, museums, performing art venues, festival and big events. The task will be conducted with geographic, economic and historical data census analysis systems aiming at the evaluation of resources, the potential territorial development and the integration between cultural heritage and urban/territorial development with a view to sustainability, integration and sharing with local communities.

Task S6_RT2.4 – Governing tourism flows to tackle overtourism and improve livelihood of places

Task Leader: UNIVE (Tamma)

Duration: M01 - M40

The task responds to the need for destinations to understand and monitor tourism flows, visitor behaviors and patterns of mobility, in order to enhance tourism sustainability. The use of technologies and all applications related to "data" will create the conditions, in terms of platforms and structures, for a "leap" forward in the ability to monitor phenomena in real time and for long periods, to make informed decisions based on more reliable analyses and forecasts. Also, the experiences of the touristic visits will be enhanced, in terms of involvement and usability with the increase in the awareness that the spaces and times of fruition must be managed as destination resources subject to scarcity and which require information and booking services easy and appealing.

Spoke6   **RT3**   **Leader: UNIVE**

Sustainable Business Models

RT Leader: UNITN (Della Lucia)

Participant (acronym):   UNIVE   UNIVR   **UNITN**   UNIBZ
Start month: 01   **End month:** 40

Objectives

– *Analyze of the state of the art on sharing and community-based business model design.*

– *Identify best practices and provide actionable examples of how experience design contributes to circular economy, accessibility, diversity and inclusivity.*

– *Analyze the social impact of tourism on local communities and promote creativity based social innovation to preserve a sense of place and citizenship.*

– *Enhance the role of artists and cultural entrepreneurs as co-creators of more sustainable narrations of tourism destinations in the iNEST ecosystem.*

– *Develop a framework for the integration of cultural and creative regeneration in the sustainable transformation of places.*

– *Support policymakers, business, cultural producers in the sustainable development of new culture and creative regeneration of natural and built environments.*

Description of Work

Task S6_RT3.1 – Sustainable experience design for circular economy in the heritage city and accessible, diverse and inclusive places

Task Leader: UNITN (Santini)

Duration: M01 - M40

The task adopts the perspective of experience design to explore innovative relationship between creative productions, culture and the experiences visitors make. It will do so by addressing issues of accessibility, diversity and inclusion as key dimensions the iNEST ecosystem sustainability. Through a multi-level approach that spans materials, cultural and creative productions, organizations and users, the task aims at: 1) developing a framework that combines the different dimensions of experience design (constraints, experience types, variety of audience) to circular economy, accessibility, diversity and inclusivity; 2) applying the framework to a set of case studies in different settings (heritage cities, heritage sites, craft, food, etc.); 3) defining conditions and best practices enabling policymakers business and creative industries deliver experience based on the principles of circular economy.

Task S6_RT3.2 – Cultural productions and artistic interventions for the promotion of a more authentic and engaging discovery of places

Task Leader: UNIVE (Panozzo)

Duration: M01 - M40

The task will investigate the cultural pre-conditions of tourism and support cultural and creative entrepreneurs in the design, prototyping and demonstration of innovative products. It will deliver a methodology that builds on cultural entrepreneurship to co-create more sustainable narrations for tourism destinations. The research task includes the establishment and upkeeping of an intense dialogue with professionals and business firms active in museum services, performing arts, digital storytelling, publishing, and media. In this way, the research results will actively contribute to the transformation of the business models that currently shape the relationship between culture, creativity, and tourism.

Task S6_RT3.3 – Sustainable business model design for the sharing and community-based economy of places

Task Leader: UNITN (Caputo)

Duration**:** M01 - M40

The research task investigates the characteristics and challenges of sustainable business model design in tourism ecosystems, primarily responding to the challenges of the co-existence of residents and visitors. The research will also advance creativity-based social innovation to tackle tourism-related controversies in either urban or rural contexts. The aims are three-fold and interrelated in nature: 1) analysis of the art on sharing and community-based business model design for the development of an operative framework that is accessible and usable, 2) identification of cases and lived experiences of business models in the sharing and community-based economy of places (urban, rural, craft and creative industries in tourist ecosystems; 3) upskilling strategies for organizational resilience and sustainable business modelling in the area of cultural and creative tourism in co-creation with stakeholders.

Task S6_RT3.4 – Culture and creative regeneration of natural and built environments for sustainable development of places

Task Leader: UNITN (Della Lucia)

Duration: M01 - M40

This task considers the need to balance conservation, management, and regeneration to empower change and dismantle lock-ins at different levels for transforming less-know tourist destinations sustainably and/or designing new ones. The focus is on the link between the institutional setting, transformation processes, models, and factors enabling authentic regeneration blending culture, creativity, and tourism. The three-fold and interrelated aims are: 1) developing a framework that integrates cultural and creative regeneration in the sustainable transformation of places; 2) identify and analyze cases and lived experiences of cultural and creative regeneration in the iNEST ecosystem; 3) support policymakers, business, cultural producers in the sustainable development of new culture and creative regeneration of natural and built environments.

**New Narratives and
Communication Strategies**

RT Leader: UNIBZ (Volo)

Participant (acronym):   UNIVE   UNIVR   UNITN   **UNIBZ**
Start month: 01   **End month:** 40

Objectives

– Provision of methodological guidelines for understanding positioning stereotypical destinations narratives.

– Design a model for the collective imagination of new narratives for a creativity-based re-positioning narratives and images of destinations.

– Analysis of UNESCO and OLYMPICS as global brands and unpack their impact non business, communities and policy makers in the iNEST ecosystem. – Development of a collaborative framework between local communities and the tourism industry for the governance of UNESCO site and the organization of big events.

– Drafting visitor guides as well as audio and video descriptions based on the principles of inclusiveness and mindfulness.

– Design of a digitally mediated and context-sensitive approach for the translation/transmediation of cultural heritage.

Description of Work

Task S6_RT4.1 – Positioning and re-positioning narratives and images of destinations in contemporary trans-media tourism discourses

Task Leader: UNIBZ (Gigliotti)

Duration: M01 - M40

The research task interprets tourisms as intertwined to the stories and images that are produced to promote destinations. It tackles the eco-systemic challenge of stereotyped narratives of tourism destinations' identities, showing how these may have negative impacts quality and quantity of tourist flow and therefore on sustainability. The research will be conducted across various arts and media (literature, film, blogs, visual marketing, user-generates images...) drawing also on discourse analysis and corpus linguistics to position and categorize tourism stereotypes in the iNEST ecosystem to gain a deeper understanding of their antecedents and consequences. The task will then develop a methodology that builds on speculative design and creativity-based practices to re-imagine multidimensional narrations of touristic destinations in the iNEST ecosystem. Entrepreneurs and professionals in both the tourism and the creative industries will be mobilized to actually implement innovative place-making and place branding strategies.

Task S6_RT4.2 – Conceptualization, design, and creation of novel communications strategies for destinations

Task Leader: UNIBZ (Volo)

Duration: M01 - M40

The task explores some of the distinctive characteristics of the iNEST ecosystem as a touristic destination, namely the presence of world cultural and heritages sites and the organization of big events (the Venice Carnival and the 2026 Winter Olympics in the Dolomites). An analysis of the specific issues related to communication of fragile sites will be undertaken. The research will also explore the significance of UNESCO and OLYMPICS as global brands and unpack their consequences in terms of communication strategies that policymakers, business and communities need to implement in order to gain full advantages of the recognition. Special attention will also be devoted to the social sustainability of big events and the protection of world of heritage sites. The research will also aim at proposing novel communication forms that can give voice to local communities alongside those of the global tourism industry.

Task S6_RT4.3 – Mindful communication and cultural mediation for more sustainable, accessible, diverse and inclusive places

Task Leader: UNIVE (Pesaro)

Duration: M01 - M40

The task formulates welcoming strategies for inbound tourism based on cultural mediation, mobilizing knowledge and artistic-literary values already present in the source cultures in a comparative perspective with the Italian artistic-literary tradition for a more conscious tourism experience. Drawing also on discursive and multimodal strategies using corpus linguistics methods and techniques, the research develops methodologies, strategies and practices for drafting visitor guides (tourist/museum translations), as well as audio and video descriptions in the languages, with a view to the accessibility of the cultural heritage of the iNEST area, based on the principles of inclusiveness and mindfulness. A digitally mediated and context-sensitive approach is proposed for the translation/transmediation of cultural heritage particularly useful in museum communication.

