

Strengthening Research and Innovation Excellence in Autonomous Aerial Systems



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UNIZG-FER

Call: HORIZON-WIDERA-2021-ACCESS-05

European Excellence Initiative (EEI):

Strengthening capacity for excellence in higher education institutions and surrounding ecosystems





25 researchers

- 4 professors
- 3 postdocs
- 18 PhD students
- 1 administrator

50+ BS and MS students



Major 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€

Major 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 2022	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€

An idea to stream AeroTwin projet positive effects and results.



PROJECT GOALS AND OBJECTIVES

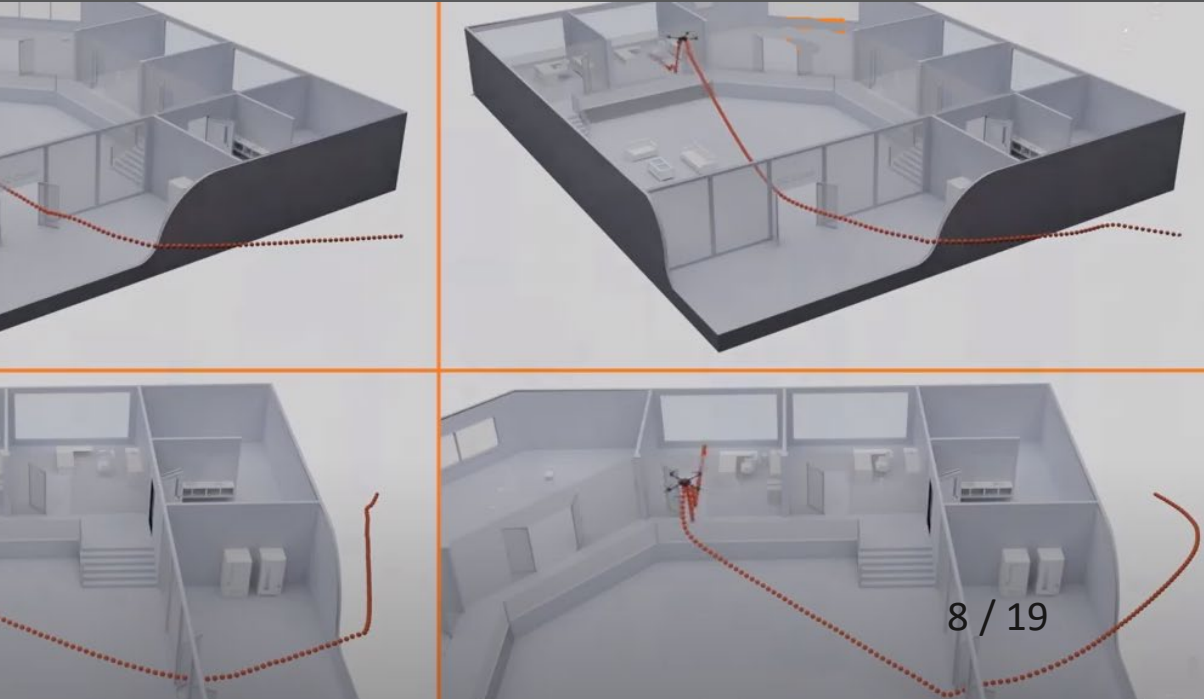
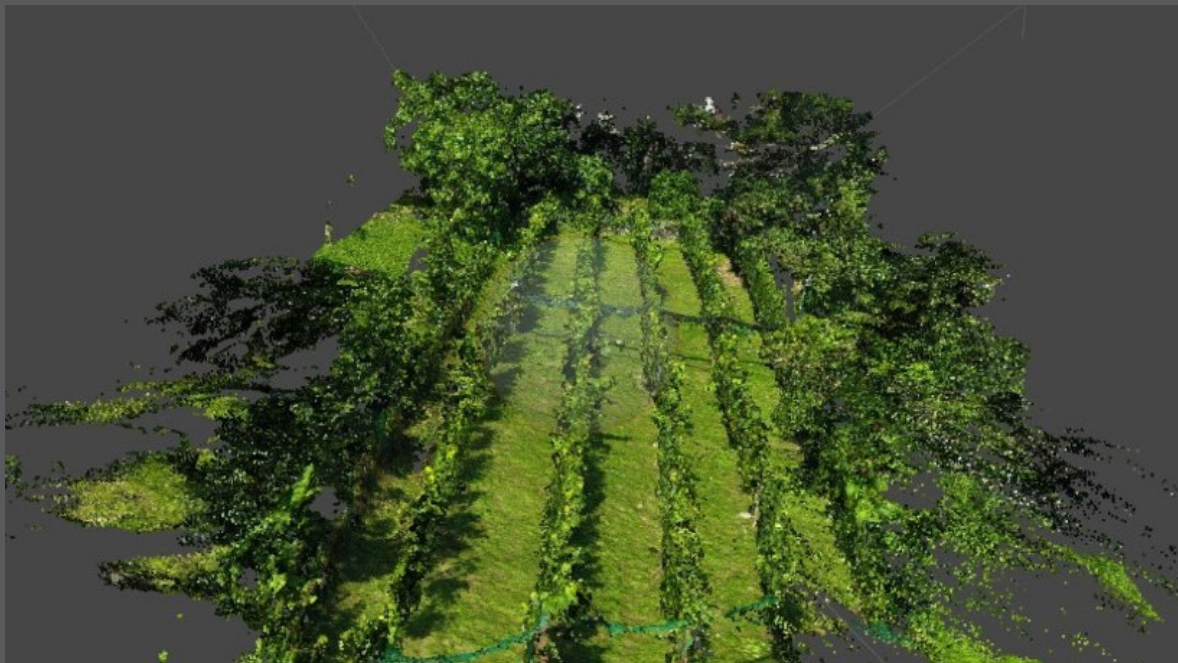
MAIN GOAL:

