Please check our wiki for help on navigating the form.

Horizon 2020

Call: H2020-ICT-2018-20

(Information and Communication Technologies)

Topic: ICT-51-2020

Type of action: RIA

Proposal number: 957076

Proposal acronym: TADDIS

Deadline Id: H2020-ICT-2020-1

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How to fill in the forms

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the steps in the submission wizard.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

1 - General information

Topic	ICT-51-2020	Type of Action	RIA
Call Identifier	H2020-ICT-2018-20	Deadline Id	H2020-ICT-2020-1

Acronym	TADDIS
Proposal title	AI technologies and semantic data fusion for enhanced analytics and decision-making on massive and diverse data streams in maritime, energy and space

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months	*36*
Fixed keyword 1	Big data
Fixed keyword 2	Scalability
Fixed keyword 3	Real time data analytics
Fixed keyword 4	Data visualization
Fixed keyword 5	Machine learning, statistical data processing and applications using
Free keywords	*Scalable semantic technologies, predictive analytics, Deep Learning, Federated learning, Data fusion*

Abstract

The convergence of Big Data Analytics and data-intensive modeling, simulations and location-enabled analytics, transforms and empowers digital infrastructures, interconnected systems and business processes, adding value to massive data assets of very large volume, velocity, variety and veracity. TADDIS indexes multiple data sources in a scalable and semantic way, offering efficient access to and communication among structured and unstructured data sources, as the volumes of diverse data from distributed sources is rapidly increasing. The processing of large streams of data involves Deep learning, Federated learning, and predictive analytics, which are optimised on HPC infrastructures, targeting the extraction of high-level knowledge and semantics from low-level data representations, in a real-time manner. The TADDIS ontologies cover the geospatial, maritime and energy sectors, linking data of extremely large volumes and a plethora of attributes per data asset. A novel architecture that combines cloud and distributed processing is developed to support decision making and extreme scale analytics in three pilot use cases. First, a cloud infrastructure from the geospatial industry (DIAS) validates new processes, such as business intelligence, digital engineering and workflow automation, to deliver content and solutions to any business sector, any level of governments, and to the civil society. Second, TADDIS is validated in emission modeling, where additional data assets on-board of a ship with passengers' mobile phones acting as sensors and video content from CCTVs that can be fully exploited to offer a unique emission modeling solution in the maritime sector. Third, in the energy sector, and especially energy exchange platforms at a national level, validate and evaluate the monitoring capabilities and short-term forecasting of TADDIS so as to create high value services with economic impact and their insertion into the market as a new product.

Remaining characters 26

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Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

Please give the proposal reference or contract number.	
xxxxxx-x	

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Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection

The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database.

2 - Participants & contacts

#	Participant Legal Name	Country	Action
1	EVERIS SPAIN SL	Spain	
2	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	ES	
3	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	Greece	
4	UNIVERSITAT POLITECNICA DE CATALUNYA	ES	
5	SERCO ITALIA SPA	IT	
6	NATIONAL OBSERVATORY OF ATHENS	EL	
7	ACCELIGENCE LTD	CY	
8	XLAB RAZVOJ PROGRAMSKE OPREME IN SVETOVANJE DOO	SI	
9	INDEPENDENT POWER TRANSMISSION OPERATOR SA	EL	
10	SCHWEIZERISCHES FORSCHUNGSINSTITUT FUER HOCHGEBIRGSKLIMA UND MEDIZIN IN DAVOS	CH	
11	ANONIMI NAFTILIAKI ETERIA KRITIS (ANEK) S.A.	EL	
12	EXUS SOFTWARE LTD	UK	
13	everis Portugal SA	Portugal	
14	ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON	EL	
15	UNIVERSITA DEGLI STUDI DI TRENTO	IT	

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2 - Administrative data of participating organisations

PIC	***Legal name***
999938081	*EVERIS SPAIN SL*

Short name: EVERIS SPAIN SL

Address of the organisation

Street AVENIDA MANOTERAS 52

Town MADRID

Postcode 28050

Country Spain

Webpage www.everis.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Support Smart Innovation ☐ not applicable

☒ Same as proposing organisation's address

Street: AVENIDA MANOTERAS 52

Town: MADRID

Postcode: 28050

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	
Same Group	everis Portugal SA	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: ○ Male ◉ Female

First name: **Ana**

Last name: **Gonzalez**

E-Mail: **ana.gonzalez.segura@everis.com**

Position in org.: R&D Project Consultant

Department: Support Smart Innovation ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: AVENIDA MANOTERAS 52

Town: MADRID Post code: 28050

Country: Spain

Website: www.everis.com

Phone: +34963477373 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Administration	Services	stevroch@gmail.com	+xxx xxxxxxxxx
Sara	Gonzalez	susi_funding@everis.com	+xxx xxxxxxxxx

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PIC	***Legal name***
999655520	*BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION*

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/03/2005 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Computer Sciences - Data Centric Computing ☐ not applicable

☒ Same as proposing organisation's address

Street: Calle Jordi Girona 31

Town: BARCELONA

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **David** Last name: **Carrera**

E-Mail: **david.carrera@bsc.es**

Position in org.: DATA CENTRIC COMPUTING GROUP MANAGER

Department: Computer Sciences - Data Centric Computing ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Calle Jordi Girona 31

Town: BARCELONA Post code: 08034

Country: Spain

Website:

Phone: +xxx xxxxxxxxx Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Juan Luis	Pérez	juan.luis.perez@bsc.es	+xxx xxxxxxxxx
Jorda	Polo	jorda.polo@bsc.es	+xxx xxxxxxxxx
Susana	Vaquero	susana.vaquero@bsc.es	+xxx xxxxxxxxx

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PIC	***Legal name***
998802502	*ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS*

Short name: CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS CERTH

Address of the organisation

Street CHARILAOU THERMI ROAD 6 KM

Town THERMI THESSALONIKI

Postcode 57001

Country Greece

Webpage WWW.CERTH.GR

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....04/03/2009 - no

SME self-assessment ..... unknown

SME validation sme.....04/03/2009 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

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Department(s) carrying out the proposed work

Department 1

Department name: Information Technologies Institute ☐ not applicable

☒ Same as proposing organisation's address

Street: CHARILAOU THERMI ROAD 6 KM

Town: THERMI THESSALONIKI

Postcode: 57001

Country: Greece

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **Stefanos** Last name: **Vrochidis**

E-Mail: **stefanos@iti.gr**

Position in org.: Senior Researcher

Department: Information Technologies Institute ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: CHARILAOU THERMI ROAD 6 KM

Town: THERMI THESSALONIKI Post code: 57001

Country: Greece

Website: https://mklab.iti.gr/

Phone: +30 2311 257754 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Vivi	NTRIGKOGIA	vividrig@iti.gr	+30 2311 257791
Ilias	Gialampoukidis	heliasgj@iti.gr	+30 2311 257810
Ioannis	Kompatsiaris	ikom@iti.gr	+30 2311 257774
Maria	Papadopoulou	marpap@iti.gr	+30 2311 257726
Gerasimos	Antzoulatos	gantzoulatos@iti.gr	+xxx xxxxxxxxx
Elias	Kosmatopoulos	kosmatop@iti.gr	+xxx xxxxxxxxx
Christos	Korkas	chriskorkas@iti.gr	+xxx xxxxxxxxx
Eleni	Kamateri	ekamater@iti.gr	+xxx xxxxxxxxx

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PIC	***Legal name***
999976202	*UNIVERSITAT POLITECNICA DE CATALUNYA*

Short name: UPC

Address of the organisation

Street CALLE JORDI GIRONA 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.upc.edu

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....yes

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....05/03/2014 - no

SME self-assessment .....05/03/2014 - no

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

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Department(s) carrying out the proposed work

Department 1

Department name: Department of Nautical Sciences and Engineering ☐ not applicable

☐ Same as proposing organisation's address

Street: Pla de Palau, 18

Town: Barcelona

Postcode: 08003

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: ○ Male ◉ Female

First name: **Anna** Last name: **Mujal**

E-Mail: **anna.mujal@upc.edu**

Position in org.: Lecturer

Department: Department of Nautical Sciences and Engineering ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Pla de Palau, 18

Town: Barcelona Post code: 08003

Country: Spain

Website:

Phone: +34934017923 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Marel-la	Castells	mcastells@cen.upc.edu	+xxx xxxxxxxxx
Daniel	Gonzalez	daniel.gonzalez-marco@upc.edu	00344017393
Agustín	Sánchez-Arcilla	agustin.arcilla@upc.edu	+34934016472
Irene	Jorge	cttinfo.europeus@upc.edu	+xxx xxxxxxxxx

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PIC	***Legal name***
998734311	*SERCO ITALIA SPA*

Short name: SERCO

Address of the organisation

Street VIALE DELLA TECNICA 161

Town ROMA

Postcode 00144

Country Italy

Webpage www.serco.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....27/11/2008 - no

SME self-assessment ..... unknown

SME validation sme.....27/11/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Serco Space Copernicus Department ☐ not applicable

☐ Same as proposing organisation's address

Street: 22-24, Via Sciadonna

Town: Frascati

Postcode: 00044

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Dr.