Specific categories of outsider visitors will be defined in terms of cognitive and/or sensory abilities, so as to take into account the issues of integration, access and social inclusion.

Spoke 7

SMART
AGRI-FOOD
Leader: UNIVR

Research Topics

RT1

Business models for sustainable agri-food at different levels

RT2

Process/product innovation for sustainable agri-food

RT3

Circular economy

RT4

Logistics, supply chain and vertical coordination

Leader

Partners

**Business models for sustainable agri-food
at different levels**

RT Leader: UNIVR

Participant (acronym) UNIVR UNIVE
Start month 01 **End month** 40

Objectives

– Analysis of sustainable business models.
– Analysis of the implications of the twin transition on agri-food business models and value chains.

Description of Work

Task S7_RT1.1 – Analysis of sustainable business models and sustainability performance in agri-food businesses and of consumer response to corporate social responsibility practices
Task Leader: UNIVR (Cantele)
Duration: M01 - M40
The purpose of this task is to analyze the sustainability practices in agri-food firms and the peculiarities of agri-food BM in order to propose specific frameworks to describe SBM typologies in the agri-food sector and to assess their sustainability performance. The task will also analyze consumer response to the implementation of corporate social responsibility (CSR) practices and sustainable business models by firms in the agri-food sector in order to study the processes underlying preferences and behavior with regards to products whose firms apply SBM and CSR practices to promote choice towards these products.

Task S7_RT1.2 – Twin transition on agri-food business models and value chains
Task Leader: UNIVE (Mauracher)
Duration: M01 - M40
The purpose of this task is to develop a systematic analysis of the strategic implications and value chain consequences of the digital and green transition in the agrifood industry, both at the level of firms' business models and at that of value chain configurations. The task will also consider the role of digital platforms in enabling sustainable strategies and sustainable transitions of agri-food value chains. The task will conduct to the elaboration of diagnostic and analytic tools measure gaps and identify transitions in business models at the firm and value chain level.

Spoke7　　　　　　　**RT2**　　　　　**Leader: UNIVR**

**Process/product innovation
for sustainable agri-food**

RT Leader: UNIVR

Participant (acronym):　UNIVR　UNIVE　UNIPD　UNIUD　FEM
Start month: 01　**End month:** 40

Objectives

– Development of innovative systems, based on real time processing of sensor data using process-based, AI and data-driven approaches, for improving crop and food production processes (i.e., pests control, crop performances, precision aquaculture, fermented beverages such as wine), finished products quality, and packaging.
– Use of extracts, bioresources, biomolecules and digital databases for development of innovative processes and products: exploitation of plants and microorganisms to enhance food and feed production and to exploit and upcycle biomasses for new food/feed or other biobased products.

Description of Work

Task S7_RT2.1 – Databases, Artificial intelligence (AI) and robotic systems

Task Leader: UNIVR (Quaglia)
Duration: M01 - M40
The purpose of this task is the development of database-driven, AI approaches, and robotic systems for securely collecting and processing data coming from sensor systems with the aim of supporting innovative processes and products (UNIVR). A case study on an integrated and holistic data-driven (digital) architecture for the "Farm-2-Fork" supply chain for grapevine and apples will also be developed (FEM).

Task S7_RT2.2 – Sensor-based approaches, innovative process control applications and smart packaging in agri-food. From technological innovation to consumers' perception

Task Leader: UNIVR (Ugliano)
Duration: M01 - M40
This task aims at evaluating novel approaches to process control in food and crop production. Sensor-based approaches will be developed for monitoring and decision-making support in pest control (grapevine, olive), crop performances (grapevine), winemaking and microbial biotechnological processes, including predictive modelling. Innovative approaches will also be developed for aquaculture and fishing activities. Finally, consumer perception and preferences towards digital innovation will be investigated, focusing on the case of smart labels in the agri-food system.

Task S7_RT2.3 – Microbial bioresources

Task Leader: UNIVR (Salvetti)

Duration: M01 - M40

The purpose of this task is to explore, characterize and develop Microbial biotechnologies and bioresources for bio transformations in agri-food production processes.

Task S7_RT2.4 – Novel plant disease management, insect control, and stress resistance strategies

Task Leader: UNIUD (Di Francesco)

Duration: M01 - M40

This task aims at developing novel pest and disease control as well as stress resistance strategies for crop production. In particular, plant, animal and microbial extracts as well as double-stranded exogenous RNAs will be used for plant disease management and/or for control of phytophagous insects in crops, whereas novel stress-resistant grapevine genotypes will be developed using novel breeding techniques. For the latter application, advanced phenotyping systems for the detection of performances of the novel genotypes under conditions of environmental stress will be also applied.

Task S7_RT2.5 – Extracts, biomolecules and smart molecules

Task Leader: UNIPD (Corich)

Duration: M01 - M40

The activities of this task will revolve around green extraction or synthesis of biomolecules and smart molecules from agrifood byproducts or natural to enhance food and feed production or for other biobased applications.
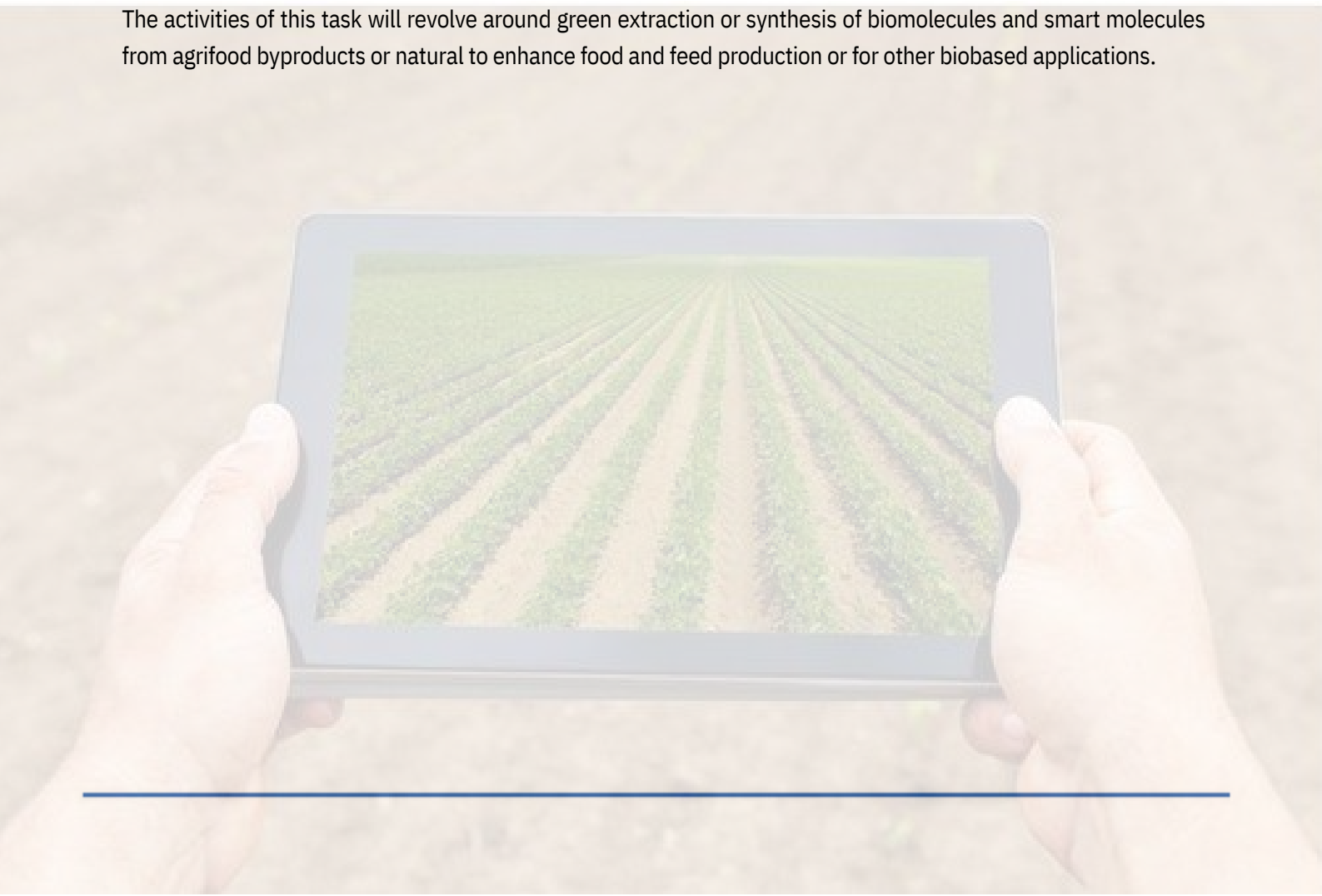
Participant (acronym): **UNIVR** UNIVE UNIPD UNIUD FEM
Start month: 01 **End month:** 40

Objectives

– Production of novel foods/feeds as well as food/feed ingredients based on agricultural by-products recovery.