- prepare and establish a long lasting and integrated cooperation
- increase of innovation capabilities of widening HEIs (w-HEIs) and their surrounding ecosystem

OBJECTIVES:

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

Autonomous aerial systems (AAS) applications with emphasis on smart agriculture, forestry, and logistics.



Partners

Info Day 2022

Number	Role	Short name	Legal name	Country
1	COO	FER	SVEUCILISTE U ZAGREBU FAKULTET ELEKTROTEHNIKE I RACUNARSTVA	HR
2	BEN	UNISA	UNIVERZITET U SARAJEVU	BA
3	BEN	CATEC	FUNDACION ANDALUZA PARA EL DESARROLLO AEROSPACIAL	ES
4	BEN	CTA	FUNDACION CORPORACION TECNOLOGICA DE ANDALUCIA	ES
5	BEN	FSB	SVEUCILISTE U ZAGREBU, FAKULTET STROJARSTVA I BRODOGRADNJE	HR
6	BEN	ICENT	INOVACIJSKI CENTAR NIKOLA TESLA	HR
7	BEN	PRL	PROTOSTAR LABS	HR
8	BEN	FTTS	SVEUCILISTE U ZAGREBU FAKULTET PROMETNIH ZNANOSTI	HR
9	BEN	SAX	STICHTING SAXION	NL
10	BEN	F4F	FLY4FUTURE S.R.O.	CZ
11	BEN	FRS	FLYING ROBOTIC SOLUTIONS SOCIEDAD LIMITADA	ES
12	AP	USE	UNIVERSIDAD DE SEVILLA	ES
13	AP	CTU	CESKE VYSOKE UCENI TECHNICKE V PRAZE	CZ
14	AP	UT	UNIVERSITEIT TWENTE	NL