Sex: (•) Male ( ) Female

First name: **Guido** Last name: **Vingione**

E-Mail: **guido.vingione@serco.com**

Position in org.: Director Business Development

Department: Serco Europe Business Unit, Space Copernicus Department ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Via Sciadonna

Town: Frascati Post code: 00044

Country: Italy

Website:

Phone: +39 06 983 54 408 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Gabriella	Scarpino	gabriella.scarpino@serco.com	*+39 06 9835 4445*
Mario	D Alessio	mario.dalessio@serco.com	*+39 06 98350 875*

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PIC	***Legal name***
999653677	*NATIONAL OBSERVATORY OF ATHENS*

Short name: NOA

Address of the organisation

Street LOFOS NYMFON

Town ATHINA

Postcode 11810

Country Greece

Webpage www.noa.gr

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....22/04/2008 - no

SME self-assessment ..... unknown

SME validation sme.....22/04/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Institute of Astronomy Astrophysics Space Application and Remote

☐ not applicable

☐ Same as proposing organisation's address

Street: Metaxa & Vassileos Pavlou Street

Town: Penteli, Athens

Postcode: 15236

Country: Greece

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **Ioannis** Last name: **Papoutsis**

E-Mail: **ipapoutsis@noa.gr**

Position in org.: Associate Researcher

Department: Institute of Astronomy, Astrophysics, Space Apps & Remote Sensing (IAASA ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Karystou 6

Town: Athens Post code: 11523

Country: Greece

Website: www.astro.noa.gr

Phone: +210 3490016 Phone 2: +xxx xxxxxxxxx Fax: +302106138343

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Haris	Kontoes	kontoes@noa.gr	*+302103490011*
Anastasios	Trypitsidis	atrypitsidis@noa.gr	*+302103490015*
Panagiotis	Kosmopoulos	pkosmo@meteo.noa.gr	*+xxx xxxxxxxxx*

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PIC	***Legal name***
900037005	*ACCELIGENCE LTD*

Short name: ACCELLIGENCE

Address of the organisation

Street ELEFTHEROUPOLEOS 1, KENNEDY TOWER

Town NICOSIA

Postcode 1076

Country Cyprus

Webpage www.accelligence.tech

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....22/11/2018 - yes

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

No department involved

Department name: *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street: *Please enter street name and number.*

Town: *Please enter the name of the town.*

Postcode: *Area code.*

Country: *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Pantelis** Last name: **Velanas**

E-Mail: **pvelanas@accelligence.tech**

Position in org.: CEO

Department: ACCELIGENCE LTD ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: ELEFTHEROUPOLEOS 1, KENNEDY TOWERS

Town: NICOSIA Post code: 1076

Country: Cyprus

Website: https://www.accelligence.tech/

Phone: +xxx xxxxxxxxx Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Rea	Levantinou	rea.levantinou@accelligence.tech	+xxx xxxxxxxxx

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
999773375	*XLAB RAZVOJ PROGRAMSKE OPREME IN SVETOVANJE DOO*

Short name: XLAB

Address of the organisation

Street POT ZA BRDOM 100

Town LJUBLJANA

Postcode 1000

Country Slovenia

Webpage http://xlab.si

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....31/12/2018 - yes

SME self-assessment .....31/12/2018 - yes

SME validation sme.....31/12/2008 - yes

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: XLAB Research ☐ not applicable

☒ Same as proposing organisation's address

Street: POT ZA BRDOM 100

Town: LJUBLJANA

Postcode: 1000

Country: Slovenia

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name: **Jolanda** Last name: **Modic**

E-Mail: **jolanda.modic@xlab.si**

Position in org.: Security and Privacy Project Manager and Researcher, Data Protection Advis

Department: XLAB Research ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: POT ZA BRDOM 100

Town: LJUBLJANA Post code: 1000

Country: Slovenia

Website: www.xlab.si

Phone: +386 12447750 Phone 2: *+xxx xxxxxxxxx* Fax: +386 12447770

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Daniel	Vladusic	daniel.vladusic@xlab.si	*+38612447750*
Flavio	Fuart	flavio.fuart@xlab.si	*+38612447750*

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

PIC	***Legal name***
953977056	*INDEPENDENT POWER TRANSMISSION OPERATOR SA*

Short name: IPTO or ADMIE

Address of the organisation

Street Dyrrachiou str. & Kifisou 89

Town ATHENS

Postcode 10443

Country Greece

Webpage www.admie.gr

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....24/02/2012 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

No department involved

Department name: *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street: *Please enter street name and number.*

Town: *Please enter the name of the town.*

Postcode: *Area code.*

Country: *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Mr. Sex: (•) Male ( ) Female

First name **Dimitris** Last name **Zografos**

E-Mail **d.zografos@admie.gr**

Position in org.: IT Manager, Infrastructure and technical support

Department: INDEPENDENT POWER TRANSMISSION OPERATOR SA ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: Dyrrachiou str. & Kifisou 89

Town: ATHENS Post code: 10443

Country: Greece

Website: http://www.admie.gr/nc/en/home/

Phone: +302109466855 Phone 2: +xxx xxxxxxxxx Fax: +302104637111

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Georgios	Krestos	gkrestos@admie.gr	*+302109466958*
Ιωάννα	Λαρίσση	i.larissi@admie.gr	*+xxx xxxxxxxxx*
Σταμάτης	Μιχαλάκης	smichalakis@admie.gr	*+xxx xxxxxxxxx*

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PIC	***Legal name***
998859732	*SCHWEIZERISCHES FORSCHUNGSINSTITUT FUER HOCHGEBIRGSKLIMA UND MEDIZIN IN DA*

Short name: PMOD WRC

Address of the organisation

Street PROMENADE 35

Town DAVOS PLATZ

Postcode 7270

Country Switzerland

Webpage www.sfi-davos.ch

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....11/11/2008 - yes

SME self-assessment ..... unknown

SME validation sme.....11/11/2008 - yes

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: World Radiation Center ☐ not applicable

☐ Same as proposing organisation's address

Street: Dorfstrasse 33

Town: Davos Dorf

Postcode: 7260

Country: Switzerland

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Dr. Sex: (•) Male ( ) Female

First name: **Stelios** Last name: **Kazadzis**

E-Mail: **stelios.kazadzis@pmodwrc.ch**

Position in org.: Senior Researcher

Department: World Radiation Center ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Dorfstrasse 33

Town: Davos Dorf Post code: 7260

Country: Switzerland

Website:

Phone: +41 81 417 5137 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Barbara	Bücheler	barbara.buecheler@pmodwrc.ch	*+xxx xxxxxxxxx*

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PIC	***Legal name***
998901248	*ANONIMI NAFTILIAKI ETERIA KRITIS (ANEK) S.A.*

Short name: ANEK LINES S.A.

Address of the organisation

Street LEOFOROS KARAMANLI

Town CHANIA

Postcode 73100

Country Greece

Webpage www.anek.gr

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....19/08/2008 - no

SME self-assessment ..... unknown

SME validation sme.....19/08/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Information Technology ☐ not applicable

☒ Same as proposing organisation's address

Street: LEOFOROS KARAMANLI

Town: CHANIA

Postcode: 73100

Country: Greece

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Mrs

Sex: ○ Male ◉ Female

First name: **Maria**

Last name: **EMMANOUILIDOU**

E-Mail: **memmanouilidou@anek.gr**

Position in org.: Director

Department: European Affairs

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: LEOFOROS KARAMANLI

Town: CHANIA

Post code: 73100

Country: Greece

Website: www.anek.gr

Phone: +302108093371

Phone 2: +302108093373

Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Michail	PACHNOS	mpachnos@anek.gr	*+302108093372*

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PIC	***Legal name***
952567840	*EXUS SOFTWARE LTD*

Short name: EXUS

Address of the organisation

Street OLD BROAD STREET 25 TOWER 42

Town LONDON

Postcode EC2N 1PB

Country United Kingdom

Webpage www.exus.co.uk

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....08/06/2015 - yes

SME self-assessment .....31/12/2014 - yes

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

No department involved

Department name: *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street: *Please enter street name and number.*

Town: *Please enter the name of the town.*

Postcode: *Area code.*

Country: *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Mr.

