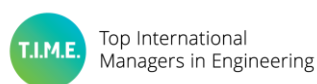


T.I.M.E. Projects 2022-2023



Application Form

Deadline for submission: **December 14th, 2021**

Please submit the completed form to: **gwenaelle.guillerme@time-association.org**

Applications must be submitted by e-mail only. You are required to attach a scanned copy of a Letter of Support signed by the Head of your Institution.

Please remember that T.I.M.E. promotes international cooperation and therefore only applications from consortia of at least three T.I.M.E. members in three different countries can be accepted.

You will be notified of the results of the selection after the Advisory Committee meeting on **February 2022**. Projects run from February 2022 to January 2023.

Title of Project	
Validation and implementation of a remote lab for environmental engineering lectures	
Acronym (if any)	
RELAB	
Details of the Applicant	
Name of Institution(s)	Universitat Politècnica de Catalunya (UPC)
Faculty/Department/Office	School of Civil Engineering; Department of Civil and Environmental Engineering (DECA)
Contact Person/s and Details	Xavier Sanchez Vila (Head of the DECA). E-mail: xavier.sanchez-vila@upc.edu . Lourdes Reig (vice dean of International Politics). E-mail: lourdes.reig@upc.edu
Summary of the Project (max. 2000 characters)	
Environmental engineering requires a strong background of concepts related to both chemistry and biology. Lab-based lectures allow students not only to apply the theoretical concepts acquired in class to practical situations, but also to handle equipment, data and instruments. Moreover, lab-based lectures are also important to make students develop other important skills (soft or generic skills) such as time management, team-work, communication, problem-solving, learning aptitude and the ability to manage heavy workloads [1]. Therefore, lab-based lectures are of paramount importance for better knowledge acquisition, consolidation and holistic formation of engineers [2]. Lab-based lectures are generally organized with small groups of students, where the contact between them (due to team-working) and between them and the professor, is very close. Unfortunately, lab-based courses within academic institutions have suffered from heavy restrictions due to the recent strike of COVID 19 pandemics, leading to almost a complete absence of this important tool for the formation of students. So far, most of the engineering schools across Europe that reinforces the biological and chemical concepts through lab-based lectures, do not have the procedures or the equipment to adequately implement remote lab courses. The objective of the RELAB project is to built up an Arduino-based model for adequately implement remote-lab lectures within the domain of environmental	

engineering, and compare the acquisition of knowledge using traditional “hands-on” courses with remote-lab courses.

[1] Stiwne, E. E., & Jungert, T. (2010). Engineering students’ experiences of transition from study to work. *Journal of education and work*, 23(5), 417-437.

[2] Jara, C. A., Candelas, F. A., Puente, S. T., & Torres, F. (2011). Hands-on experiences of undergraduate students in Automatics and Robotics using a virtual and remote laboratory. *Computers & Education*, 57(4), 2451-2461.

Reason for applying for T.I.M.E. funding (max. 2000 characters)

T.I.M.E association provides support for the development of strategic and innovative approaches to both education and science worldwide. RELAB project fits perfectly within the scope of the funding schemes of T.I.M.E association and it will improve the application of remote-lab teaching practices worldwide. The main objective of this project is to improve the available tools in civil engineering schools for the improvement of lab-courses under special circumstances (such as home-restrictions due to pandemics) or under low resources scenarios. T.I.M.E association, with its international dimension, will be of outmost help in the diffusion and application of the results of the project.

Expected outputs of the project

- 1) Construction of a Arduino-based model for remote-lab courses to be carried out in a wide range of environmental engineering related courses
- 2) Hands-on manual that allows to implement the remote lab courses to any academic institution
- 3) Comparison of knowledge acquisition between students following a traditional “hands-on” lab course and a remote lab course
- 4) A paper will be written to deliver the results of the project to the scientific community devoted to improve the education within the domain of engineering (journal selected: *Computers and Education*; Elsevier editorial).

Target group/s and expected impact

Targeted groups of students considered in the project are both undergraduate and graduate (master level). Some of the courses considered have already “hands-on” lab courses on a regular basis, other have great potential for lab-courses, especially if one considers the remote strategy of the project. Table 1 summarizes the main characteristics of the potential courses where RELAB could be implemented.

Expected impacts of the project can be summarized as follows:

From an educational point of view, we expect to specifically contribute to the European Sustainable Development Goal (SDG 4 – Quality education):

- 1) Improve the biological and chemical knowledge acquisition of students following environmental engineering courses.
- 2) Improve the logistics and tools of lab-courses under special circumstances (such as home restrictions of students, lack of resources for lab-courses to be carried out, etc,)
- 3) Promote the academic context for the development of soft skills even under a home-restriction scenario.

From an environmental point of view, we expect to contribute :

- 1) Positive impact on the environment due to the absence of mandatory traveling from home to academic institution. This will align with SDG 13 – Climate action).

From an economic point of view, we expect:

1) Better management of academic resources.

Institution	Course	Studies level	Semester	year	num. of students	Lab lectures
Politecnico di Torino	Environmental design	Master	1st	2nd	50	YES
	Purification plants with low environmental and energy impact		2nd	3rd	5	YES
	Industrial Plants for environmental engineers		1st	1st	15	YES
Instituto Superior Técnico	Sanitary Engineering	Master	1st	2nd	140	NO (potentially applicable)
	Water and wastewater treatment processes		1st	2nd	30	NO (potentially applicable)
	Environmental Biological and Chemical Engineering Processes		1st	1st	30	YES
	Environmental Biotechnology		1st	2nd	60	NO (potentially applicable)
Universitat Politècnica de Catalunya	Environmental Technology	Grade	2nd	2nd	60	YES
	Probability and Statistics	Grade	2nd	1st	120	YES
	Environmental Biology	Master	1st	1st	30	NO (potentially applicable)

Table 1. Courses selected for the project that can benefit from a remote-lab approach.