– Life cycle assessment (LCA) and development of tools and technologies for the assessment of the nutritional value.

– Economic feasibility and market attractiveness of the exploitation of byproducts, including consumers perception studies.

Description of Work

Task S7_RT3.1 – By-products recovery and valorization and exploitation of biomasses

Task Leader: UNIUD (Spanghero)

Duration: M01 - M40

Novel technologies for by-products and biomasses processing will be developed for this task. By-products recovery will be oriented to the development of functional and sustainable foods/feeds and food/feed ingredients, in particular using by-products from wine, farming, dairy, aquaculture, but also other agricultural activities. As for biomasses, activities will be focused on the optimization of biological processes for the energy and agronomic exploitation of organic biomasses and agro- environmental characterization of the products obtained (circular bioeconomy).

Task S7_RT3.2 – LCA in agri-food and novel approaches to assessment of environmental and nutritional sustainability

Task Leader: FEM (Tomasi)

Duration: M01 - M40

Two main areas will be covered in this task:

1. Application of LCA to agriculture and agri-food processing chains will be investigated, focusing on the case study of a mountain territory.

2. Novel chemometrics approaches will be developed for assessing environmental but also nutritional sustainability, with a focus to the context of animal farming.

Task S7_RT3.3 – Marketing of upcycled foods

Task Leader: UNIPD (Rossetto)

Duration: M01 - M40

The aim of this task is to investigate economic feasibility and market attractiveness of upcycled foods and assessing consumer perception and preferences towards novel foods arising from circular economy approaches
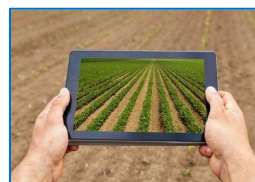
**Logistics, supply chain
and vertical integration**

RT Leader: UNIVR

Participant (acronym):   UNIVR
Start month: 01   **End month:** 40

Objectives

– Analyzing the sustainability and circular economy practices in agri-food firms across the supply chain and develop suitable data management platforms.
– Developing novel technologies for sustainable supply chain through management, integration, transparency, and authenticity of large amount of heterogenous data.

Description of Work

Task S7_RT4.1 – Sustainable logistic models and technologies

Task Leader: UNIVR (Russo)

Duration: M01 - M40

This task will focus on analyzing logistics models and practices for a sustainable supply chain, with particularly attention to the role of third-party logistics. In parallel, strategies for management and integration of large amount of heterogenous data through RESTful API and blockchain smart contracts will be explored, in particular but not exclusively in relationship to transparency and authenticity.

Task S7_RT4.2 – Traceability of large amounts of data by means of blockchain technology combined with data integration and analysis

Task Leader: UNIVR (Migliorini)

Duration: M01 - M40

The aim of this task is to develop solutions for big-data integration to ensure traceability across the entire food production and supply chain.

iNEST

Spoke 8
MARITIME, MARINE, AND
INLAND WATER TECHNOLOGIES:
TOWARDS THE DIGITAL TWIN
OF THE UPPER ADRIATIC

Leader: UNITS

Research Topics

RT1
Biology of hydrosphere ecosystems

RT2
Physical-chemical risks and impacts on the hydrosphere

RT3
Sustainable waterway mobility

RT4
Land-sea integrated maritime and spatial Planning

RT5
North Adriatic Digital Twin

Leader

UNIVERSITÀ
DEGLI STUDI
DI TRIESTE

Partners

OGS

UNIVERSITÀ
DI TRENTO

Università Iuav di Venezia

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Ca'Foscari
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800 1222/2022 ANNI
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DEGLI STUDI
DI PADOVA

Autorità di Sistema Portuale
del Mare Adriatico Orientale
Porti di Trieste e Monfalcone

Spoke8	**RT1**	**Leader: UNITS**
	Biology of hydrosphere ecosystems	

RT Leader: UNITS (Pallavicini)

Participant (acronym): **UNITS** UNIPD OGS UNITN UNIVE
Start month: 01 **End month:** 40

Objectives

Within the RT1 of iNEST spoke 8, we aim to fuse a large volume of diverse biological data to enable communication with real-world systems and mathematical and informatics models. We need to recover relevant "sleeping" or produce news biodiversity data and establish regional partnerships with data owners to unlock information on marine and freshwater life and human activities that affect it.

The goal is to harmonize data, protocols and vocabularies amongst biodiversity monitoring activities and actors and to warrant a secured, sustained, and reliable data flow from biodiversity monitoring programs, including research projects, and local, national and international monitoring programs, into data repositories, from data collectors to data integrators, and their integration/assimilation in existing models.

Among the first but very important benefits of this action, we intend to develop of an ecosystem of researchers engaged in the study and conservation but also the sustainable exploitation of the resources of the regional hydrosphere.

Description of Work

Task S8_RT1.1 – Digital databases for innovation in biodiversity and water quality assessment

Task Leader: UNITS (Malfatti)

Duration: M01 - M28

We want to start developing a local database of metabarcoding data, both eukaryotic and prokaryotic, and better characterize the space-time variability of environmental conditions. Marine vertebrates (including mammals and reptiles) will also be monitored as they find breeding and foraging areas in the waters of the North Adriatic Sea.

Task S8_RT1.2 – Bioresources and biomolecules for blue biotechnology

Task Leader: UNITS (Pallavicini)

Duration: M01 - M40

Mussels, clams, and oysters have some relevant applications in biomedical research. Species in this group can generate substances with effects analogous to those of antimicrobials. Fish industry generates large amounts of waste that can be sustainably valorized for the generation of high-added-value molecules and materials. We aim to identify peptides and other molecules for blue biotechnology exploitation.

Task S8_RT1.3 – Biological and biogeochemical data integration for local blue carbon managing

Task Leader: OGS

Duration: M01 - M28

We aim to develop blue carbon research unit to facilitate policy climate integration and inform accurate carbon accounting across multiple habitats through, for example, an understanding of the distribution of carbon sequestering habitat for Marine Spatial Planning (MSP) that addresses ocean climate-driven change.

Task S8_RT1.4 – Digital databases and modelling tools for assessing and quantifying freshwater habitat

Task Leader: UNITN (Zolezzi)

Duration: M01 - M40

Habitat availability is recognized as one of the key critical constraints to freshwater biodiversity. We aim to develop modelling tools in this field, able to link the hydromorphological dynamics of rivers with habitat availability for flora and fauna, are still in their infancy, and this project proposes a major step forward in their development, testing and application.

Physical / chemical risks and impacts on the hydrosphere

RT Leader: UNITS (Fontolan, Zini)

Participant (acronym):   **UNITS**   UNITN   UNIVE   OGS   PNAEAS
Start month: 01   **End month:** 40

Objectives

– *Analysis and modeling of chemical contamination in the hydrosphere.*
– *Development of sustainable water treatment technologies.*
– *Marine underwater noise.*
– *Underground water resources identification, modeling and management.*
– *Natural and anthropic risks related to water resources on land and inland-marine/coastal environment.*
– *Development of a GIS integrated hydrogeological model.*
– *Coastal erosion, storm surges, sea-level rise, salt water intrusion, subsidence and related risks.*
– *Monitoring and modeling sediment transport from the river source to the sea to prevent coastal erosion.*
– *Marine and coastal environment management and protection.*

Description of Work

Task S8_RT2.1 – Risks and impacts related to chemical contaminants and noise pollution in the hydrosphere
Task Leader: UNIVE (Zanardi)
Duration: M01 - M40
This task is focused on defining the major physical and chemical hazards that affect the quality of water resources, both fresh and marine, in north-eastern Italy.

Task S8_RT2.2 – Modeling the impact of climate change and anthropic pressures on water resources
Task Leader: UNITN (Bellin)
Duration: M01 - M40
This task is focused on the evaluation of the alteration of the hydrological cycle due to human pressures and climate change, also considering the interactions occurring between surface and subsurface water resources in north-eastern Italy.