Sex: (•) Male ( ) Female

First name: **Giorgos**

Last name: **Konstantinidis**

E-Mail: **gk@exus.co.uk**

Position in org.: CEO

Department: EXUS SOFTWARE LTD ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: OLD BROAD STREET 25 TOWER 42

Town: LONDON Post code: EC2N 1PB

Country: United Kingdom

Website: www.exusinnovation.co.uk

Phone: +44 2 081237407 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Dimitris	Kanakidis	dkan@exus.co.uk	*+302107450347*
Anaxagoras	Fotopoulos	a.fotopoulos@exus.co.uk	*+30 2107450374*

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PIC	***Legal name***
907835320	*everis Portugal SA*

Short name: everis Portugal

Address of the organisation

Street Pç. Duque de Saldanha, nº 1, 10º E,

Town Lisbon

Postcode 1050-094

Country Portugal

Webpage https://www.everis.com/portugal/pt-pt/home-pt

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Data & Analytics ☐ not applicable

☒ Same as proposing organisation's address

Street: Pç. Duque de Saldanha, nº 1, 10º E,

Town: Lisbon

Postcode: 1050-094

Country: Portugal

Dependencies with other proposal participants

Character of dependence	***Participant***	
Same Group	EVERIS SPAIN SL	

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Person in charge of the proposal

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Title: Mr. Sex: (•) Male ( ) Female

First name: **Hugo** Last name: **Balseiro**

E-Mail: **hugo.balseiro.santos@everis.com**

Position in org.: Director

Department: Data and Analytics ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Pç. Duque de Saldanha, nº 1, 10º E,

Town: Lisbon Post code: 1050-094

Country: Portugal

Website: https://www.everis.com/portugal/pt-pt/home-pt

Phone: +351 962 103 082 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

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PIC	***Legal name***
999643007	*ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON*

Short name: NKUA

Address of the organisation

Street 6 CHRISTOU LADA STR

Town ATHINA

Postcode 10561

Country Greece

Webpage www.elke.uoa.gr

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....yes

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....25/09/2008 - no

SME self-assessment ..... unknown

SME validation sme.....25/09/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Informatics and Telecommunications ☐ not applicable

☐ Same as proposing organisation's address

Street: Panepistimioupolis, Ilisia

Town: Athens

Postcode: 15771

Country: Greece

Dependencies with other proposal participants

Character of dependence	***Participant***	

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Person in charge of the proposal

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Title: Prof. Sex: (•) Male ( ) Female

First name: **Manolis** Last name: **Koubarakis**

E-Mail: **koubarak@di.uoa.gr**

Position in org.: Professor

Department: Informatics and Telecommunications ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Panepistimioupolis, Ilisia

Town: Athens Post code: 15771

Country: Greece

Website: www.uoa.gr

Phone: +302107275213 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Lydia	Themeli	lthemeli@di.uoa.gr	*+302107275207*

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PIC	***Legal name***
999841954	*UNIVERSITA DEGLI STUDI DI TRENTO*

Short name: UNITN

Address of the organisation

Street VIA CALEPINA 14

Town TRENTO

Postcode 38122

Country Italy

Webpage www.unitn.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....yes

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....14/08/1982 - no

SME self-assessment .....14/08/1982 - no

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Department(s) carrying out the proposed work

Department 1

Department name: Information Engineering and Computer Science ☐ not applicable

☐ Same as proposing organisation's address

Street: Via Sommarive 5

Town: Trento-Povo

Postcode: 38123

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Person in charge of the proposal

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Title: Prof. Sex: (•) Male ( ) Female

First name: **Lorenzo** Last name: **Bruzzone**

E-Mail: **lorenzo.bruzzone@unitn.it**

Position in org.: Full professor

Department: Information Engineering and Computer Science ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Via Sommarive 9

Town: Trento-Povo Post code: 38123

Country: Italy

Website: https://www.disi.unitn.it/

Phone: +390461282056 Phone 2: +390461283966 Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Laura	Paternoster	laura.paternoster@unitn.it	*+390461283230*
Graziano	Giordano Olivieri	graziano.giordano@unitn.it	*390461285341*

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3 - Budget

No	Participant	Country	(A) Direct personnel costs/€	(B) Other direct costs/€	(C) Direct costs of sub-contracting/€	(D) Direct costs of providing financial support to third parties/€	(E) Costs of inkind contributions not used on the beneficiary's premises/€	(F) Indirect Costs / € (=0.25(A+B-E))	(G) Special unit costs covering direct & indirect costs / €	(H) Total estimated eligible costs / € (=A+B+C+D+F+G)	(I) Reimburse-ment rate (%)	(J) Max.EU Contribution / € (=H*I)	(K) Requested EU Contribution/ €
1	Everis Spain Sl	ES	234188	31000	0	0	0	66297,00	0	331485,00	100	331485,00	331485,00
2	Barcelona Supercomputing Center -	ES	189000	20000	0	0	0	52250,00	0	261250,00	100	261250,00	261250,00
3	Ethniko Kentro Erevnas Kai Technologikis	EL	482400	55000	0	0	0	134350,00	0	671750,00	100	671750,00	671750,00
4	Universitat Politecnica De Catalunya	ES	155380	22000	0	0	0	44345,00	0	221725,00	100	221725,00	221725,00
5	Serco Italia Spa	IT	276000	38000	0	0	0	78500,00	0	392500,00	100	392500,00	392500,00
6	National Observatory Of Athens	EL	284800	26000	0	0	0	77700,00	0	388500,00	100	388500,00	388500,00
7	Acceligence Ltd	CY	136000	22000	0	0	0	39500,00	0	197500,00	100	197500,00	197500,00
8	Xlab Razvoj Programske Opreme In	SI	253000	36500	0	0	0	72375,00	0	361875,00	100	361875,00	361875,00
9	Independent Power Transmission	EL	45000	18000	0	0	0	15750,00	0	78750,00	100	78750,00	78750,00
10	Schweizerisches Forschungsins	CH	363000	23000	0	0	0	96500,00	0	482500,00	100	482500,00	482500,00

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11	Anonimi Naftiliaki Eteria Kritis	EL	185600	20000	0	0	0	51400,00	0	257000,00	100	257000,00	257000,00
12	Exus Software Ltd	UK	382500	39000	0	0	0	105375,00	0	526875,00	100	526875,00	526875,00
13	Everis Portugal Sa	PT	194250	35500	0	0	0	57437,50	0	287187,50	100	287187,50	287187,50
14	Ethniko Kai Kapodistriako Panepistimio	EL	216000	31000	0	0	0	61750,00	0	308750,00	100	308750,00	308750,00
15	Universita Degli Studi Di Trento	IT	157500	28000	0	0	0	46375,00	0	231875,00	100	231875,00	231875,00
	Total		3554618	445000	0	0	0	999904,50	0	4999522,50		4999522,50	4999522,50

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4 - Ethics

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	◉ Yes ○ No	117
Are they volunteers for social or human sciences research?	○ Yes ◉ No	
Are they persons unable to give informed consent?	○ Yes ◉ No	
Are they vulnerable individuals or groups?	○ Yes ◉ No	
Are they children/minors?	○ Yes ◉ No	
Are they patients?	○ Yes ◉ No	
Are they healthy volunteers for medical studies?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	◉ Yes ○ No	115
Does it involve the collection and/or processing of sensitive personal data (e.g: health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	○ Yes ◉ No	
Does it involve processing of genetic information?	○ Yes ◉ No	
Does it involve tracking or observation of participants?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	◉ Yes ○ No	116
5. ANIMALS		**Page**

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Does your research involve animals?	◯ Yes ◉ No	
6. THIRD COUNTRIES		Page
In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	◯ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	◯ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	◯ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	◯ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	◯ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	◯ Yes ◉ No	
7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	◯ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	◯ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	◯ Yes ◉ No	
8. DUAL USE		Page
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	◯ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		Page
Could your research raise concerns regarding the exclusive focus on civil applications?	◯ Yes ◉ No	
10. MISUSE		Page
Does your research have the potential for misuse of research results?	◯ Yes ◉ No	
11. OTHER ETHICS ISSUES		Page
Are there any other ethics issues that should be taken into consideration? Please specify	◯ Yes ◉ No	

This proposal version was submitted by **Administration SERVICES** on **16/01/2020 16:48:06** Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

5 - Call-specific questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

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TADDIS: AI TECHNOLOGIES AND SEMANTIC DATA FUSION FOR ENHANCED ANALYTICS AND DECISION-MAKING ON TREMENDOUS AMOUNTS OF DIVERSE DATA STREAMS IN MARITIME, ENERGY AND SPACE