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01/7/2022 – 30/06/2025



1.995.700,00



5 EU countries

9 / 19



Horizon Europe
2021-2027

ACTIONS FOR STRENGTHENING SCIENTIFIC EXCELLENCE AND INNOVATION CAPACITY

TOWARDS OBJECTIVE 1: RESEARCH EXCELLENCE

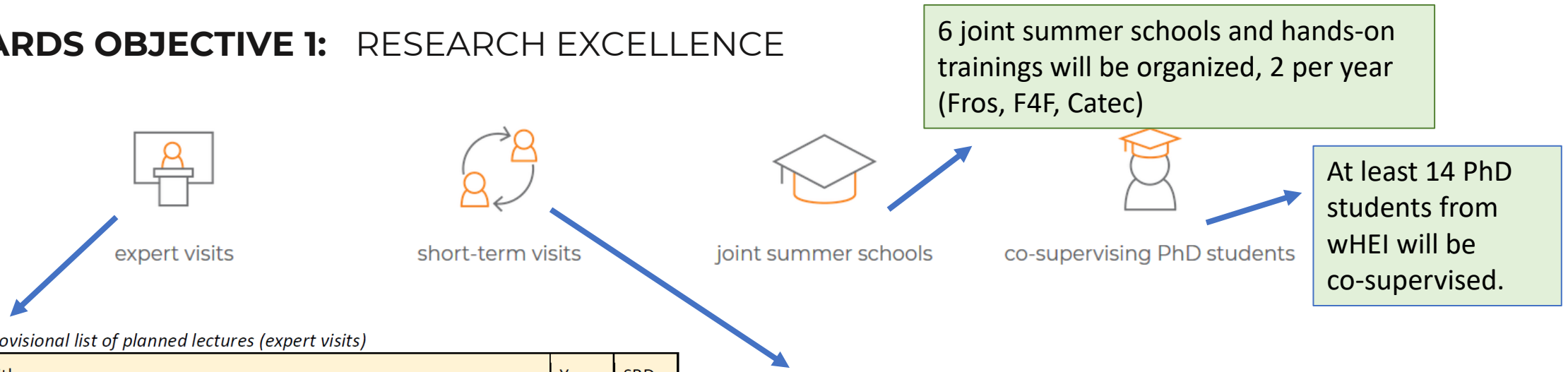


Table 1.3.4.1a Provisional list of planned lectures (expert visits)

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



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



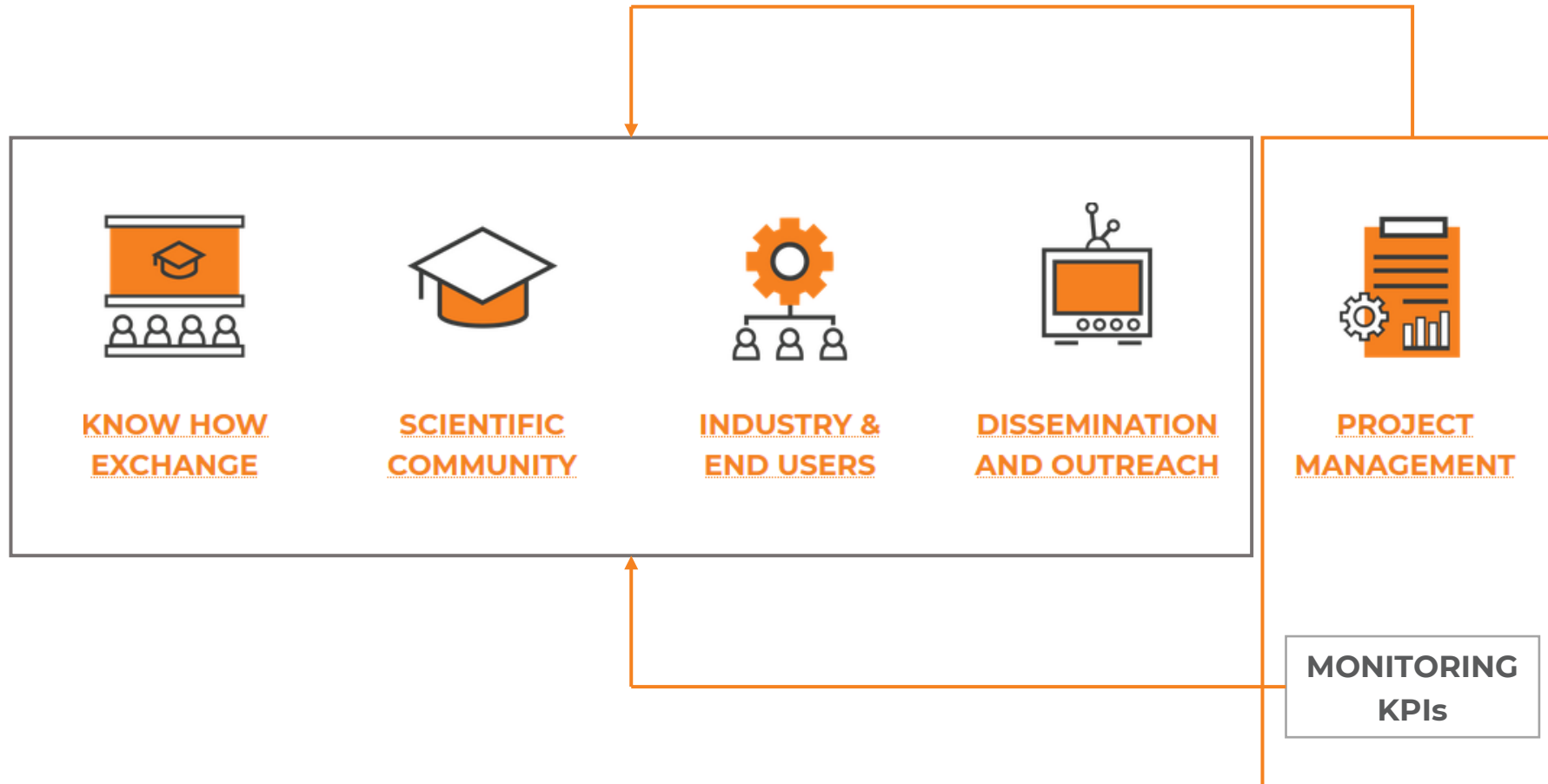
innovation management knowledge transfer



