AeRoTwin

Twinning coordination action for spreading excellence in Aerial Robotics

Stjepan Bogdan
UNIZG-FER

Laboratory for Robotics and Intelligent Control Systems

Established 1996

larics.fer.hr

4 professors
3 postdocs
18 PhD students
1 administrator

50+ BS and MS students

Research projects (current and last 5 years)

Title	Grant	Duration	Budget Total	Budget LARICS
AeroTwin - Twinning coordination action for spreading excellence in Aerial Robotics	EU H2020	2018 2022	990 k€	290 k€
ENCORE – ENergy aware BIM Cloud Platform in a COst-effective Building REnovation Context	EU H2020	2019 2022	5.5 M€	316 k€
MORUS - Unmanned System for Maritime Security and Environmental Monitoring	NATO SpS	2015 2019	800 k€	115 k€
EuRoC - EOLO: Wind Generator Remote Inspection System	EU FP7	2015 2018	7 M€	270 k€
SPECULARIA – Structured Ecological CULtivation with Autonomous Robots in Indoor Agriculture	HRZZ	2018 2023	280 k€	280 k€
MBZIRC – The Mohamed Bin Zayed International Robotics Challenge	Khalifa Uni.	2018 2020	140 k€	140 k€
VirtualUAVs - Development of Unmanned Aerial Systems Trained in Virtual Environments	ESI - ERDF	2020 2023	1 M€	115 k€

Research projects (current and last 5 years)

Title	Grant	Duration	Budget Total	Budget LARICS
AeroWind - Autonomous UAV inspection of wind turbine blades	EU H2020	2020 2021	6 M€	199 k€
HEKTOR – Heterogeneous autonomous robotic system in viticulture and mariculture	ESI - ERDF	2020 2023	810 k€	610 k€
ENDORSE – Effective Robotic GriNDing of Surface Areas through HORSE framework	EU H2020	2018 2019	192 k€	78 k€
ADORE – Autism Diagnostic Observation with Robot Evaluator	HRZZ	2015 2018	150 k€	150 k€
ASAP - Autonomous System for Assessment and Prediction of Infrastructure Integrity	ESI - ERDF	2019 2022	920 k€	380 k€
WatchPlant - Smart Biohybrid Phyto-Organisms for Environmental In Situ Monitoring	EU H2020	2021 2025	3.74 M€	404 k€
EkoKomvoz - Environmentally friendly vehicle for cleaning public surfaces with autonomous control system	ESI - ERDF	2020 2023	10 M€	520 k€
AerialCore - COgnitive Integrated Multi-task Robotic System with Extended Operation Range and Safety	EU H2020	2019 2023	8.59 M€	420 k€

PROJECT GOALS AND OBJECTIVES

MAIN GOAL:

- decrease networking gaps and deficiencies

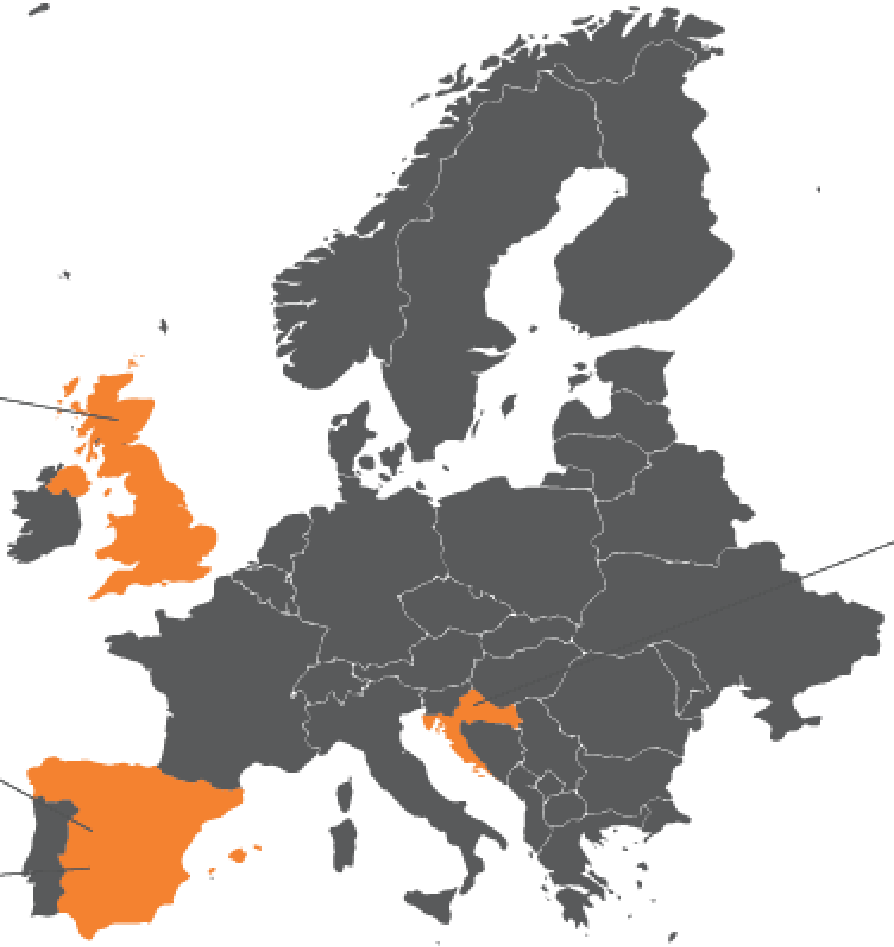
OBJECTIVES:

- increase research excellence and innovation capacity
- enhance networking capacity and scientific visibility
- improve quality of innovation management and technology transfer

Imperial College London
United Kingdom

University of Seville
Spain

Technological Corporation of Andalusia
Spain



University of Zagreb Faculty of Electrical Engineering and Computing
Croatia

1/9/2018 – ~~31/8/2021~~ 28/2/2022

€ 997,897.50

3 EU COUNTRIES

ACTIONS FOR STRENGTHENING SCIENTIFIC EXCELLENCE AND INNOVATION CAPACITY

TOWARDS OBJECTIVE 1: RESEARCH EXCELLENCE

6 joint summer schools and hands-on trainings will be organized, 2 per year

expert visits

short-term visits

joint summer schools

co-supervising PhD students

At least 4 PhD students will be co-supervised.

Table 1.3.4.1a Provisional list of planned lectures (expert visits)

ID	Provisional title	Year	SRD
USL1	On board 3D mapping based on vision and radio signals	Y1	SRD2
USL2	Distributed sensing of multiple aerial robots		SRD2
ICLL1	Bio - inspiration: Morphing aerial platforms		SRD3
ICLL2	New aerial robots with soft materials		SRD3
USL3	SLAM in complex large GNSS denied industrial environments	Y2	SRD2
USL4	Cooperation (joint tasks) with humans		SRD1
ICLL3	Autonomous configuration and run time self-configuration of aerial robots		SRD3
USL5	Heterogeneous robot cooperation	Y3	SRD1
ICLL4	Fail-safe constructions and novel propulsion systems for aerial robots		SRD3

7 staff exchanges are planned; USE will host different LARICS research staff members for 2 months, three times during the project lifetime (once per year);ICL will organize two short-time visits (2 months each); two short-term visits (for 3 weeks at CTA and for one week at ICL) are planned for UNIZG-FER project management staff.