Work programme topic addressed

ICT-51-2020: Big Data Technologies and Extreme Scale Analytics

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ict-51-2020

Coordinator

Ana González Segura, EVERIS Spain, SLU, Spain, ana.gonzalez.segura@everis.com

Part. no.	Participant organisation name	Part. short name	Country
1 (CO)	EverisSpain, SLU	EVR	Spain
2	Barcelona Supercomputing Center	BSC	Spain
3	Information Technologies Institute, Centre for Research and Technology Hellas	CERTH	Greece
4	Polytechnic University of Catalonia	UPC	Spain
5	Serco Italia SpA	SERCO	Italy
6	National Observatory of Athens	NOA	Greece
7	Accelligence	ACCELI	Cyprus
8	XLAB razvoj programske opreme in svetovanje doo	XLAB	Slovenia
9	Independent Power Transmission Operator	IPTO	Greece
10	Physikalisch-Meteorologisches Observatorium Davos / World Radiation Center	PMODWRC	Switzerland
11	ANEK Lines SA	ANEK	Greece
12	Exus Software LtD	EXUS	United Kingdom
13	Everis Portugal SL	EVRPORT	Portugal
14	National and Kapodistrian University of Athens	UoA	Greece
15	University of Trento	UniTN	Italy

No	AB Name	AB Institution
1	Pedro Puigdengoles Briones	Ports de Les Illes Balears
2	Antoni Tio Sauleda	Associacio Barcelona Cluster Nautic
3	Oriol Altisench i Barbeito	Canals i Ports de Catalunya
4	Grigoris Antoniou	University of Huddersfield
5	John Soldatos	University of Glasgow
6	Gerardo Gantes Rodriguez	MRCC Barcelona
7	HoonJoo Yoon	Sundosoft LtD
8	George Vouros	University of Piraeus
9	Philippe Chrobocinski	Airbus Defence and Space

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List of abbreviations			
AI	Artificial Intelligence	**IPR**	Intellectual Property Rights
(C/D/R)NN	Convolutional/Deep/Recurrent Neural Networks	**KB**	Knowledge Base
GDPR	General Data Protection Regulation	**KPIs**	Key Performance Indicators
IoT	Internet of Things	**KRs**	Key Results
RTM	Radiative Transfer Model	**AIS**	Automatic Identification System
PUCs	Pilot Use Cases	**ML**	Machine Learning

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1 EXCELLENCE

The convergence of **Big Data Analytics** and **data-intensive models**, **simulations** and **location-enabled** analytics, transforms and empowers digital infrastructures, interconnected systems and business processes, adding value to **massive data assets** of very large **volume**, **velocity**, **variety** and **veracity**. The management of large and heterogeneous data sources and the extraction of valuable knowledge and commercial value through a **High-Performance Data Analytics** (**HPDA**) platform is a sine qua non condition for the development of innovative engineering applications and business solutions. In the space sector, the central storage and indexing of **more than 100 petabytes of Copernicus data** and information in five cloud-based infrastructures, known as the DIAS (https://www.copernicus.eu/en/access-data/dias), offer a new set of data assets where any Big Data platform is able to test, validate and standardise the developed technologies in extreme-scale analytics. In the maritime sector, emission modeling requires not only **real-time AIS data** on the position and route of every ship, but additional data assets are added in the analysis, less structured than sensor data, which need to be effectively indexed in a scalable and semantic way. In the energy sector, cloud densities can be observed in large areas using terabytes of data, fused with weather data and other in-situ data assets, to **provide rapid, short-term estimations and precise predictions** about the solar irradiance and energy amounts in energy exchange platforms.

To that end, TADDIS indexes multiple data sources in a scalable and semantic way (UoA), offering efficient access to and communication among structured and unstructured data sources, as the volumes of diverse data from distributed sources is rapidly increasing. The processing of large streams of data involves Deep learning, Federated learning (CERTH, NOA, BSC), and predictive analytics (XLAB) which are optimised on HPC infrastructures (BSC), targeting the extraction of high-level knowledge and semantics from low-level data representations, and formulate the TADDIS Intelligent Analytics integrating the AI workflows (EXUS). The TADDIS ontologies cover the geospatial, maritime and energy sectors, linking data of extremely large volumes and a plethora of attributes per data asset. A novel architecture that combines cloud and distributed processing (EVERIS) and scalable user interfaces are developed to support decision making and extreme scale analytics in three pilot use cases. First, a cloud infrastructure from the geospatial industry (SERCO) validates new processes, such as business intelligence, digital engineering and workflow automation, to deliver content and solutions to any business sector, any level of governments, and to the civil society. Second, TADDIS is validated in emission modeling, where AIS (UPC) and additional data assets on-board of a ship (ANEK) with passengers' mobile phones acting as sensors and video content from CCTVs are fully exploited to offer a unique emission modeling solution in the maritime sector. Third, in the energy sector, and especially energy exchange platforms at a national level (IPTO), validate and evaluate the monitoring capabilities and short-term forecasting (PMOD, NOA) of TADDIS so as to create high value services with economic impact and their insertion into the market as a new product. The overall concept of TADDIS aligned with the following objectives is illustrated in Figure 1.1.

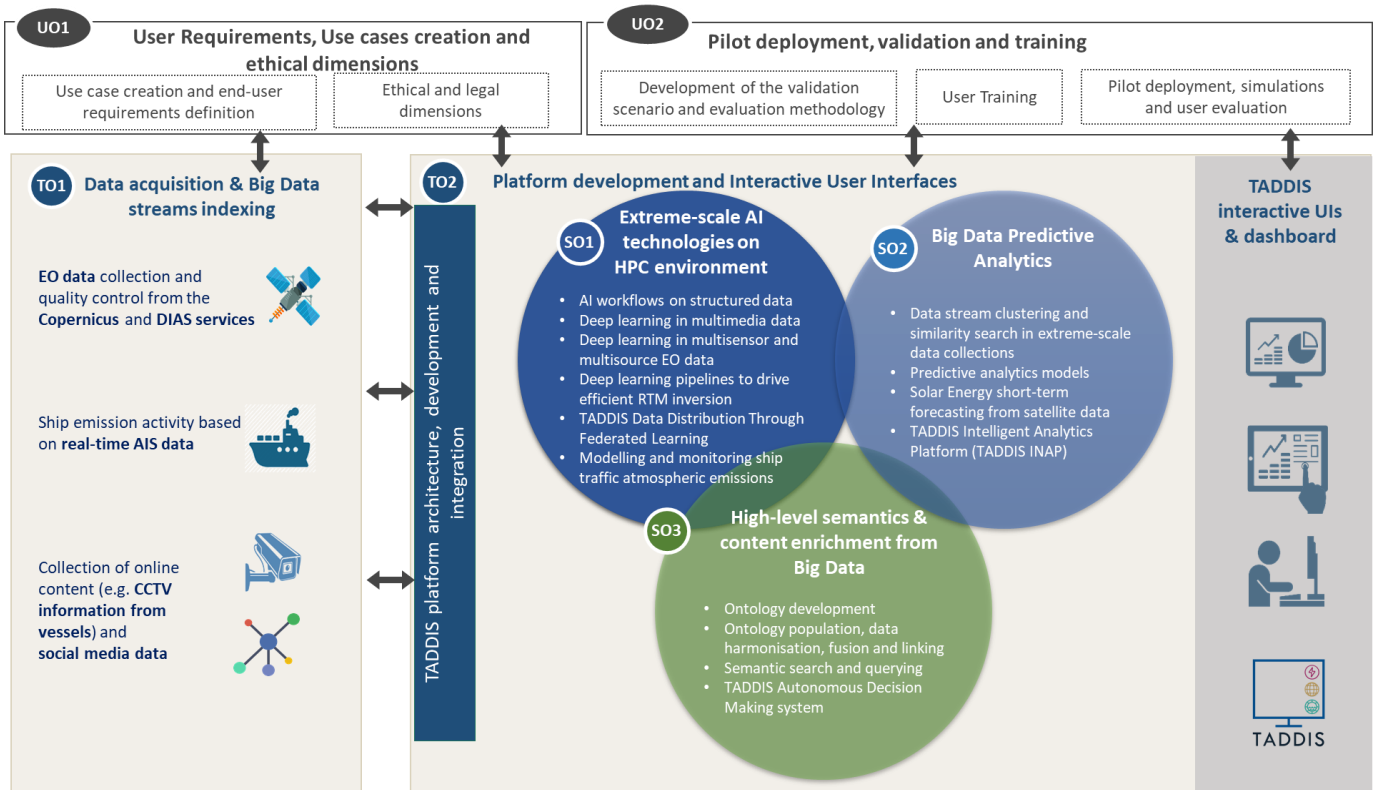

Figure 1.1: The overall TADDIS concept

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1.1 Objectives

The overall objective of the project is to exploit existing **HPC infrastructure** and **edge processing capacities to collect large streams of raw data, combining different approaches (EO data, IoT sensor data, weather data, AIS data, social media), processing** them on the **edge and** on the **cloud** in a **secure** and **efficient** manner. The project **boosts** the **research/scientific efforts** to deliver **value-added data** through **novel predictions, visualisations** and **extreme scale analytics for decision making on HPC environment. TADDIS** proposed approaches aim to demonstrate as a **novel industrial solution** to three main sectors**: maritime**, **energy** and **space**.