Task S3_RT2.3 – Risks and impacts on the coastal zone due to episodic events and sea-level rise
Task Leader: UNITS (Fontolan)
Duration: M01 - M40
This task aims to investigate the major changes and vulnerability of the coastal area caused by episodic (short-term) forcing as well as the possible effects associated with relative sea-level rise (RSLR) in north-eastern Italy.
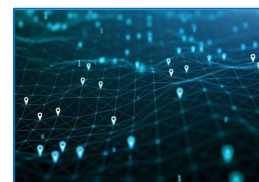
Spoke8	RT3	Leader: UNITS

Sustainable waterway mobility

RT Leader: UNITS (Marinò, Sulligoi)

Participant (acronym): UNITS
Start month: 01   **End month:** 40

Objectives

A pilot case of sustainable waterway mobility related to Trieste, a "via-sea" summer transport connection from the city to the seaside spots along the coast between Muggia and Duino will be developed. A small fleet of boats will be appropriately sized to be used for "on call" transports. Boats will be built with sustainable construction materials for easy recyclability and employ hybrid-electric propulsion systems with very low polluting emissions (chemical pollutants and underwater noise).

Landing spots and the infrastructures to be installed will be identified on the base of sustainability criteria. Boats will be designed with a modular approach to be converted during winter months to be used on different routes than the summer ones, and to support scientific experimental campaigns for the coastal chemical/biological monitoring.

Activities of applied research and technology transfer are aimed to reach: Sustainable marine mobility, in-between the sea and the inland waters, understood as a system interconnected to terrestrial transport for tourism and for everyday commuting; Enabling green ship/boat building practice in order to support the decarbonization production processes; Boosting electrification of vessels; Green ports/marinas smart grids; Realization of full-scale prototype of an innovative boat for people transport, and test in relevant environment; Realization of (at least) two smart and green berthing facilities for innovative boat for public transport; Digital twinning of ship/boat/port/marina power and energy systems.

Description of Work

Task S8_RT3.1 – State of the art

Task Leader: UNITS (Sulligoi)

Duration: M01 - M04

Literature review and technology scouting about methods, materials and systems enabling sustainable mobility in-between the sea and the inland waters. In-depth analysis of hybrid-electric propulsive systems for boats and small ships. Literature review and collection of available and future technologies useful for supporting the infrastructures to be installed *in situ* to ensure the service of sustainable passenger boats for coastal mobility.

Task S8_RT3.2 – Product/technology conceptualization
Task Leader: UNITS (Bucci)
Duration: M05 - M16
Identification of sustainable materials and best practice to be adopted for green boat/ship-building in order to reduce the environmental impact of production processes, operations and decommissioning. Testing of materials. Design of the on-shore charging platforms. Determination of fleet composition and of boats for coastal mobility. Preliminary design of prototype boat and smart and green berthing facilities.

Task S8_RT3.3 – Realization of prototypes and proofs of concept
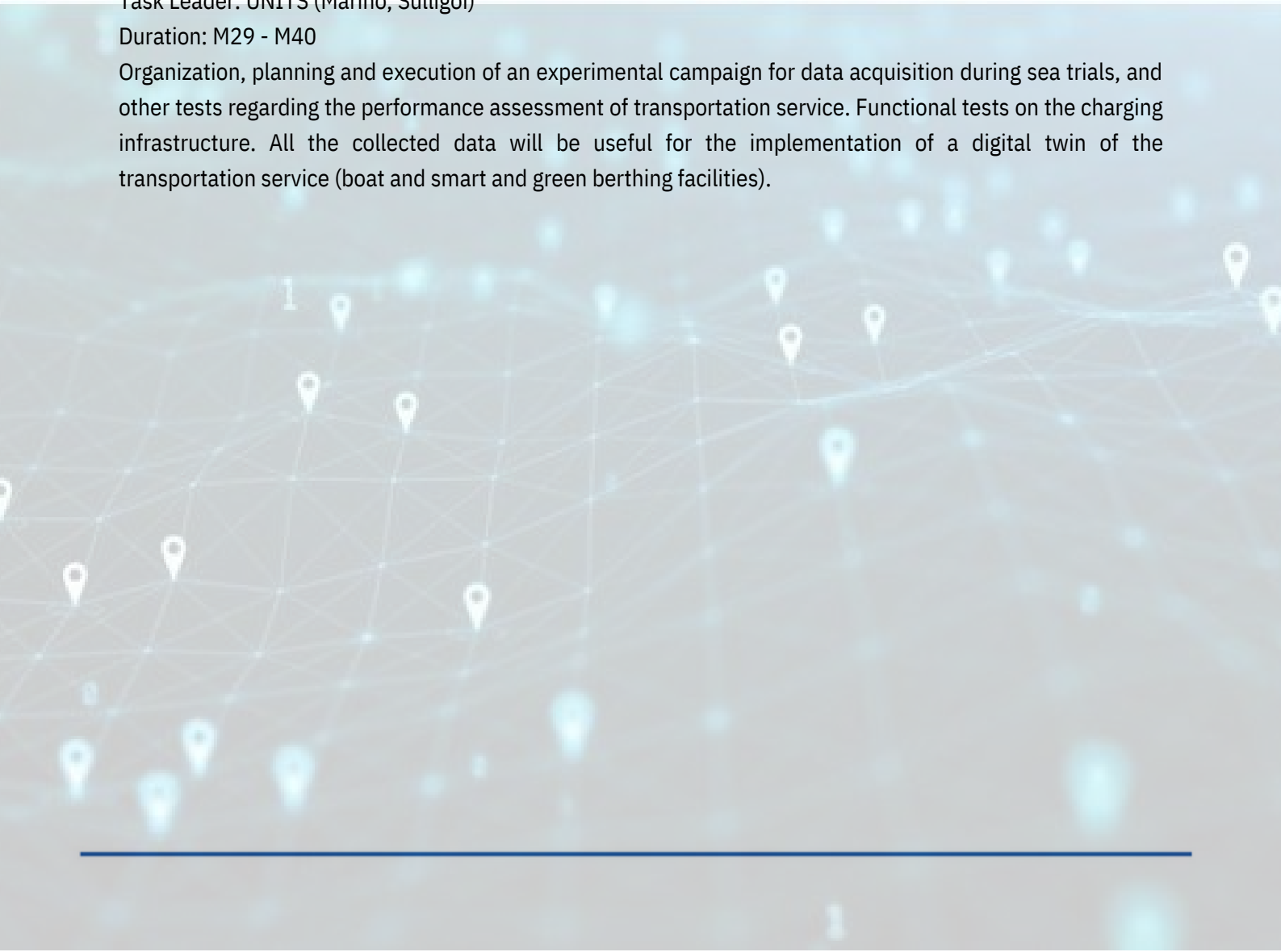Task Leader: UNITS (Marinò)
Duration: M17 - M28
Detailed design and construction of a full-scale prototype of a sustainable boat for passenger transportation. Realization of smart and green berthing facilities for supporting the service of the prototype boat. Implementation of digital-intelligent interface to extend the on-shore platform functionality.

Task S2_RT3.4 – Testing in relevant environment and data acquisition
Task Leader: UNITS (Marinò, Sulligoi)
Duration: M29 - M40
Organization, planning and execution of an experimental campaign for data acquisition during sea trials, and other tests regarding the performance assessment of transportation service. Functional tests on the charging infrastructure. All the collected data will be useful for the implementation of a digital twin of the transportation service (boat and smart and green berthing facilities).
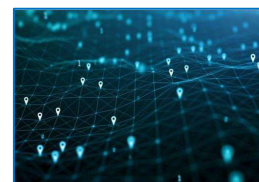
Spoke8   **RT4**   **Leader: UNITS**

Land-sea integrated maritime and spatial planning

RT Leader: UNITS (Marchigiani, Bucci)

Participant (acronym):   **UNITS**   IUAV
Start month: 01   **End month:** 40

Objectives

Specifically, the activities of applied research and technology transfer will focus on the pilot area of the Gulf of Trieste and will strongly integrate with those of RT3. The aim is to reach the following objectives:
– Mapping dynamics and effects of climate change in coastal areas.
– Planning and design tools for climate change adaptation.
– Building land-sea integrated visions and proposals for planning sustainable mobility (and related collective facilities and logistics) in-between the sea and the inland, as a service and a system of infrastructures addressed to both tourism and everyday commuting.
– Integration of mobility and logistics proposals into overall scenarios for the conservation and enhancement of environment, landscape, settlements and cultural assets in coastal and inland areas.