ACTIONS FOR STRENGTHENING SCIENTIFIC EXCELLENCE AND INNOVATION CAPACITY

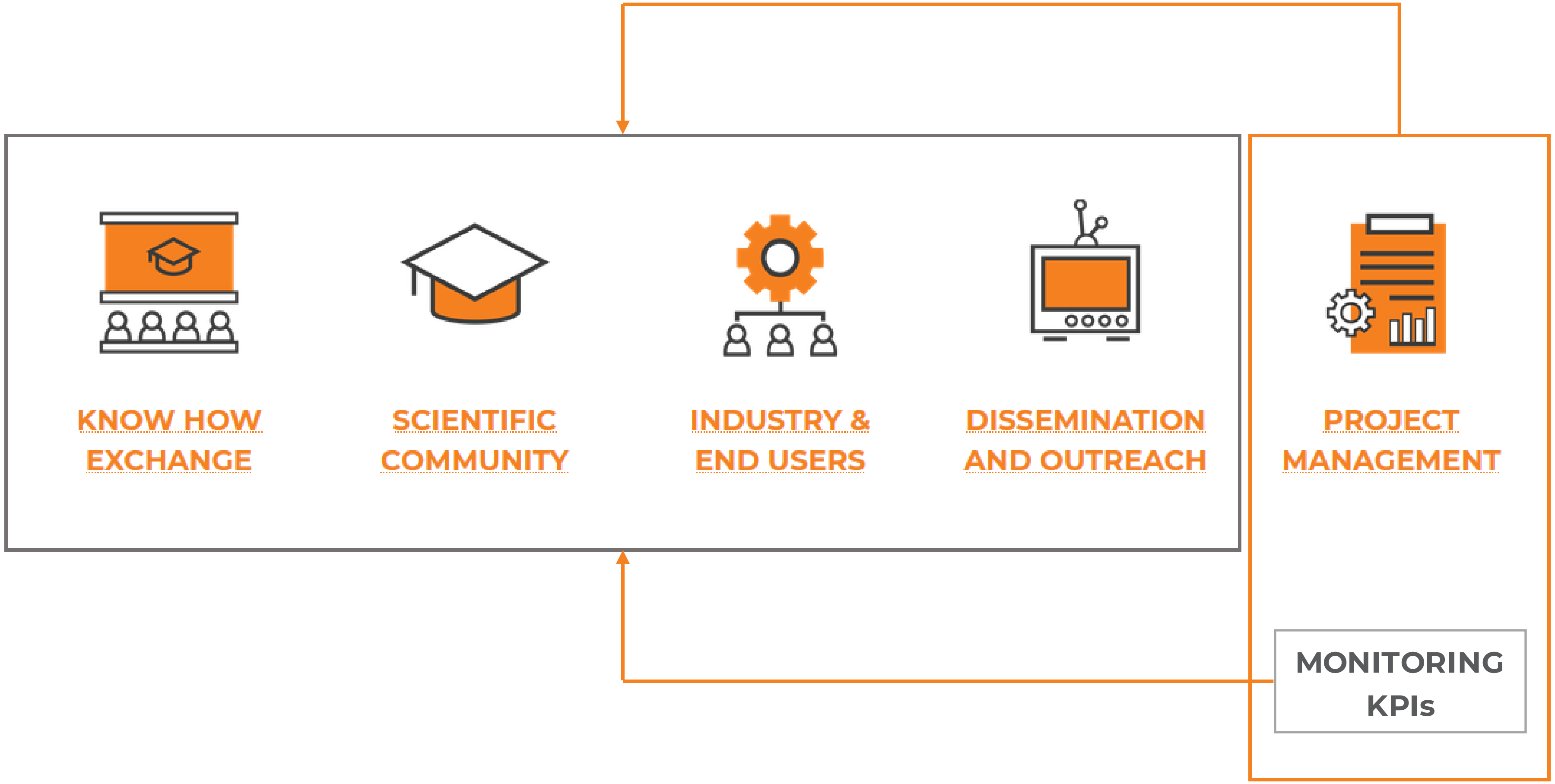
TOWARDS OBJECTIVE 2: NETWORKING CAPACITY AND VISIBILITY

- conference attendance
- special sessions organization
- workshops and tutorials attendance
- participation in joint EU and international projects
- publication of joint journal papers

TOWARDS OBJECTIVE 3: INNOVATION MANAGEMENT TRAINING AND TECHNOLOGY TRANSFER

- participation at industry fairs
- collaboration agreements with businesses
- implementation of end-user oriented workshops
- hands-on on-site trainings
- innovation management knowledge transfer
- transfer workshops

PROPOSAL (tips … and some tricks)