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

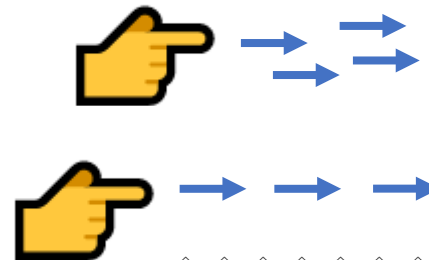


- ***Think of reviewers as your friends, not enemies*** => help them to smoothly go through your proposal => short & clear sentences; refer to the call wherever possible;

=> 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 Summary of staff effort for same WP there is 11 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*

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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].

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.

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.

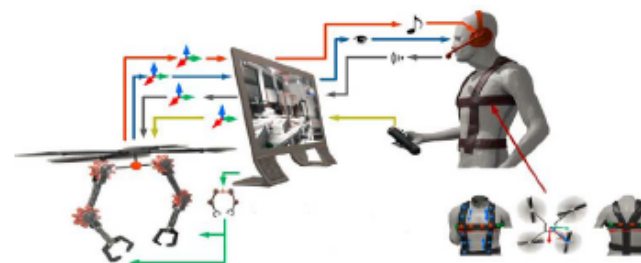


Fig. 1.3.2.1 Augmented HMI concept - human friendly command modalities, haptic cues, tactile and auditory information exchange