Description of Work

Task S8_RT4.1 – State of the Art

Task Leader: IUAV (Musco)
Duration: M01 - M04
Survey of methods and tools for analyzing climate change and for planning climate change adaptation in coastal areas. Analysis of ongoing studies, projects and spatial planning tools for the Upper Adriatic Italian Coasts. Mapping of significant territorial systems of infrastructures, settlements, landscapes, environmental assets, collective facilities, and multisectoral risks in the territories in-between the sea and the inland, with a focus on the Upper Adriatic Italian Coasts.

Task S8_RT4.2 – Demands and potentials

Task Leader: UNITS (Marchigiani)
Duration: M05 - M16
Survey and data collection of available services and demands for sustainable mobility in the fields of tourism and everyday commuting considering the trans-border Upper Adriatic Region. Building of scenarios for future development of sea and inland sustainable mobility infrastructures and services, towards the definition of land-sea integrated planning visions and proposals.

Task S8_RT4.3 – Planning guidelines

Task Leader: UNITS (Marchigiani)

Duration: M17 - M28

Drafting of planning advices for the integration of sustainable sea-land mobility and logistics into territorial projects addressed to the conservation and enhancement of environmental, landscape, settlements and collective facilities in the Upper Adriatic coastal and inland areas.

Task S8_RT4.4 – Pilot project

Task Leader: UNITS (Marchigiani)

Duration: M29 - M40

Operational study and testing of an integrated water route for public and sustainable transportation (see RT3), with a focus on the pilot area of the Gulf of Trieste. Definition of a methodology able to assess the impact of the new transportation service on road traffic reduction, upgrade of touristic attractiveness, water pollution reduction and adaptability to climate change.

Spoke8   **RT5**   **Leader: UNITS**

North Adriatic Digital Twin

RT Leader: OGS (Querin), UNITS (Bortolussi)

Participant (acronym):   **UNITS**   UNITN   **OGS**   PNAEAS
Start month: 01   **End month:** 40

Objectives

– *Implementation of numerical models and Artificial Intelligence for space-time interpolation of available observations and short term forecast of North Adriatic state.*
– *Reanalysis and quantitative assessment of the North Adriatic state and variability.*
– *Setup and testing of an operational numerical weather prediction model covering the North Adriatic for short term forecasts of atmospheric variables.*
– *Computational framework for model integration and reuse, data interpolation and uncertainty evaluation and reduction for the North Adriatic digital twin.*
– *Development of Port DT concept.*

Description of Work

Task S8_RT5.1 – Numerical models and AI for space-time interpolation of observations and short term forecast of North Adriatic
Task Leader: OGS (Querin)
Duration: M01 - M40
Improvement of the forecast capability of the OGS northern Adriatic model system, integrating AI-based algorithms for data assimilation of remote and in situ observations.

Task S8_RT5.2 – Reanalysis and quantitative assessment of the North Adriatic state and variability Task Leader: OGS (Di Biagio)
Duration: M01 - M40
Implementation of a physical-biogeochemical reanalysis of the spatio-temporal variability of the physical and biogeochemical state over the last decades, to estimate response to climate change effects.

Task S8_RT5.3 – Numerical weather prediction for short term forecasts of atmospheric variables of North Adriatic
Task Leader: UNITN (Zardi)
Duration: M01 - M40
Setup and test of an operational modeling chain, based on WRF model, to provide twice per day suitable predictions of fields of atmospheric variables (like air temperature, surface pressure, wind speed and direction, etc.) up to T+72h.

Task S8_RT5.4 – A computational framework for the North Adriatic digital twin.
Task Leader: UNITS (Manzoni)
Duration: M01 - M40
Implementation of artificial intelligence techniques for the development of a digital twin of the north Adriatic Sea, focussing on model integration and reuse, uncertainty estimation and data integration.

Task S8_RT5.5 – Development of Port DT concept
Task Leader: PNAEAS (Cozzi)
Duration: M01 - M40
Assessment of needs and priorities for the development of a Port DT, linking them to specific, medium to long-term objectives and designing the Port DT concept.

Spoke 9
MODELS, METHODS,
COMPUTING
TECHNOLOGIES FOR
DIGITAL TWIN
Leader: SISSA

Research Topics

RT1

Mathematical, numerical and data-driven modeling

RT2

Model Order Reduction

RT3

Automatic learning for Digital Twins

RT4

Applications of DT in industry, medicine,
Environmental sciences, daily life

Leader

Partners

Mathematical, numerical and data driven modeling

RT Leader: UNIPD (Putti)

Participant (acronym):   SISSA   **UNIPD**   UNITS
Start month: 01   **End month:** 40

Objectives

– *Creation of a framework for the mathematical modeling of complex systems (mathematical analysis, mathematical physics).*
– *Development of the framework in a numerical setting, supported by existing software to be expanded and renewed.*
– *Inclusion of available datasets and data assimilation methods to test and improve the numerical structure realized (testing, development and final deployment).*
– *Estimation of uncertainty of the models in an Uncertainty Quantification frame when possible.*

Description of Work

Task S9_RT1.1 – Review of the state of the art for the most updated techniques for mathematical modeling of complex systems, with a focus on data science, together with the most updated techniques in Uncertainty Quantification, applied to complex systems

Task Leader: UNIPD (Putti)

Duration: M01 - M04

I. Broad introduction of the topic

II. Overview of the topic (from early development to stable affirmation)

III. Latest advancements and new frontiers

IV. Conclusions with identification of possible future applications of interest

Task S9_RT1.2 – Identification and design of one or more applications in the mathematical analysis and mathematical physics context. Identification of a proper database to collect suitable data for the relative application

Task Leader: UNIPD (Putti)

Duration: M05 - M16

Within this task, the complete context of the application(s) will be identified and specified. Potential collaboration with other partners will be communicated in name and type. Contacts with partners will be taken.

The kind of data needed for the research will be detailed in source and type; moreover, it has to be stated if the data are going to be produced internally or obtained from an outside source. Preliminary data start to be collected. Hardware and software requirements have to be specified in this phase if needed for the application(s).

Task S9_RT1.3 – Design of a protocol for data exchange and realization of a data science study for the problem under consideration. Development of the data analysis application

Task Leader: UNIPD (Putti)

Duration: M17 - M28

Within this task, the actual application(s) will be implemented. A complete pipeline from input to output will be realized and tested. In case of collaboration with other entities, all the different steps are going to be discussed and agreed, iteratively. Data analysis of the application(s) outputs, errors, tests, are going to be identified in this phase.

Task S9_RT1.4 – Establishment and deployment of a proper application for the data analysis and mathematical modeling of complex systems

Task Leader: UNIPD (Putti)

Duration: M29 - M40

Within this task, the final outline of the application(s) will be developed and established. If other entities are involved, the complete deployment of the application(s) will be realized, consistently with the software and hardware requirements of the entity itself. If agreed, a final promotion of the application(s) is going to take place in this phase.

Spoke9   **RT2**   **Leader: SISSA**

Model Order Reduction

RT Leader: SISSA (Rozza)

Participant (acronym):   **SISSA**   UNIPD   OGS
Start month: 01   **End month:** 40

Objectives

– Study and application of Model Order Reduction techniques to multi-physics problems of diverse nature with existing techniques (POD, RB, PGD, DMD).
– Develop and enhance real time computing structure (offline + online) to reduce computational time for real applications (e.g., in an industrial environment).
– Establishment of an efficient parametrization technique for complex systems (e.g., geometrical and physical) at Reduced Order level in an automatic way, with possible comparison with machine learning equivalent scheme.
– Apply Uncertainty Quantification framework to the established model.

Description of Work

Task S9_RT2.1 – Review of the state of the art on the most updated ROM techniques and of the most updated Uncertainty Quantification techniques
Task Leader: SISSA (Rozza)
Duration: M01 - M04
I. Broad introduction of the topic
II. Overview of the topic (from early development to stable affirmation)
III. Latest advancements and new frontiers
IV. Conclusions with identification of possible future applications of interest

Task S9_RT2.2 – Design of one or more real-time applications, using the Full Order Model (FOM) and the Reduced Order Model (ROM) paradigm
Task Leader: SISSA (Rozza)
Duration: M05 - M16
Within this task, the complete context of the application(s) will be identified and specified. Potential collaboration with other partners will be communicated in name and type. Contacts with partners will be taken.
The kind of data needed for the research will be detailed in source and type; moreover, it has to be stated if the data are going to be produced internally or obtained from an outside source. Preliminary data start to be collected. Hardware and software requirements have to be specified in this phase if needed for the application(s).