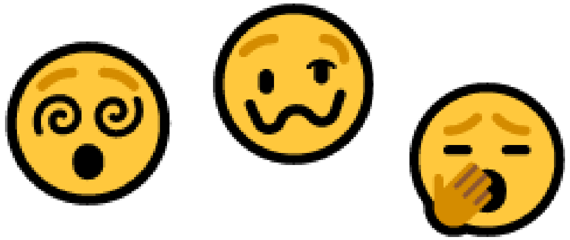


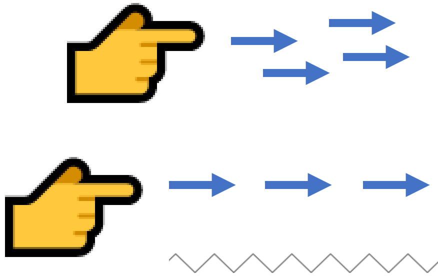
PROPOSAL (tips … and some tricks)

- You might have the smartest idea in the world, but … ***if it is not related to the call, you would not get it*** => align with the call

- ***Think of reviewers as your friends, not enemies*** => help them to smoothly go through your proposal => short & clear sentences; refer to the call wherever possible;

  => person that reads your proposal might have had a bad day, make it better;
  => don't give them "ammunition" to "shoot" at you;
  => don't confuse them, don't be boring





PROPOSAL (tips ... and some tricks)

- ***Your proposal should look nice ... literally*** => use graphics; use text boxes in colors; put important statements in text boxes, upper-right part of a page

- ***Double check numbers*** => for example, in WP description you set 12 PMs, but in Summery of staff effort for same WP there is 9 PMs

- ***Luck plays very important role***

1. Excellence

1.1 Objectives

The overarching goal of AeRoTwin is to decrease networking gaps and deficiencies between UNIZG-FER and internationally leading counterparts in EU, by significantly enhancing S&T capacity of the Laboratory for Robotics and Intelligent Control Systems (LARICS) at UNIZG-FER in the field of Aerial Robotics. Through carefully planned twinning actions, AeRoTwin will raise UNIZG-FER research profile as well as the research profile of its personnel. On the way to reach the main goal of the project, we plan to achieve the following Objectives:

Objective 1
Increase UNIZG-FER research excellence and innovation capacity in the field of aerial robotics, in the following Strategic Research Domains (SRDs): ***SRD1) Cooperative robotic missions, SRD2) Aerial robot navigation, and SRD3) Aerial robot configurability*** (explained in more details in section 1.3.2). This Objective will be achieved through:

- I. **S&T knowledge transfer** that will implement expert visits, short-term visits, joint summer schools and co-supervising PhD students,
- II. **hands-on experience** that will implement on-site trainings.

Objective 2
Enhance UNIZG-FER networking capacity and scientific visibility. This Objective will be achieved through:

- I. **strengthening links to aerial robotics research community** by conference attendance, special sessions organization, workshops and tutorials attendance, participation in joint EU and international projects and publication of joint journal papers,
- II. **dissemination and outreach activities** planned for the general public and school students.

Objective 3
Improve UNIZG-FER quality of innovation management and technology transfer. This Objective will be achieved through:

- I. **strengthening links to aerial robotics industry** by participation at industry fairs and by collaboration agreements with businesses,
- II. **strengthening links to aerial robotics end users** by implementation of end-user oriented workshops,
- III. **innovation management knowledge transfer** by organization of innovation management trainings and technology transfer workshops.

Specified objectives will be achieved through close cooperation (twinning) with University of Seville (USE), Imperial College London (ICL) and Technological Corporation of Andalusia (CTA), the leading European research and innovation intensive organizations, deeply involved in the most relevant European Robotics related initiatives and projects. The mechanism that will provide the necessary feedback for keeping the project execution in line with the workplan is based on close monitoring of Key Performance Indicators (KPIs), clearly defined and explained in section 2.1.3. Excelling LARICS research and innovation capacities will facilitate the growing field of aerial robotics, and provide the members of AeRoTwin consortium with an equal partner for future collaboration.

1.2 Relation to the work programme

AeRoTwin project is related to the *Topic identifier: WIDESPREAD-05-2017* within pillar *Spreading excellence and widening participation*. In order to clearly demonstrate direct relation to this call, herein we specify particular challenges from the call text and give our view on how AeRoTwin will address those challenges.