Sustainability of the programme

Most of the courses considered in the present project proposal present lab-courses (traditional “hands-on” approach) already implemented. Other courses have great potential of application (especially if resources for conducting them are low). (Table 1). Therefore, once the pilot lab system is designed and built up, the professors involved in the present project could just carry out the remote-lab courses on a sustainable manner, without the need for any more resources (or even less) than the ones that are already required. Therefore, the sustainability of the programme is very high.

Specific deliverables

Each expected outcome of the project will produce a deliverable. The following list describes the expected outcome and its associated deliverable.

- 1) Construction of a Arduino-based model for remote-lab courses to be carried out in a wide range of environmental engineering related courses. DELIVERABLE 1. Design of the Arduino model with remote module implemented (due on JUNE 2022).
- 2) Friendly guide to the development of remote-lab courses with RELAB pilot. DELIVERABLE 3. JANUARY 2023.
- 3) Statistical analysis of comparison of knowledge acquisition between students following a traditional “hands-on” lab course and a remote lab course. DELIVERABLE 4. JANUARY 2023.

Total duration of the project

The total project is expected to last one year. Table 2 summarizes the activities/tasks planned and the deliverables.

Table 2. Gantt chart and activities/tasks planned.

TASKS	YEAR											
	2022											2023
	Month											
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY
1	2	3	4	5	6	7	8	9	10	11	12	
1.Design de remote module for the Arduino pilot												
2.Assemblage and testing of the remote module												
3.Built up the hands-on manual for remote operation												
4.Testing of Arduino-base pilot with remote control with selected courses												
5.Evaluation of knowledge acquisition with remote-lab approach												
6.Reports and deliverables												

Planned budget

The requested budgeted (9.886,5 euros) is specified in Table 3:

Table 3. Budget of the project

	items	Unitari cost (eur)	total cost
pumps	10	20	200
Tubes, connectors, pvc material,...	-	-	250
Electric material (consumables)	-	-	100
Sensors for lab-lectures (turbidity, oxygen, pH, temperature,...)			1500
Arduino DUE	5	30	150
Sending equipment to partners			1000
Dragano LoRa Shield - remote radio module	5	50	250
Contract of student.	1	5000	5000
SUBTOTAL			8450
overhead (17%)			1436,5
total			9886,5

Requested financial support from T.I.M.E.

Currently, the Universitat Politècnica de Catalunya, has granted the IP of the present project (Prof. Jaume Puigagut) the cost of a student until June 2022 for developing and Arduino-based model for lab-based courses. However, the remote control unit and the cost of the student to carry out the friendly guide and the cost of materials to build up the system with remote-control unit, is out of the financial support of the UPC. Therefore, the requested financial support from T.I.M.E is the cost of the update of the Arduino-system to a remote control unit system and the production of the user guide.

Other sources of funding

Project: Innovation in teaching from Universtitat Politècnica de Catalunya. Financial support for hiring a student to work 20 hours/week. 23.000 EUROS. From September 2021 to June 2022.

Members of the consortium

The following table summarizes the people involved in the project and their role.

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Person	Status	Role		Institution
Manel Grifoll	Associate professor	Professor at Nautics School - Experience on low cost sensors		UPC
Maribel Ortego	Associate professor	Professor on statistics and probability		UPC
Enrica Uggetti	Post-doc - Ramon y Cajal	Post-doc on water quality		UPC
Person	Status	Role		Institution
Jaume Puigagut	Associate professor	Professor in Environmental Engineering - PROJECT LEADER	jaume.puigagut@upc.edu	UPC
Vincenzo Riggio	Associate professor	Professor in Environmental Engineering	vincenzo.riggio@polito.it	POLITO
Ana Galvao	Assistant professor	Professor in Environmental Engineering	ana.galvao@tecnico.ulisboa.pt	IST

Note that special care has been taken to build up a working team with gender parity.

Key Staff (Name, Position, E-mail)

Person	Status	E-mail	Institution
Jaume Puigagut	Associate professor	jaume.puigagut@upc.edu	UPC
Vincenzo Riggio	Associate professor	vincenzo.riggio@polito.it	POLITO
Ana Galvao	Assistant professor	ana.galvao@tecnico.ulisboa.pt	IST

Check List

- **Attach a signed Letter of Support from the Head of the Applicant Institution** ·

Send this form and supporting documents by e-mail only to:

gwenaelle.guillerm@time-association.org

THE DEADLINE FOR THE SUBMISSION OF APPLICATIONS IS [DECEMBER 14th 2021](#)



To whom it may concern,

By the present letter we want to express our institutional support to the proposal submitted by Prof. Jaume Puigagut to the T.I.M.E call for projects 2022. The project, entitled “validation and implementation of a remote lab for environmental engineering lectures”, aims at building up an Arduino-based equipment that will allow students from Civil Engineering Schools to follow remotely laboratory lectures within the domain of environmental engineering. We believe that the project is of capital importance to balance both the adequate management of University resources and also to improve practical skills to a wider range of students from engineering schools across Europe. Furthermore, the project will bring out a new tool to improve the teaching of lab courses under special circumstances (such as the unfortunate home-restrictions that we all have experienced from COVID pandemics).

Best regards,

MARIA
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Lourdes Reig
Vicerectora de Política Internacional

Barcelona, 7th December 2021



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Department of Civil and Environmental
Engineering

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Best regards,

FRANCISCO
JAVIER SANCHEZ
VILA - DNI
35084119B
(TCAT)

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Xavier Sánchez

Head of the Department of Civil and Environmental Engineering