Task S9_RT2.3 – Development of the application: extraction and analysis of problem geometry, discretization, identification of parameters of interest, exploitation of a FOM model, elaboration of a ROM counterpart. Comparison between FOM and ROM and error analysis
Task Leader: SISSA (Rozza)
Duration: M17 - M28
Within this task, the actual application(s) will be implemented. A complete pipeline from input to output will be realized and tested. In case of collaboration with other entities, all the different steps are going to be discussed and agreed, iteratively. Data analysis of the application(s) outputs, errors, tests, are going to be identified in this phase.

Task S9_RT2.4 – Establishment of an Uncertainty Quantification approach for the model into consideration. Deployment of the application
Task Leader: SISSA (Rozza)
Duration: M29 - M40
Within this task, the final outline of the application(s) will be developed and established. If other entities are involved, the complete deployment of the application(s) will be realized, consistently with the software and hardware requirements of the entity itself. If agreed, a final promotion of the application(s) is going to take place in this phase.

Spoke9   **RT3**   **Leader: SISSA**

Automatic learning for Digital Twins

RT Leader: UNITS (Bortolussi)

Participant (acronym):   SISSA   **UNITS**
Start month: 01   **End month:** 40

Objectives

– *Study and application of automatic learning techniques (Machine Learning, Reduced Order Models) in a High-Performance Computing setting.*
– *Study of the latest realization of automatic Digital Twins in industry (state of the art).*
– *Implementation of a Digital Twin with a continuous data exchange between the twin and the real asset, exploiting the techniques previously considered.*
– *Deploy a smart integrated framework in the form of a Digital Twin within a real industrial configuration.*

Description of Work

Task S9_RT3.1 – Automatic learning techniques for continuous data and model integration
Task Leader: UNITS (Bortolussi)
Duration: M01 - M40
Within this task, we will explore methods from literature and develop novel approaches for real-time integration of data and models, informed by and tailored to an array of case studies identified, for example, in the project in collaboration with S9_RT4. We will consider machine learning and deep learning tools for real-time data and model integration, tackling problems like real-time sensor anomaly detection, automatic data cleaning, fast estimation of posterior model uncertainty, and fast solution of inverse problems.

Task S9_RT3.2 – Machine learning and artificial intelligence techniques for modularized digital twin development
Task Leader: UNITS (Bortolussi)
Duration: M01 - M40
Within this task, the focus will be on methodologies based on machine learning, artificial intelligence and simulation intelligence to interface and connect different models, to improve modular Digital Twin development. This task will be informed by and tailored to an array of case studies identified, for example, in the project in collaboration with S9_RT4. We will explore languages and frameworks for co-simulation and model transformation and complement them with machine and deep learning tools for input/output connection, temporal and spatial resolution integration, automatic learning of boundary conditions, fast uncertainty quantification and propagation.

Task S9_RT3.3 – Automatic learning techniques and artificial intelligence for efficient real time simulation, optimization and adaptation of Digital Twins

Task Leader: UNITS (Bortolussi)

Duration: M01 - M40

This task will be devoted to methodologies to improve simulation efficiency and on the fly optimization methods for control and adaptation of digital twins, to run whenever possible on low resource and low power hardware. The approaches investigated in the task will be tested and modulated on a set of case studies identified, for example, in the project in collaboration with S9_RT4. We will consider issues like efficient surrogate models based on (geometric) deep learning, deep learning abstractions for real-time predictive monitoring, real-time control and adaptation algorithms.
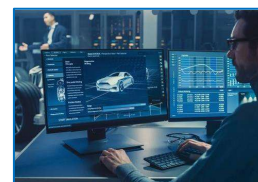
Spoke9

RT4

Leader: SISSA

Applications of DT in industry, medicine, environmental sciences daily life

RT Leader: OGS (Salon)

Participant (acronym): SISSA   UNIPD   UNITS   **OGS**
Start month: 01   **End month:** 40

Objectives

− Review the most updated techniques and hottest topics regarding the applications of Digital Twins to environment (harbors, rivers, waters), daily life (human being lifestyle, medicine) and infrastructures (ports, cities, transportation system).

− Identification of product and processes that can be digitized and integrated in a proper network in order to create a connected smart environment.

− Design applications for Digital Twins in environment, daily life and infrastructures.

− Creation and eventually connection of the different applications in a smart technology perspective.

Description of Work

Task S9_RT4.1 – Review of the state of the art of the latest applications of Digital Twins to the environment, daily life and infrastructure

Task Leader: OGS (Salon)

Duration: M01 - M04

I. Broad introduction of the topic

II. Overview of the topic (from early development to stable affirmation)

III. Latest advancements and new frontiers

IV. Conclusions with identification of possible future applications of interest

Task S9_RT4.2 – Use cases developments for demonstration purposes in each field (medicine, industry, environment)

Task Leader: OGS (Salon)

Duration: M05 - M16

Within this task, the complete context of the application(s) will be identified and specified. Potential collaboration with other partners will be communicated in name and type. Contacts with partners will be taken.

The kind of data needed for the research will be detailed in source and type; moreover, it has to be stated if the data are going to be produced internally or obtained from an outside source. Preliminary data start to be collected. Hardware and software requirements have to be specified in this phase if needed for the application(s).

Task S9_RT4.3 – Integration and extension of benchmarks and use cases within project partners

Task Leader: OGS (Salon)

Duration: M17 - M28

Within this task, the actual application(s) will be implemented. A complete pipeline from input to output will be realized and tested. In case of collaboration with other entities, all the different steps are going to be discussed and agreed, iteratively. Data analysis of the application(s) outputs, errors, tests, are going to be identified in this phase.

Task S9_RT4.4 – Integration and extension of benchmarks and use cases within external partners and final deployment.

Task Leader: OGS (Salon)

Duration: M29 - M40

Within this task, the final outline of the application(s) will be developed and established. If other entities are involved, the complete deployment of the application(s) will be realized, consistently with the software and hardware requirements of the entity itself. If agreed, a final promotion of the application(s) is going to take place in this phase.
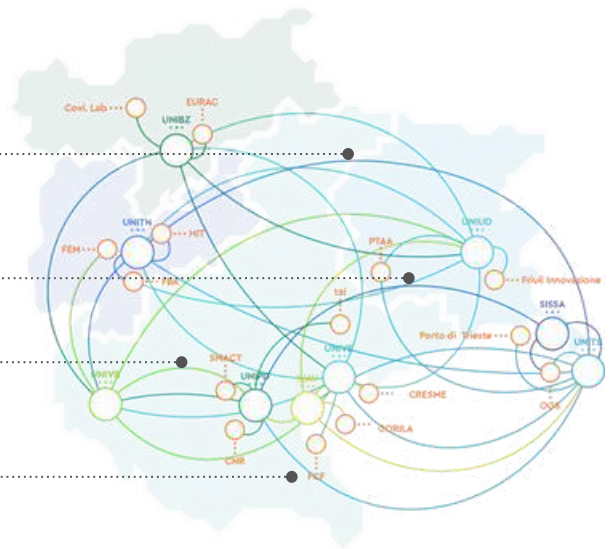
iNEST: Cross-cutting activities
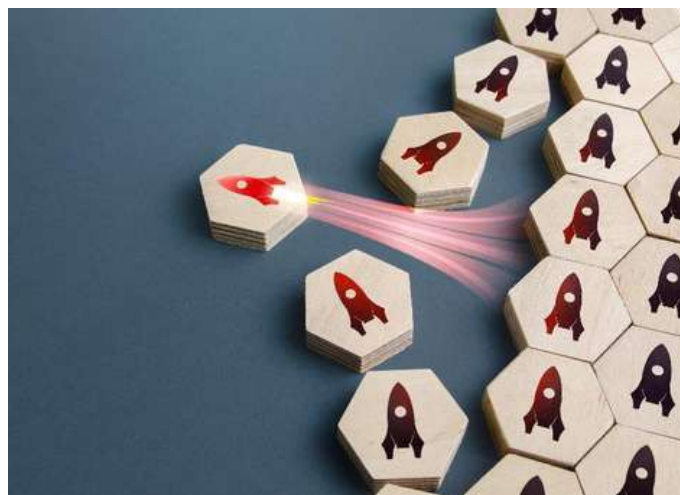
Education, from ITS to Lifelong Learning

Creation of a network of joint strategic labs between universities and companies

Citizen engagement initiatives

Support to the generation and the development of start-ups and spin-offs

Cross-Cutting Activity #1

Support to the generation and the development of start-ups and spin-offs

Leader: UNIVE

Leader

Università Ca'Foscari Venezia

Start month: 01 **End month:** 36

Objectives

Within the design of an innovation ecosystem, functional for the generation and the development of research start-ups and spin-offs, it is considered strategic to favor the development of a transversal action to all SPOKEs, characterized by:

– A decentralized, yet coordinated, management of the Pre-Acceleration phase, as a course of action entrusted to the individual SPOKEs to generate and select innovative ideas to be turned into research start-ups e spin-offs. Decentralized management allows to help the neo-entrepreneurs-to-be (students, PhDs, researchers, etc.), while the coordination allows reaching economics of replication, designing methodologies and technological platforms applicable to all SPOKEs, starting from the best cases of each university.