➔ *The specific challenge is to address networking gaps and deficiencies between the research institutions of the Widening countries and internationally-leading counterparts at EU level. Driven by the quest for excellence, research intensive institutions tend to collaborate increasingly in closed groups, producing a*

text boxes in color for important things

Project logo

been demonstrated that with an increase in the demand and use of unmanned aerial systems, accident rates among these systems are also steadily rising, with human error found to be a major causal factor [hmi5].

Unfortunate events caused by a human error lead to another important aspect of HMI design, called the humancentred approach, designed to intelligently interact with people [hmi6]. In contrast, a traditional autonomous system executes pre-written commands without even recognizing people in the environment. Once the autonomous autopilot takes over the control of an agent, the operator still needs to retain its supervisory control over the entire system. Like human subordinates, agents use their cognitive capabilities to adapt task execution to the current situation [hmi7].

AeRoTwin overall concept is built around three strategic research domains:

- ***Cooperative robotic missions,***
- ***Aerial robots navigation,***
- ***Aerial robots configurability,***

all of them recognized in Robotics 2020 Multi-Annual Roadmap (MAR) as ***key system abilities and key technology targets*** for future robotics systems.

Autonomy is just one of the components required to design an effective human machine interface. Another ***important HMI component is the manner in which the information between the human and the machine is exchanged***, which has two dimensions: i) the communications medium (visual displays, gestures, speech, non-speech auditory information and haptics), and ii) the nature of the communications (control inputs, warnings and data) [hmi2]. One of the earliest examples of haptic control interfaces was implemented in the control of large, commercial aircrafts once the fly-by-wire concept was introduced. In this earliest implementations, external aerodynamic forces were not fed directly to the joystick, but rather a set of warnings were programmed in the system. For instance, as the aircraft approached the stall, vibrations were felt in the pilot's controls, thus notifying him/her of dangerous flight conditions. ***Tactile information is very important***, especially for manipulation tasks, but as far as agent's motion is concerned, ***one can use auditory information*** and emulate aircraft motion through 3D sound positioning via headphones. The third, and probably the most common way of passing information to the operator is through visual feedback. Although very common, 2D image representation lacks the necessary depth to capture the entire motion of the aircraft and correctly interpret the surrounding environment. Nevertheless, it is possible to develop ***augmented visual feedback that automatically highlights salient information for the assigned task***. On the other hand, by using inertial measurement units, positional and hand tracking, it is possible to estimate operator's head position and movement and change the angle of view, perspective and scene. In that way operator does not have to use hands for changing information displayed at the screen, which in turn allows him/her to fully concentrate on control tasks.

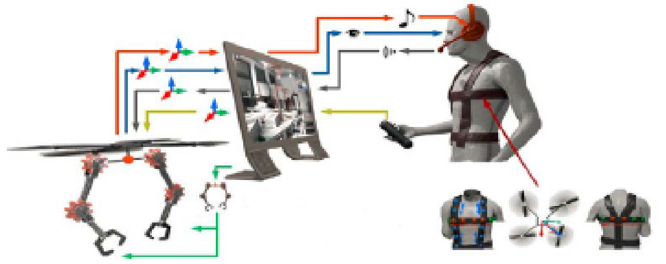


Fig. 1.3.2.1 Augmented HMI concept - human friendly command modalities, haptic cues, tactile and auditory information exchange

SRD1.B - Heterogeneous robot cooperation

No single robot is, like a Swiss Army knife, a multi-purpose machine, but when put to work together they can accomplish various tasks set before them. To achieve the overall goal of decision making in complex mission scenarios in heterogeneous robotic systems in a decentralized manner, ***one has to tackle the problems of task planning (task decomposition and allocation), and motion planning***. Two approaches can be combined (depending on a mission type): 1) ***static decentralized task-planning***, where robots use predefined plans or rules for task execution [hrc1], and 2) ***dynamic decentralized task-planning***, where plans are constructed during the task execution and are reactive to changes in the environment and within the group [hrc2]. ***One of the ways to***