Existing approaches are closed and provide fragmented solutions focusing on a very specific problem, that an industry face. This leads to technological advances with limited interoperability in designed solutions. One the other hand, the massive and diverse data that are generated rapidly due to the penetration of new technological achievements to every aspect of our lives increase the challenges for accurate, reliable and timely intelligent analytical processes and solutions. TADDIS fosters collaboration among large and diverse European industries in cross- and multi-disciplinary approaches. Specifically, TADDIS will create a highly-scalable federated and well-orchestrated architecture (**TO2**) that allows robust extreme-scale AI and Big Data Predictive Analytics processes on **HPC environments** for **processing both at the edge and at the cloud level (SO1 and SO2). Semantic content management and enrichment** technologies are also part of a high-level analysis for the delivery of interpretable information and autonomous decision-making capabilities to end users adapted to the considered TADDIS industrial applications (**SO3**).Hence, large-scale data streams coming from AIS and sensor data, as well as cameras (CCTVs mounted on vessels), social media, satellites and real-time AIS data (**TO1**) can be processed efficiently to quickly extract concepts and to detect events effectively, so as to be useful to industrial end users, taking also into account the recent General Data Protection Regulation (GDPR) and the upcoming ePrivacy EU Regulation.

1.1.1 Scientific Objectives (SOs) and Research Activities (RAs)

TADDIS will use and advance SoA extreme-scale analytics and big data technologies to deliver highly-scalable solutions towards to enhance the predictive models' accuracy and machine/deep learning performance. TADDIS addresses a number of multidisciplinary Scientific Objectives (SO), each relating to a specific challenge defined by the current and foreseen needs. In the following, we describe each SO and provide details on the respective Research Activities (RA) they consist of.

SO1. Extreme-scale AI technologies on HPC environment: One of the main objectives of the TADDIS is to design and develop novel, robust and scalable machine/deep learning algorithms enable to work on HPC environments and handle extremely large volumes and streams of data.

RA1.1 AI workflows on structured data: RA1.1 aims to develop a virtual platform for designing Machine Learning workflows with user-friendly manner facilitating users to create rapid prototypes consolidating AI algorithms.
RA1.2 Deep learning in multimedia data: RA1.2 deals with the application and evaluation of deep learning techniques on air quality estimation by considering visual information.
RA1.3 Deep learning in multisensor and multisource Earth Observation data: RA1.3 deals with the design and the development of deep learning techniques that can efficiently integrate and classify multisensor and multisource EO data.
RA1.4 Deep learning pipelines to drive efficient radiative transfer model inversion:RA1.4 designs and tests advanced deep learning architectures as Gaussian processes to invert a Radiative Transfer Model (RTM) and forecast physically meaningful, spatially explicit, and temporally resolved maps of **solar spectral irradiances.**
RA1.5 TADDIS Data Distribution Through Federated Learning: In RA1.5 we will design and implement novel federated learning architectures aiming to optimize the data distribution and training on multi-node systems.
RA1.6 Modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona: In RA1.6 innovative AI methods in HPC and low-power environments, enabling to collect and process AIS data will be developed, aiming to improve the quality of data and ship emissions estimations.

	Key Results	Deliverable
RA1.1	**KR01** Virtual platform for AI workflows	D4.1, D4.5
RA1.2	**KR02** Deep Learning Networks for multimedia data	D4.2, D4.6
RA1.3	**KR03**Deep learning Networks for multisensor and multisource EO data	D4.2, D4.6
RA1.4	**KR04** Deep Learning Architectures to forecast solar spectral irradiances	D4.2, D4.6
RA1.5	**KR05** Data Distribution Through Federated Learning	D4.3, D4.7
RA1.6	**KR06**Machine Learning module in HPC and low-power environments	D4.4, D4.8

SO2. Big Data Predictive Analytics: TADDIS will investigate scalable machine learning algorithms that cover clustering of extreme-scale data streams and predictive analytics. The proposed scalable techniques will encompass both data-at-rest and data-in-motion. This objective corresponds to the following activities:

RA2.1 Data stream clustering and similarity search in extreme-scale data collections: The aim of the RA2.1 is to design and develop novel clustering and similarity search algorithms on cloud and HPC environments.

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RA2.2 Predictive analytics models: In RA2.2 innovative predictive analytics models mainly from the field of AI and ML will be developed to support EO applications, maritime emissions models and energy demand forecasting.
RA2.3 Solar Energy short-term forecasting from satellite data: In this activity we plan to implement TADDIS related developed techniques (scalable machine learning algorithms) in the nextSENSE solar energy forecasting system. The inclusion of a product end user (IPTO) will help including tailored to the end user needs.
RA2.4: TADDIS Intelligent Analytics Platform (TADDIS INAP): The aim of RA2.4 is to encompass visual analytics techniques with predictive analytics capabilities. Specifically, in the RA2.4, the outcomes of the packaged AI workflows along with the fused information from the BIDOFE and other TADDIS extreme-scale analytics.

	Key Results	Deliverable
RA2.1	**KR07**Extreme-scale clustering and similarity search algorithms on cloud and HPC environments	D5.1, D5.5
RA2.2	**KR08** Predictive analytics models	D5.2, D5.6
RA2.3	**KR09** a real time solar energy forecast spatiotemporal resolution system for continental domains	D5.3, D5.7
RA2.4	**KR10** TADDIS Intelligent Analytics Platform	D5.4, D5.8

SO3. High-level semantics and content enrichment from Big Data: An important objective of TADDIS is to develop technologies for representing the massive and diverse data streams of the project and the knowledge extracted from them, and make it available to the three use cases. To achieve this objective, the following research activities will be carried out:

RA3.1 Ontology development: In this activity, we will develop the TADDIS ontologies that will integrate the TADDIS data sources using the Web ontology language OWL2.
RA3.2 Ontology population, data harmonisation, fusion and linking: In this activity, we will utilize the state-of-the-art tools GeoTriples-Spark and JedAI developed by partner UoA to transform geospatial and temporal data from the TADDIS data sources into RDF and interlink it with other data using the JedAI toolkit.
RA3.3 Semantic search and querying: In this activity, we will utilize the well-known search and analytics engine Elasticsearch to drive the search functionality of the TADDIS platform. We will also extend the highly scalable systems Strabon and Ontop-spatial of partner UoA for querying the temporal and geospatial data streams.
RA3.4 TADDIS Autonomous Decision-Making system: In RA3.4 we will develop a platform responsible for user notifications, recommendations enabling intelligent and autonomous Decision Support capabilities.

	Key Results	Deliverable
RA3.1	**KR11** The TADDIS ontologies	D6.1
RA3.2	**KR12** New versions of the systems GeoTriples-Spark and JedAI	D6.2, D6.5
RA3.3	**KR13**New versions of the systems Strabon and Ontop-spatial	D6.3, D6.6
RA3.4	**KR14**New version of the Autonomous Decision-Making System	D6.4, D6.7

1.1.2 Technological Objectives (TOs) and Technological Activities (TAs)

TADDIS aims also to address the following **Technological Objectives** (**TOs**) and the respective **Technological Activities** (**TA**) they consist of:

TO1. Data acquisition & Big Data streams indexing: This objective deals with the development of appropriate data channels and wrappers to facilitate content extraction from heterogeneous resources (e.g. Copernicus data, real-time AIS data, online content from CCTVs and social media). The obtained data are fused through the TADDIS Big Data Operations Fusion Engine to enable the utilisation powerful analytics and extract useful knowledge.

TA1.1 EO data collection and quality control from the Copernicus and DIAS services: The SERCO DIAS data consists of data collections available, both online and offline, through the DIAS data access services.
TA1.2 Ship emission activity based on real-time AIS data: This activity aims to apply ML techniques to clean and analyse the obtained AIS data along with vessel's technical characteristics to estimate the air pollution.
TA1.3 Collection of online content (e.g. CCTV information from vessels) and social media data: TA1.3 deals with the detection of suitable and relevant online content in social media platforms, such as Twitter posts and Flickr, as well as the collection of images from CCTVs mounted on vessels to support the estimation of air quality.
TA1.4 TADDIS Big Data Operations Fusion Engine: The objective of TA1.4 is to develop and integrate a novel Data Workflow Model with different levels of information pre-processing that will run autonomously in a seamless and robust manner in order to process, manage and exploit vast amounts of data efficiently.