SRD1.B - Heterogeneous robot cooperation

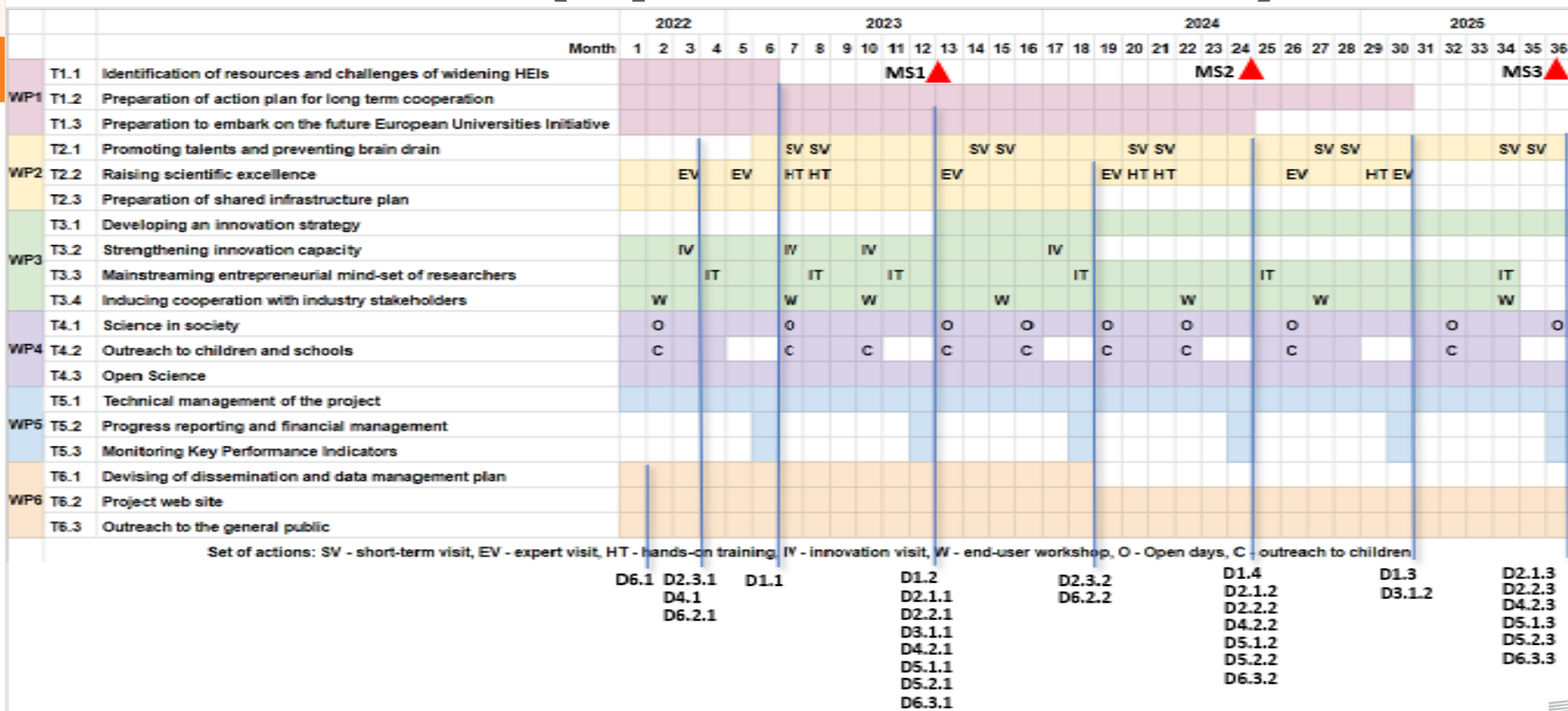
No single robot is, like a Swiss Army knife, a multi-purpose machine, but when put to work together they can accomplish various tasks set before them. To achieve the overall goal of decision making in complex mission scenarios in heterogeneous robotic systems in a decentralized manner, **one has to tackle 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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the page

nice image



PROPOSAL (tips ... and some tricks)



PROPOSAL (tips ... and some tricks)

Table 2.1.3 Key performance indicators (some of them)

	2016 - 2021				AeroSTREAM M36			
	UNISA	FSB	FTTS	FER	UNISA	FSB	FTTS	FER
KPI1.1 Avg. No. of publications in Q1&Q2 journals per year	2,2	5,40	1,6	4	4	8	3	7
KPI1.2 Avg. No. of conference publications per year	9	8	7	10	12	12	10	15
KPI1.3 Avg. No. of citations per year (Scopus)	106	59	46	100	150	20	60	150
KPI2.1 Avg. No. of nat. and internat. proposal submitted per year	0,5	2,20	4	6	3	4	6	8
KPI2.2 Percentage of nat. and internat. proposal granted	35%	45%	30%	40%	40%	45%	40%	40%
KPI3.1 Number of agreements with businesses (cumulative)	11	2	5	8	15	5	8	14
KPI3.2 Number of innovative products or services (cumulative)	8	0	0	3	10	2	2	5
KPI4.1 Percentage of joint publications	80%	0	20%	20%	80%	20%	30%	30%
KPI4.2 Number of joint events (cumulative)	20	0	11	14	30	6	20	25
KPI4.3 Co-supervising of PhD students (cumulative)	8	6	2	5	12	8	5	10
KPI4.4 Number of outreach events for public (cumulative)	10	2	15	15	20	8	25	25
KPI4.5 Number of participations at ind. fairs (cumulative)	6	0	5	7	9	4	9	12

and ... You Got It!





THANK YOU!

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