– A centralized management of the Acceleration & Fundraising phases, as a course of action for the definition of the business model of the research start-ups and spin-offs and the management of the investment rounds, to get those to enter the market and consequently scale up. Centralized management of the phases, along which the new enterprises face the real market (clients and investors), allows reaching economics of scale, using methodologies and technological platforms already developed and tested.

Description of Work

Task CC1.1 – Pre-Acceleration

Task Leader: UNIVE (Bagnoli)

Sub-Task CC1.1.1: Development of the Key Standardized Elements (Pre-Acceleration Framework; Pre-Acceleration Physical Spaces; Management & Educational Platform) of the pre-acceleration phase.
Duration: M01 - M04

Sub-Task CC1.1.2: Engagement and training of the Key Aligned Actors (Project Managers; Instructors; Mentors) of the pre-acceleration phase.
Duration: M01 - M04

Sub-Task CC1.1.3: Implementation of the Research Stage to attract entrepreneurs-to-be from the university's ecosystems and drive the research effort toward a proof-of-concept.
Duration: M03 - M22

Sub-Task CC1.1.4: Implementation of the Pre-Seed Stage to support the development of proofs-of-concept and to enable participants to maximize their solution-market fit by exposing them to real market actors in their target sectors.
Duration: M07 – M26

Task CC1.2 – Acceleration

Task Leader: UNIVE (Bagnoli)

Sub-Task CC1.2.1: Development of the Key Standardized Elements (Acceleration Framework; Acceleration Physical Spaces) of the acceleration phase.
Duration: M01 - M04

Sub-Task CC1.2.2: Engagement and training of the Key Aligned Actors (Project Managers; Instructors; Mentors) of the acceleration phase.
Duration: M05 - M08

Sub-Task CC1.2.3: Implementation of the Seed Stage through scouting, selection, and acceleration sub-phases.
Duration: M09 - M32

Task CC1.3 – Fundraising

Task Leader: UNIVE (Bagnoli)

Sub-Task CC1.3.1: Development of the Fundraising Network and Management.
Duration: M09 - M32

Sub-Task CC1.3.2: Implementation of the VC-Invested Stage to support investment-ready scaleups fulfilling their financial needs.
Duration: M17 - M36

Sub-Task CC1.3.3: Design of the Sustainable Stage to support scale-ups towards their final Exit-IPO or Trade-Sale.
Duration: M19 - M32

Task CC1.4 – Validation
Task Leader: UNIVE (Bagnoli)
Sub-Task CC1.4.1: Validation of project results to support the progression of the Innovation Ecosystem.
Duration: M25 - M36

Cross-Cutting Activity #2
Creation of a network of joint strategic labs between universities and companies

Leader: UNIUD

Leader

UNIVERSITÀ DEGLI STUDI DI UDINE
hic sunt futura

Start month: 01   **End month:** 40

Objectives

Lab Villages are real infrastructures, deployed in physical spaces, where people coming both from academia and research institutions and from companies join their efforts and act to create advanced products, services, or innovation artifacts. The nature of these infrastructures is not necessarily uniform, e.g., they can be traditional, physical joint laboratories as well as software infrastructures.

The specific characteristics of the outcomes of the different labs may also vary a lot, depending on the specific agreements decided case by case and place by place. They can be discussion groups on common tasks, live demos on specific topics, or even, in some cases, real prototypes being developed.

The iNEST project aims at boosting such an initiative, contributing to the advancement of the lab villages spread in the Triveneto territory. Its ultimate goal is to create a network of lab villages and to suitably connect them in such a way that companies may establish fruitful interactions with those ones that better match their interests/needs.

Description of Work

Task CC2.1 – Synthesis of the activity plan

Task Leader: UNIUD (Montanari)

Duration: M01 - M04

Definition of goals and contents of the tasks. Organization of each task. Identification of the interactions with the activities of the various spokes as well as of the other transversal initiatives.

Task CC2.2 – Consolidation and expansion of existing labs and settlement of new labs

Task Leader: FBK (Muzio)

Duration: M05 - M16

As for those spokes interested in new settlements, organization of meetings with institutions, trade associations, and companies in order to identify the most interesting scientific and technological areas from the point of view of both the territory and the project. As for those spokes with active lab villages, analysis of their strengths and weaknesses, and consolidation and expansion of the most successful existing laboratories (updating, integration, and extension of available instrumentation, consolidation of partnerships with existing participating companies and establishment of new partnerships).

Task CC2.3 – Pilot experiences, and knowledge and technology transfer initiatives

Task Leader: FBK (Muzio)

Duration: M17 - M28

Starting some pilot experiences, where there is not a lab village. As for existing lab villages, promotion of initiatives for knowledge and technology transfer, including live demos, thematic workshops, and university-companies joint seminars.

Task CC2.4 – Definition of a model of lab village and development of a network of lab villages

Task Leader: UNIUD (Montanari)

Duration: M29 - M40

Definition of an exportable model of lab village, that may support the various spokes in promoting and consolidating such an initiative. Design and organization of a network of lab villages, that jointly offer a number of opportunities to the companies operating in Triveneto. In particular, design, development, and implementation of a website, which exhibits the overall offer of the network of lab villages.

iNEST

Cross-Cutting
Activity #3
Citizens
Engagement

Leader: UNITS

Leader

UNIVERSITÀ
DEGLI STUDI
DI TRIESTE

Start month: 01   **End month:** 40

Objectives

People are at the heart of the European agenda for research and innovation. Scientific solutions must not be regarded as an end in themselves; instead, they must be a mean of bettering our lives, our communities and our environment. Citizens' engagement is therefore a key element in any research and innovation project and represents an important and strategic aspect in the frame of iNEST.

In this view, a more active citizens and societal role and engagement must be pursued, not only at the end of the process of research as a means to communicate more effectively to the audience but - more importantly – as part of the research design. Engaging citizens in defining the research questions favors the process of legitimation of scientific world, thus reinforcing a positive perception of science as a shared experience. Therefore, in iNEST, the engagement of citizens, local community and civil society will be implemented by different and integrated actions already in the phase of planning and realization. Citizens will be called to co-design and co-implement specific programs, mainly by the application of citizens science initiatives and through the mediation of communicators and/or artists. Innovative citizens engagement and dissemination actions will be implemented in order to raise awareness of the importance and impact of research and innovation in people's daily lives and to increase trust in science. Considering that the way we approach people must depend on their previous experiences and on their cultural or socio- economic context, iNEST will produce "tailored – made initiatives" according to the specific targets we want to involve (e.g. kids, schools at all levels, universities, elderly people, general citizens, specific professional categories, professors, business people, policy makers).

To reach these different targets, we also intend to use all spaces already dedicated to the heritagization of scientific knowledge (mainly museums). These spaces could be devoted to permanently connect the territory with the Spokes activities. Such activities will be in line with the recent museum definition by ICOM (2022): "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibitstangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing".

All activities will be realized in North-East of Italy – meaning, in particular the Veneto Region, the Autonomous Region of Friuli-Venezia Giulia and the Autonomous Provinces of Bolzano and Trento.

Description of Work

Task CC3.1 – iNEST Working Group on Citizens Engagement – State of the art

Task Leader: UNITS (Pedicchio)

Duration: M01 - M04

The organization and performing of Citizens Engagement initiatives and objectives will be managed by a Working Group that will be then enlarged to the participation of all interested partners and affiliates.

The WG will be highly multi- and inter-disciplinary. It will develop previous analyses on:

– Existing best practices in terms of content sharing with the public.

– Possible institutions/key actors to be involved, like Scientific Museum or other kind of Museum institutions (artistic, ethnographic, historical.), artists, experts in market surveys, opinion and institutional polls...