	Key Results	Deliverable
TA1.1	**KR15**Copernicus data collection module	D3.1, D3.3
TA1.2	**KR16**Ship emission activity and AIS data collection module	D3.1, D3.3
TA1.3	**KR17A** Social media crawler **KR17B** CCTV data collection	D3.1, D3.3
TA1.4	**KR18**TADDIS Big Data Operations Fusion Engine	D3.2, D3.4

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TO2. Platform development and Interactive User Interfaces: TO2 deals with the objective of defining a robust and resilient TADDIS platform, considering the needed development and integration activities with the several components of the solution. Additionally, it will be defined interactive interfaces (UI) and dashboards that will support the end users on their operations and analysis. These interfaces and dashboards will be built on top of the Big Data platform so it can scale and process data to empower end users consuming data and analysis.

TA2.1 TADDIS platform architecture, development and integration: We will define the platform architecture based not only on the use cases of the project but also taking in consideration future requirements in terms of scalability and growth. The entire architecture will be defined aligned with the market best practices and principles.
TA2.2 TADDIS interactive UIs & dashboard: Interactive UIs and dashboards will be implemented based on a Service Design methodology including the steps: *Discovery*; *Understand and Imagine*; *Design*; *Build*; *Development*; *Testing*; *Deliver*. Training is also considered to the IT and business teams.

	Key Results	Deliverable
TA2.1	**KR19**TADDISPlatform	D7.1, D7.2
TA2.2	**KR20** Interactive UIs and Dashboards	D7.3, D7.4, D7.5, D7.6

1.1.3 User-oriented Objectives (UOs) and User-oriented Activities (UAs)

In order to ensure a user-driven approach, TADDIS will be built upon the concept of co-design with end-users. To this end, the aforementioned scientific and technological objectives will be based on user-oriented objectives (UO) for addressing the user goals and requirements. These user-oriented objectives are:

UO1. User Requirements, use cases creation and ethical dimensions: aims to apply a user-driven design approach, starting from the initial use cases throughout the entire lifecycle of the platform development, so as to ensure that the developed modules and applications meet end user needs in TADDIS.
UA1.1 Use case creation and end-user requirements definition: The end users shall define their requirements based on their own environments and their existing management systems in order to have a familiar environment that will be easier to adopt and integrate.
UA1.2 Ethical and legal dimensions: aims to explicitly integrate a legal, social and ethical impact assessment into its methodology in order to ensure the product development cycle follows a privacy, data protection and ethics-by-design approach and effectively integrates the principles of Responsible Research and Innovation (RRI).

	Key Results	Deliverable
UA1.1	**KR21A** End user requirements analysis; **KR21B** TADDIS pilot use cases	D2.1, D2.3
UA1.2	**KR22** Legal, social and ethical impact assessment	D2.2, D2.4

UO2. Pilot deployment, validation and training: aims to deploy, evaluate and validate the TADDIS tools, applications, and platform through iterative user-centred field demonstrations and test case simulations.

UA2.1 Development of the validation scenario and evaluation methodology: Adaptive tests will be developed in collaboration with practitioners of the three sectors (maritime, energy and space), in order to demonstrate the efficiency, feasibility and performance of the novel TADDIS technologies in simulated and near "real" conditions. A set of KPIs shall be defined, which will follow the user functional and non-functional requirements.
UA2.2 User Training: The end users will be trained on TADDIS and how to best take advantage of its capabilities in order to prepare and comprehend the benefits of provided services and innovative technologies.
UA2.3 Pilot deployment, simulations and user evaluation: Following the identification of the industrial test cases according to the needs of the TADDIS end users, several test case simulations and field demonstrations will be performed in order to test and evaluate all the functionalities of the TADDIS solution.

	Key Results	Deliverable
UA2.1	**KR23** Validation scenaria and evaluation methodology	D8.1
UA2.2	**KR24** TADDIS training procedures and handbooks	D8.5
UA2.3	**KR25** Iterative user evaluations and test case simulations	D8.2, D8.3, D8.4

1.1.4 Impact-making objectives (IMOs) and impact-making activities (IMAs)

The following objectives will be pursued to develop key strategies for the exploitation of the project's main results by exploring their potential market, wider use and sustainability, business feasibility and implications for intellectual property rights. The involvement of relevant market and innovation stakeholders is expected to provide a wide range of exploitation prospects. The methodology is analysed in Section 2.

IMO1. Widening Dissemination and Collaboration: TADDIS will create impact not only through dissemination and communication activities, but also by linking with other Big Data initiatives and through its activities on long-term data preservation. In addition, new operational procedures will be proposed.

IMA1.1 Disseminating project results: TADDIS will be widely disseminated to end-users and stakeholders, to promote TADDIS 's uptake and ensure collaboration with external parties.

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IMA1.2 Synergies with other H2020 Big Data projects and Big Data initiatives: TADDIS will approach multiple other Big Data initiatives to foster synergies between the findings in TADDIS and other European initiatives based on extreme-scale data analytics.

	Key Results	Deliverable
IMA1.1	**KR26** Dissemination and Communication plans	D9.1, D9.5
IMA1.2	**KR27** Collaboration report	D9.6

IMO2. Exploitation and sustainability: Following a market analysis to determine potential project result adoption, TADDIS will maximise exploitation by defining marketable features and modules and future roadmaps relevant to end users' capabilities and needs. The achievement of an exploitable and sustainable model of TADDIS results and solutions at different levels as key to the success of the project vision, is the main core of this objective.

IMA2.1 Analysis of the market for existing solutions: In order to define the best exploitation plans for project results, TADDIS will conduct a detailed market analysis ranging from the identification of national and international target markets, market segmentation, relevant user needs and preferences, to competition analysis.

IMA2.2 Exploitation and innovation management plans for the proposed tools: A full exploitation and innovation management plan will be developed to position the TADDIS solution amongst key target audiences. Simulated in real world environments, the solution testing and outcomes will provide a basis for the TADDIS exploitation.

IMA2.3 Sustainability plan for project outcomes and Intellectual property (IP) protection: Each partner brings a significant amount of background knowledge and/or directly applicable work. An IPR strategy will be devised to identify IPs at all possible different levels and encourage re-assessment during the project lifetime.

	Key Results	Deliverable
IMA2.1	**KR28** Detailed market analysis and business models	D9.3, D9.4, D9.7
IMA2.2	**KR29** Exploitation and innovation management plans	D9.3, D9.4, D9.7
IMA2.3	**KR30** Sustainability and IPR protection plan	D9.4, D9.5, D9.7

1.2 Relation to the work programme

This section shows how TADDIS meets the expectations of the work programme and in particular the topic ICT-51-2020 Big Data technologies and extreme-scale analytics.

Rapidly increasing volumes of diverse data from distributed sources create challenges for extracting valuable knowledge and commercial value from data but at the same time have huge potential towards more accurate predictions, better analytics and responsible AI.

TADDIS aims to collect diverse and massive data (**TO1**) from multiple and heterogeneous sources of information, such as satellite data from the Copernicus programme (**TA1.1**), real-time AIS data (**TA1.2**), social media and online multimedia data from CCTVs located in vessels (**TA1.3**), in order to intelligent fuse via TADDIS Big Data Operations Fusion Engine (**TA1.4**).The discovered valuable knowledge proceeds for further analysis (**SO1 & SO2**) aiming to generate more accurate predictions, robust analytics and explainable AI orchestrated through high-level semantically technologies (**SO3**) to strengthen the decision-making processes.

This calls for novel methods, approaches and engineering paradigms in machine learning, analytics and data management.

In the TADDIS framework, innovative methods and approaches will be delivered from multi-disciplinary fields of machine/deep learning, AI workflows, predictive big data analytics applied on heterogeneous and massive data streams.

As the success will require not only efficient data processing/management but also sufficient computing capacity and connectivity, a coordinated action with the appropriate technology areas (e.g. AI, analytics, software engineering, HPC, Cloud technologies, IoT and edge/fog/ubiquitous computing) is necessary and will contribute to a European leadership in these areas.

TADDIS is built on top of European Big Data infrastructures so as to cover all related areas and ensure sufficient computing capacity and connectivity (**TO2**), regardless the nature of the gathered data (**TO1**). In a general context, TADDIS aims at an automated orchestration of HPC with respect to scalability, time-criticality and dependability (**SO3**) and couples HPC with High Performance Data Analytics (**SO1 & SO2**). Semantic knowledge structures (**RA3.1**) assist the indexing of EO and non-EO data (**RA3.2**), offering diverse solutions and novel cloud technologies towards on intelligent semantic search (**RA3.3**) and autonomous decision-making (**RA3.4**). From a non-technical level, TADDIS foresees several synergies with other H2020 Big Data projects (**IMA1.2**), continuously exchanging knowledge from similar Big Data initiatives.

Developing new methodologies and engineering solutions addressing industrial and/or societal challenges.