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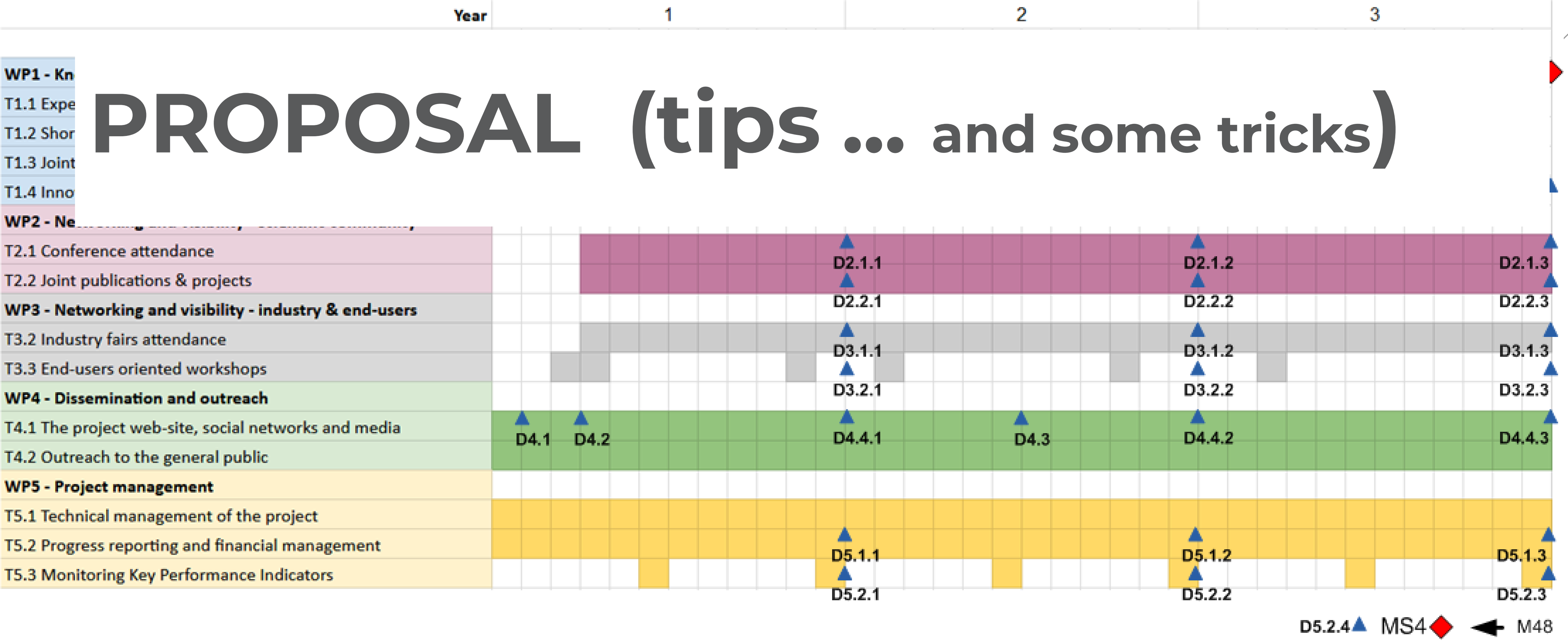
nice image

PROPOSAL (tips … and some tricks)



PROPOSAL (tips … and some tricks)

	Year 1											
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
UNIZG-FER								to CTA		to US		
US			USL1				USL2	UST1				
ICL					ICLL1				ICLL2	ICLT1		
CTA				TT1								
Expert visits				Short term visit							Hands-on	

	Year 2											
	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
UNIZG-FER			to ICL					to ICL			to US	
US		USL3								USL4	UST2	
ICL						ICLL3	ICLT2					
CTA					TT2							
Expert visits					End-user wksh							Inov. trainig

	Year 3											
	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
UNIZG-FER				to ICL						to US		
US								USL5	UST3			
ICL						ICL4	ICLT3					
CTA		TT3										
Expert visits												

PROPOSAL (tips … and some tricks)