– Available data on distribution of community and generalized social capital in North-East of Italy.

The WG participants will collect and discuss experiences and investigate on innovative formats of citizens engagement. Possible approaches that are relating art and science will be considered. Also, different kinds of citizens target groups will be considered, with particular attentions for kids and students.

Task CC3.2 – Citizen Engagement: share experiences, codesign new formats of collaboration and first pilot experiences

Task Leader: UNITS (Pedicchio)

Duration: M05 - M16

Dissemination and engagement actions will be defined and implemented, in coordination with the Spokes. Concretely:

- At least 5 dissemination events will be organized in the North-East with a common attention to the digital aspects of the different spokes.
- A iNEST survey on citizens residing in North-East of Italy attitude towards the different topics considered in the project will be planned, and submitted to about 2.000 people: in particular, this research will focus on a general analysis of the main ways through which individuals enjoy the cultural activities organized by museums and similar institutions dedicated to the production of culture and the relationship between these ways and the sociodemographic, cultural, and socioeconomic features of respondents.
- A video and an artistic project will be planned and produced.

- A competition for schools related to the specific themes of iNEST will be designed, planned and implemented with the active involvement of professors and students.
- iNEST project and its main aspects will be included in the program of platforms like the Researchers Night, Next Festival, Barcolana Sea Summit....

Task CC3.3 – Citizen Engagement: realizations of different kinds of initiatives

Task Leader: To be defined

Duration: M17 - M28

- At least 5 dissemination events will be organized with a common attention to the digital aspects of the different spokes.
- The video and the artistic project will be presented in different locations in live sessions and exhibition as well as online.
- The iNEST survey will be presented.
- Citizens Science initiatives will be realized.
- The competition for schools related to the specific themes of iNEST will be presented in public events.

Task CC3.4 – Citizen Engagement: realizations of different kinds of initiatives and impact evaluation

Task Leader: To be defined

Duration: M29 - M40

- At least 5 dissemination events will be organized with a common attention to the digital aspects of the different spokes.
- Museum activities will continue.
- iNEST project and its main aspects will be disseminated thanks to public events like the Researchers Night, Next Festival, Festival dell'Economia, and also in events that are not strictly science oriented, but involve a large number of citizens, Barcolana Sea Summit...
- The iNEST survey will be represented to a limited number of the previous responders to verify the effect of the dissemination activities.
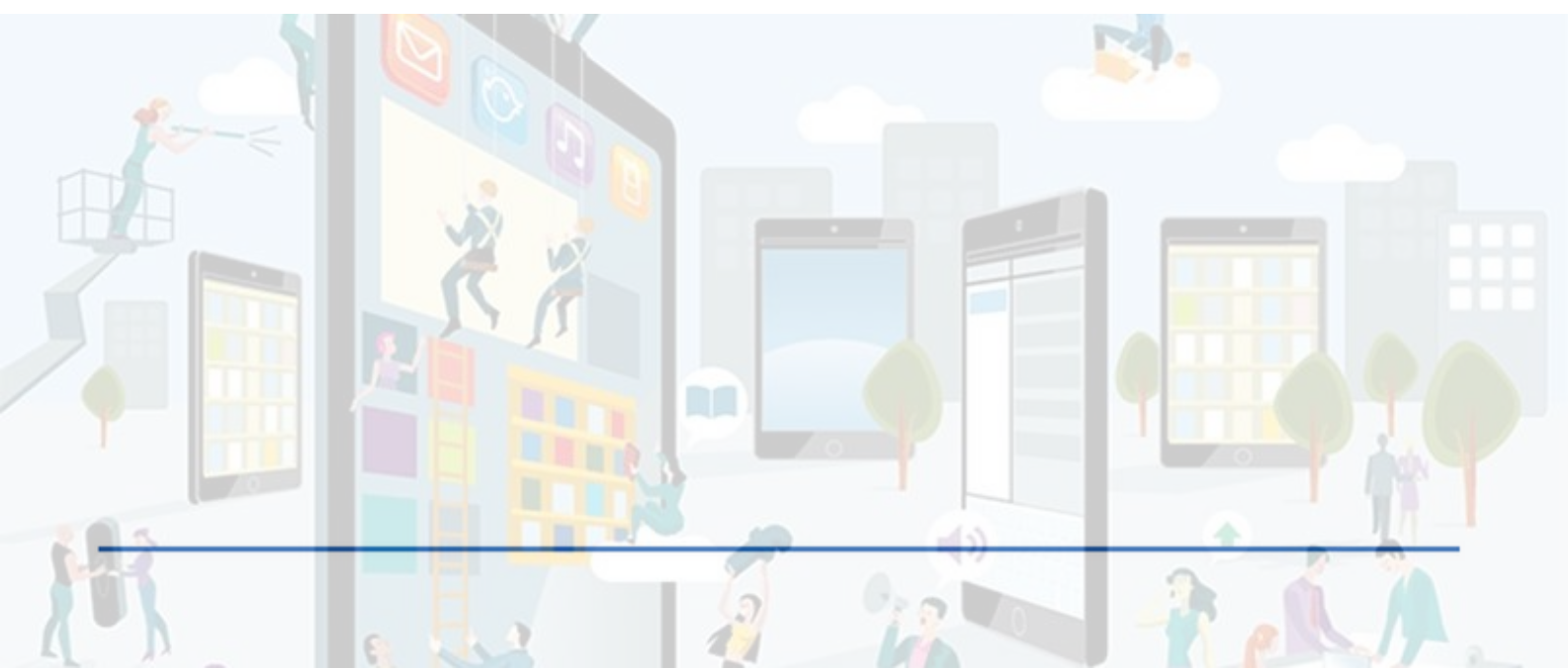
Cross-Cutting Activity #4

Education, from ITS to Lifelong Learning

Leader: UNIPD

Leader

Start month: 01   **End month:** 40

Objectives

The development of knowledge, skills, attitudes and values that enable people to contribute to and benefit from an inclusive and sustainable future is a process based on two pillars: i) Education, to equip students with the skills they need to become active, responsible and engaged citizens, and ii) Lifelong Learning, which is a strategic instrument for implementing innovation into society, with special attention paid to SMEs.

The capability of developing an integrated view of Education and Lifelong Learning paths is the key-challenge individuated in the frame of iNEST. Such challenge will be faced by designing, managing and exploiting some pilot-actions and projects, which have been identified and include the creation of an iNEST Innovation Academy and of innovative and multi-disciplinary micro-credential programs.

Such Education activities

- *must maintain strong links with environmental and social sustainability issues (inclusion, human resources...);*
- *have to be carried out in tune with the Local Public Administration as a partner of the ecosystem also operating with a focus on marginal-internal areas;*
- *should have the important role of identifying and enhancing entrepreneurial competences considered closest to iNEST's objectives and professional profiles.*

Description of Work

Task CC4.1 – iNEST 2040 Working Group on Education and Lifelong Learning

Task Leader: UNIPD (Bonollo)

Duration: M01 - M04

The organization and performing of Education and Lifelong Learning will be managed by "iNEST 2040 Working Group on Education and Lifelong Learning", which will be established with involvement of Hub, Spokes and Affiliates interested in such topics.

Task CC4.2 – Understanding Education and Lifelong learning needs and design of actions

Task Leader: To be defined

Duration: M05 - M16

In coordination with the Spokes, at least 5 matchmaking events will be organized in early 2023, to launch the iNEST 2040 survey and questionnaires. Results will be collected and elaborated.

Task CC4.3 – First cycle of iNEST 2040 Academy initiatives

Task Leader: To be defined

Duration: M17 - M28

iNEST 2040 Academy will be operative, and, from experience achieved by performing pilot events, several Education initiatives will be launched and carried out, maximizing synergies with Spokes and other Cross Cutting initiatives. Results coming from Task CC4.1 and CC4.2 will be implemented in a coordinated set of matchmaking events and lifelong learning programs based on micro-credentials, highly innovative and multi- and inter-disciplinary.

Task CC4.4 – Second cycle of iNEST 2040 Academy initiatives and final assessment

Task Leader: To be defined

Duration: M29 - M40

A second cycle of matchmaking events and lifelong learning programs based on micro-credentials will be implemented, with a strong effort devoted to upgrade of contents and increase of topics and targets. The activity on development of high TRL innovation project ideas will be replicated and enriched.

The final part of this Task will be devoted to a wide assessment activity, which will be the basis for future and permanent Education and Lifelong Learning initiatives.