TADDIS addresses both industrial and societal challenges. Solar irradiance monitoring supports energy exchange platforms (**IPTO, PMODWRC**) to efficient estimate the energy demands and to create a better plan on the energy storage solutions (**RA1.4& RA2.3**). Furthermore, the development novel deep/machine learning cloud-based solutions(RA1.3& RA2.2) to analyse EO and satellite data (**UniTN**) and fuse them with non-EO data (**RA1.2& RA2.1**), enhances the provided DIAS infrastructure (**SERCO**) provided services to the space sector as well as could be applied to numerous industries and sectors. TADDIS will aim to face the challenges in the maritime sector (**ANEK**) by deploying sustainable methodology for modelling and monitoring ship traffic emissions in the city of Barcelona (**BSC**, **UPC**) using as input sensor-based activity data (**RA1.6**).

Proposals should cover at least one of the following technology areas (but may additionally cover others): machine learning/deep learning (especially on distributed data sets); architectures for collecting, managing and exploiting vast amounts of data; system engineering/tools to contribute to the co-design of federated/distributed systems (to involve all

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stakeholders/technology areas); new methods for extreme-scale analytics, deep analysis, precise predictions and automated decision-making; novel visualization techniques; data fusion and data integration technologies; standardized interconnection methods for efficient sharing of heterogeneous data pools, seamlessly using distributed tools and services.

TADDIS is a multi-tier federated architecture (**TA2.1**) for extreme-scale and big data analytics both at the edge and at the cloud (**RA1.5& RA2.4**), having interactive user interfaces for the visualisation of batch, stream and interactive analytics (**TA2.2**). Specifically, the TADDIS intelligent analytics platform (**RA2.4**) attains to provide unified solutions will encompass and orchestrate innovative extreme-scale AI workflows (**RA1.1**), machine learning and deep learning networks at the edge and at the cloud (**RA1.2 – RA1.3**) along with big data predictive analytics solutions (**RA2.2 & RA2.3**)seamlessly coupled on HPC environment and enhancing the autonomous decision making functionalities and precise predictions (**RA3.4**). TADDIS will adopt novel fusion approaches and data clustering of similar content (**RA2.1**) to manage and exploit efficiently vast amounts of heterogeneous data. Hence, the discovered knowledge, will be harmonised and semantically fused and linked (**RA3.2 & RA3.3**)aiming to enrich the forecasting capabilities and decision-making processes (**RA3.4**).The development of new ontologies (**RA3.1**) equipped with semantic search and querying (**RA3.3**)improves the management of the heterogeneous data.

The data assets must be sufficiently large, realistic, available to the project and described in the proposal.

In TADDIS framework, the developed solutions will be tested in a sufficiently large amount of data assets which will be available to the project. Particularly, the data assets of TADDIS are described in **Table 1.1** to **Table 1.3** in **Section 1.3.3** as well as in a dedicated Data Management plan (**Task 1.4**) is foreseen for this purpose, as it is described in Section 3 in **WP1**. It is worth to note, that the obtained data assets encapsulate the 4 V's of Big Data, namely the Volume, Variety, Velocity and the Veracity. In PUC1, the volume of EO data which is gathered in DIAS Infrastructure estimated approximately in the order of 10 petabytes, in PUC2 the real-time AIS data are collected in high frequency (Velocity) is going to fuse with multimedia data from CCTVs (Variety). Finally, in PUC3 heterogeneous data are utilised in order to attain precise predictions for the energy demands (Variety). As the Big Data is a highly complex problem, it is important to know how accurate and applicable the collected data is. In TADDIS, the TADDIS Big Data Operations Fusion Engine (**TA1.4**) aims to ensure the relevant and the quality of the massive data and filter through what is important and what is not providing a deeper understanding of the data.

1.3 Concept and approach

1.3.1 The TADDIS concept

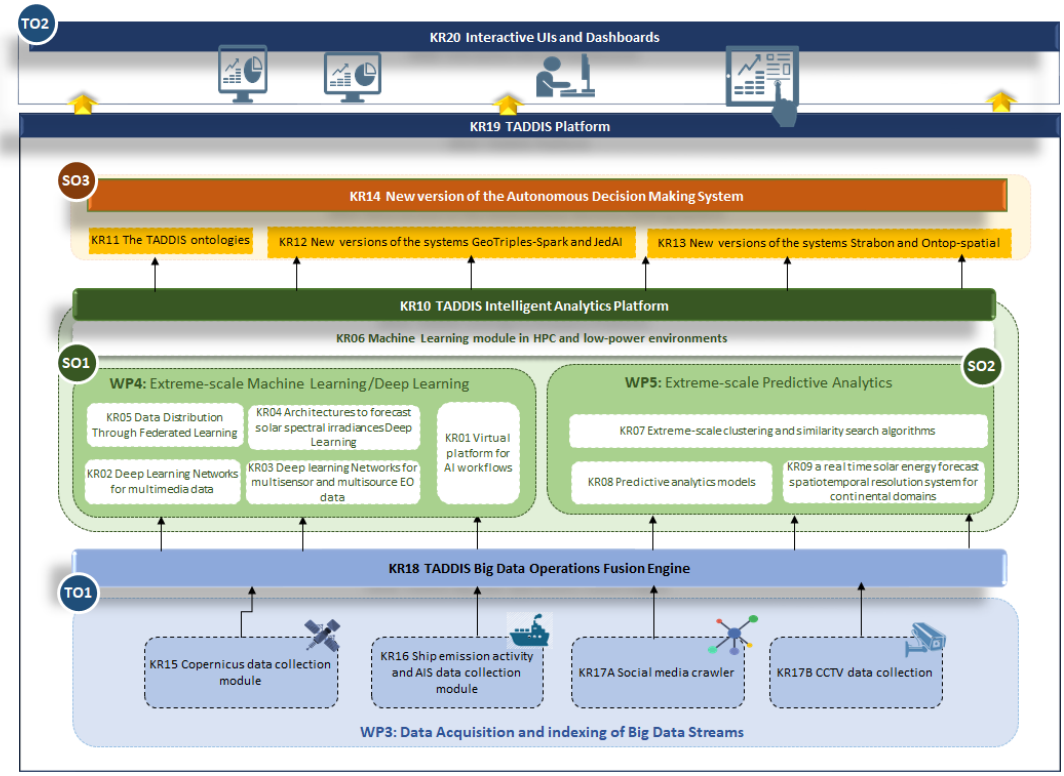

Figure 1.2: The preliminary TADDIS Reference Architecture

A preliminary TADDIS reference architecture is provided in Figure 1.2. The architecture consists of layers addressing specific needs of extreme-scale applications. TADDIS platform orchestrates in an efficient and seamless manner the heterogeneous Cloud/Edge data sources, which generates massive and diverse data, with novel AI methodologies and Big Data predictive analytics in HPC environment to support real-time and autonomous decision-making processes. The TADDIS modular architecture will be empowered with a SoA toolset enable to analyse massive and diverse data in different levels aiming to address the end-users' needs and requirements. Specifically, TADDIS Big Data Operations Fusion engine is aiming to efficiently and effectively integrate and fuse wide spectrum of heterogeneous resources. When massive amounts of data from a very large number of distributed sources are properly

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processed and stored, they are made available to the analytics layers. TADDIS will encompass innovative extreme-scale AI, machine/deep learning methodologies (SO1) and extreme-scale predictive analytics (SO2) enable to extract valuable knowledge, assisting the decision making, addressing both industrial and societal challenges. The TADDIS High-level semantics and Extreme-scale Content Enrichment layer (SO3) provides all the fundamentals for the provision of higher-level services, such as semantic search and reasoning, data interoperability, and data harmonization and fusion. The obtained knowledge would be able to support the autonomous decision-making processes. Obtaining a deep understanding of various environments and events described by the collected and analysed data assets will create value and increase productivity of the TADDIS end users. Interactive UIs and Dashboards will be enabled end-users to monitor and share the outcomes of the analysis. In this section, we provide the overall description of layer functionalities, while more details about specific components are provided in the corresponding tasks in Section 3.

1.3.2 TADDIS application and validation

To demonstrate the applicability, validity and usability of the TADDIS platform, three **Big Data Pilot Use Cases** (**PUCs**) have been selected as reference background stories. Each TADDIS technology is applied and validated (UO2) so as to receive feedback and measurable KPIs in real operational scenarios, as shown in Figure 1.3.