In order to keep a track of the project execution, we defined Key Performance Indicators (KPIs)

KPI1 - Publications

KPI2 - Participation in national and EU research projects

KPI3 - Innovation and technology transfer

KPI4 - Networking and visibility

Table 2.1.3.c KPI3 - Innovation and technology transfer

In this area of activity LARICS performance is way below international research groups. Any increase of defined KPIs will be a quantum leap for our laboratory.	**2012 - 2017**	**M36**
KPI3.1 *Number of agreements with businesses (cumulative)*	0	3
KPI3.2 *Number of patent applications (cumulative)*	0	1
KPI3.3 *Number of commercialization agreements (cumulative)*	0	2
KPI3.4 *Number of new innovative products or services (cumulative)*	0	2

and .... You Got It!


AeRoTwin
LARICS


Ultimake

conference attendance

special sessions organization

workshops and tutorials attendance

participation in joint EU and international projects

publication of joint journal papers


quipo
AeRoTwin
Twinning coordination action for spreading excellence in Aerial Robotics
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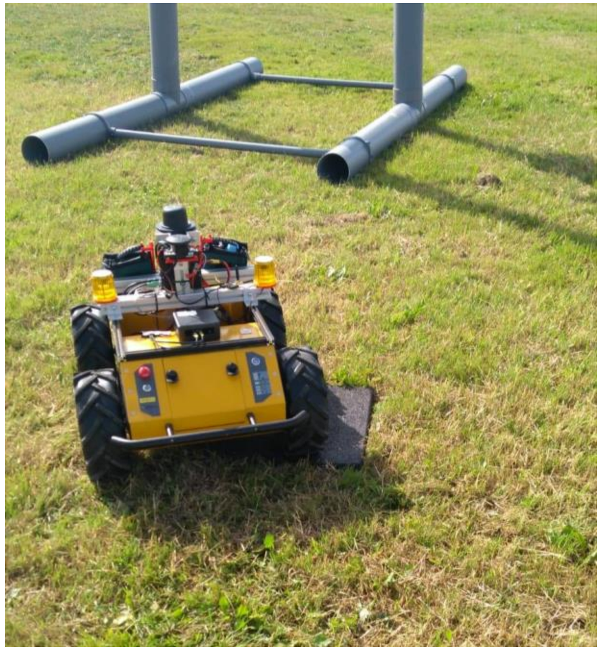
www.fibra.hr


2018 IEEE/RSJ International Conference
on Intelligent Robots and Systems
TOWARDS A ROBOTIC SOCIETY
October, 1-5, 2018 | Madrid, Spain, Madrid Municipal Conference Centre
MADRID 2018
IROS


BTS
BLS




CERTIFICATE
LARICS
EUROPEAN
ROBOTICS
LEAGUE


FER@ROBOTICS

participation at industry fairs

collaboration agreements with businesses

implementation of end-user oriented workshops

DRONEDAYS

aerial vehicles end-user workshop

26 – 27 MARCH / FER / ZAGREB, CROATIA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 810321.


AquaMAV-RoboBee



TECHNOLOGICAL CHALLENGES


DRONEDAYS PILOT


AVITEH
dronova i opreme
www.aviteh.hr


HRVATSKA
TOPCON


HRVATSKA KONTROLA
ZRAČNE PLOVIDBE
AMC
PORTAL
INFORM BEFORE FLIGHT
DPO

DISSEMINATION AND OUTREACH


33
DOBRO JUTRO,
HRVATSKA
EUROPSKI TJEDAN
ROBOTIKE


09:36


23. Smotra Sveučilišta u Zagrebu
Prehrambeno-biotehnološki fakultet
Studentski centar, Savska 25, Zagreb
150.000 likes


Test your sensors

hands-on on-site trainings

innovation management
knowledge transfer

transfer workshops


Laboratory for underwater systems and technologies (LABUST)


DRONEDAYS
FER


ZAHVALNICA
DARIO LESIĆ
ZAHVALNICA
GORAN BAJČI
ZAHVALNICA
ZAHVALNI
JOSIP ĆURIN

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