POLITECNICO DI MILANO

PhD in ARCHITETTURA, INGEGNERIA DELLE COSTRUZIONI E AMBIENTE COSTRUITO / ARCHITECTURE, BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING - 37th cycle

THEMATIC Research Field: A DIGITAL TWIN BASED ON IN SITU, UAV, IOT, TLS, EO, AND OD, DATA ACQUISITION AND MONITORING FOR CLIMATE CHANGE MITIGATION POLICIES IN THE MEDITERRANEAN AREA (I.E., LAND DEGRADATION, HISTORIC SITE ABANDONMENT) SUPPORTED BY XG SOLUTIONS FOR LAST-MILE SUSTAINABLE COMMUNITIES GOVERNANCE MODELS

Monthly net income of PhDscholarship (max 36 months)
€ 1180.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The subject of this proposal is the study, definition and implementation of a social-economic-environmental-technological sustainable methodological model addressed to the analysis of the risks and pressures related to climate change threats within the Mediterranean basin, with particular attention to the internal areas of the regions of Central-Southern Italy and North Africa within international cooperation policies. In fact, in these areas pressures linked to social fragility, depopulation and ageing of the population are added to those linked to climate change and soil degradation which results in a loss not only of landscape and cultural values but also of economic and social value. The aim of the research is to implement a Digital Twin model for the definition of methods of analysis of the phenomena of land degradation and abandonment of historic centers, integrating information from different platforms (in situ, drones, satellite) for a reading of the current phenomena and their monitoring over time. The definition of areas under threats and hazards, is intended to support the development and implementation of appropriate policies

	to increase the environmental sustainability of agricultural and forestry policies as well as investment plans and land use. The purpose of implementing a multi-source digital twin is based on image processing and on the integration of data collected from ground-based sensor networks, Open Data and climate information: Big Data requiring appropriate analysis methods, interpretation and validation. In particular, the proposal provides for the prevention of techniques of Artificial Intelligence (AI) and in particular of Deep Leerning for the study and classification of images (satellite Copernicus, i.e. Sentinel-1 and Sentinel-2, from drone, and multi-sensor data for the definition of stress trends within vegetation, vegetation and desiccation indices, sustainable use of water resources. The correlation of these stress indices with the information acquired by UAV is intended to provide more detail to the analyses as well as to validate the results. The integration of advanced IOT monitoring technologies for in-situ data analysis and Digital Twins is aimed at supporting the control of response and mitigation policies activated by the slowdown of phenomena. The digital twin is addressed to the development of tools based on XG connectivity solutions for last-mile sustainable communities governance models is aimed to organize thematic pathways relating the different target groups as a lever to reach Agenda 2030 Green Deal Goals and SGDs, measuring the impact.
Methods and techniques that will be developed and used to carry out the research	• Application of advanced remote sensing data processing techniques integrating different time series and different sensors (such as drones images, Copernicus programme Sentinel-1 and Sentinel-2, Landsat); • Multi-band spectral and hyper-spectral for NDVI analysis; • Knowledge of data and analysis tools GIS and DB from remote sources for the creation of automatic or semi-automatic routines for the extraction of meaningful indices and KPI (Key Performance Indicators); • Modelling and optimisation through integration and

	validation with ground data acquisition (such as rainfall indices, desertification indices and land degradation); • Development of data harmonisation skills from different platforms, including Open Data (such as daily local rainfall data, smart metering, forecast, humidity indexes); • Knowledge in the field of IOT and sensory monitoring for the development of Digital twins aimed at connecting physical spaces and digital replication for real time control of phenomena and mitigation techniques and policies supported by XG connectivity solutions; • Development of knowledge of data analysis; • Development of analytical and management knowledge Big Data; • Development of computer knowledge in the field of artificial intelligence and deep learning techniques for the extraction of content and knowledge; • Development and implementation of an open source platform where to process cloud-edge data to support last-mile communities governance models; • Design and implementation of Multi-criteria Radar chart information management based on deep learning data processing; • eXtended Reality using VR/AR/MR implementation.
Educational objectives	• Knowledge of processing techniques, optimization of algorithms through ground-satellite integration; • Programming languages; • Current trends monitoring, through the optimization of data models for the recognition of Kpis (Key Performance Indicators); • Decision Support System (DSS) implementation based on deep learning to address sustainability, socio-economic policy planning of Public Administrations (Regions, Municipalities involved in landscape plans and risk plans still lacking environmental policies aimed at mitigating soil degradation phenomena due to climate

	change) and local communities for the activation of sustainable circular economy policies; • Best practices and recommendation for policy addressing at national, regional and local level.
Job opportunities	European centres of excellence with qualified expertise in the use of Earth Observation such as DLR (German Space Agency, Munich, GE) , Telespazio (Italy), ESA Eu Space Agency (Brussels, BE, Frascati, Italy) and NEREUS (Network EU Regions for the Use of Satellite data, Brussels, Belgium). Public Administrations at regional level, local in territorial departments. Private Industry (Companies, Smes, Smart Agriculture developers).
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 1 PhD Students
Name of the research directors	Prof. Raffaella Brumana

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	564.01 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
This schoolarship is funded by INPS (Italian National Institute for Social Previdence)   **Additional information can be found in the Regulations for the 37th Cycle of ABC-PhD:** download is available at link: *https://beep.metid.polimi.it/web/abcphd/documenti-e-media*

Additional information about ABC department and ABC-PhD programme:
available at link:
https://www.dabc.polimi.it/

Additional economic support:
Budget for the research activity:
total amount Euro 3.068,66 per student
In detail:
- 1st year 0,00 Euro
- 2nd year 1.534,33 Euro
- 3rd year 1.534,33 Euro

Computer availability:
A laptop for standard use is required.

Desk availability:
The ABC department provides non-permanent desks to be temporarily booked in common PhD rooms.

Teaching assistantship
There are various forms of financial aid for activities of support to the teaching practice.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.