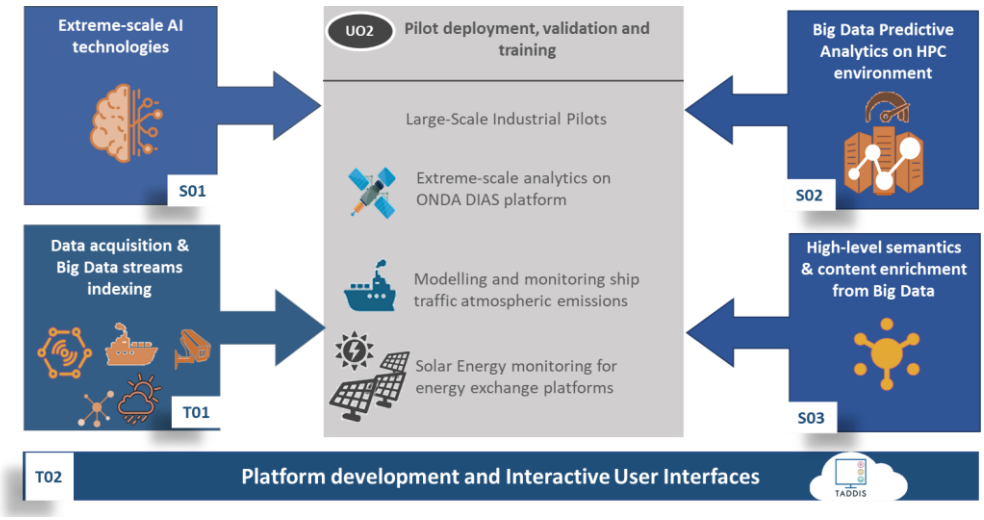

Figure 1.3: The TADDIS concept

The timeline for implementing the operational scenarios, demonstrated in both real-life and simulated settings, is shown in Figure 1.4.

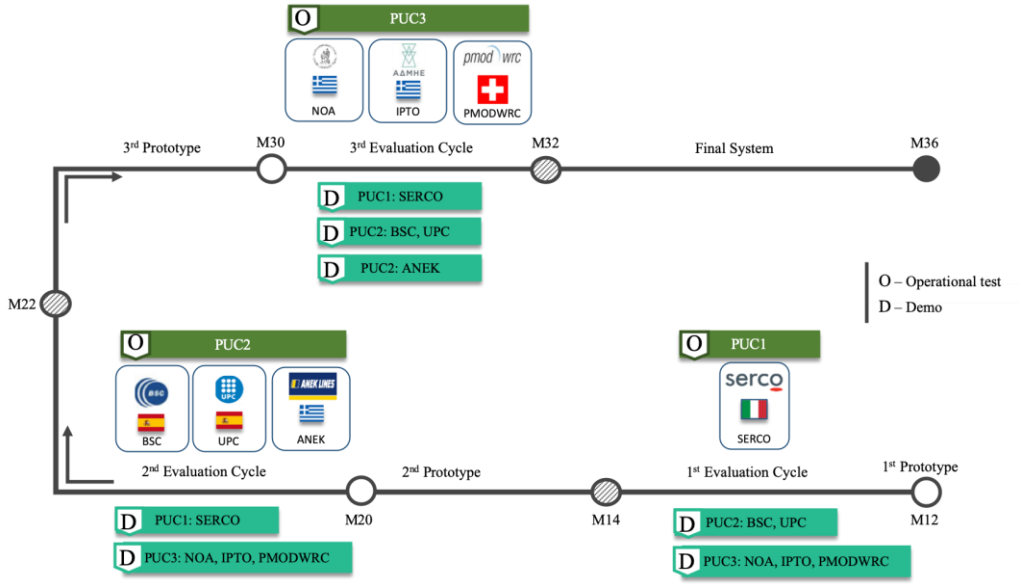

Figure 1.4: The timeplan of the PUCs

1.3.2.1 PUC1: Extreme-scale analytics on ONDA DIAS platform [Lead: SERCO]

Motivation

The huge volume of Copernicus data has raised the attention of the digital services providers, especially those pertaining to Big Data solutions. For this reason, the Copernicus Ground Segments are or will be largely relying on Cloud computing. Indeed, the Cloud computing continues to be a fast-growing market, enabling new, easier ways to

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access data, and facilitating large-volume storage. ONDA users do not need to download and store the data on their own hardware, so as to reduce the cost of access and processing data on the cloud.

Data assets and cloud environment

ONDA (https://www.onda-dias.eu/cms/) is the Serco Data and Information Access Service (DIAS) Big Data platform with the aim of facilitating, fostering and expanding the exploitation of Earth Observation satellite data and geospatial information, enables users to build and operate applications in the Cloud by providing Data, Services and Support. The ONDA paradigm is to bring people on data, by offering custom solutions to cover the needs of all prospective users, who range from the general public having minimal or no knowledge of Remote Sensing through professionals and SMEs up to public authorities, agencies and large enterprises. The ONDA platform also provides services that benefit from the performance of a market leading Cloud environment. The ONDA Cloud computing solutions are scalable, easy to set up and have predictable costs as well as optimised and consistent performance. In addition, all data, information, applications and transactions are securely protected.

Data assets available to the project

ONDA offers on the one hand free and open access to a wealth of datasets from different sources - from the Copernicus Sentinels family, to Earth Observation (EO) missions to the Copernicus Services projects - and provides easy-to-use resources for accessing, downloading and processing the data and information. In addition to the Copernicus data, ONDA also includes additional commercial data and Copernicus Services as well as in situ measurements, and a subset of them can be available to the project for research and development purposes only. A general overview of the available data assets can be found in the ONDA dashboards (https://dashboard.onda-dias.eu/#/dashboard), but a more detailed table is provided as follows:

Table 1.1: The Big Data assets of PUC1

Source of data	Total Volumes (in TBs)	Velocity Data Ingestion (avg. TBs per month)	Variety (number of attributes per image)
Sentinel 1	7,700	200	Level-0: 29; Level-1: 31; Level-2: 31
Sentinel 2	7,800	350	Level-1C: 33; Level-2A: 46
Sentinel 3	1,100	50	OLCI Level 1: 37; OLCI Level 2: 38; SLSTR: 32; SRAL: 37; SYNERGY L2 SYN: 37; SYNERGY L2 VGP: 38; SYNERGY L2 VG1;V10: 34
Sentinel 5P	110	10	Level-1B and Level-2 Products: 20 Auxiliary NetCDF Products: 13 Auxiliary NISE Products: 14
CAMS	70	10	11
CMEMS	11	0.5	13
CLMS	1,700	0.1	12
Landsat 8	40	2	18
Envisat	160	N/A	23
TOTAL	**18,691**	**623**	

Additional data assets - Very High-Resolutionsatellite Images

ONDA has partnered with SI Imaging Services for the dissemination of the KOMPSAT series, which provides a significant imagery source. **For the purpose of this project, an advantageous access to KOMPSAT-3 (optical), KOMPSAT-3A (optical) and KOMPSAT-5 (SAR) satellite imagery is provided**.

KOMPSAT-3 is a high-performance remote sensing satellite, which provides 0.7 m GSD panchromatic image and 2.8 m GSD multi-spectral image data for various applications. KOMPSAT-3 was launched into a sun synchronous low Earth orbit on the 18th of May 2012 and the lifetime of more than 7 years is expected.

KOMPSAT-3Auses same platform and payload with KOMPSAT-3, but it provides higher resolution earth observation imagery by lowering the altitude to 528km. KOMPSAT-3A products are adequate for applications in defence, mapping, infrastructure monitoring, agriculture and disaster monitoring.

KOMPSAT-5system provides three different imaging modes: High Resolution Mode (HR Mode, EH Mode, UH Mode), Standard Mode (ST Mode, ES Mode), and Wide Swath Mode (WS Mode, EW Mode). High Resolution Mode provides SAR image of 0.85m / 1 m resolution (sliding spotlight), Standard Mode provides SAR image of 2.5 m resolution (Strip mode), and Wide Swath Mode provides SAR image of 20 m resolution (ScanSAR).

For the purpose of TADDIS project, a total of 128 credits are available to request KOMPSAT data.Table 1.2 shows the number of credits needed to order a scene of a given size, which can sum up to 128 for the TADDIS evaluation and validation phase in PUC1.

Table 1.2: Credits Schema for single scenes of a given size

Satellites	Acquisition mode	New Acquisition scene	Archive scene	Monitoring Package scene	Scene Size
KOMPSAT3 & KOMPSAT-3A	-	8	1.5	-	New: 100 km2 Archive: 25 km2

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KOMPSAT 5	UH & EH/HR - Spotlight mode	14	7	5	5km x 5 km
	ES/ST - Strip mode	9	4.5	3.5	30 km x 30 km
	EW/WS - ScanSAR mode	7	3.5	3.5	100km x 100 km

The Provision of Third-Party Content will be performed in accordance with the ONDA Services Terms and Conditions:https://www.onda-dias.eu/cms/terms-and-conditions/.

The TADDIS solution

The proposed platform will enhance and improve the provided services and tools from ONDA platform by providing efficient management of satellite and EO data and data fusion with other non-EO data. Deep learning solutions will be developed and executed on the cloud. Enhanced location-based services will enable users to handle and correlate effectively EO data with data from social media and multimedia content aiming to strengthen the accuracy of the services. Extreme-scale analytics involve the analysis of unstructured (multimedia) data to foster the capabilities for precise predictions and estimations from EO data. The discovered knowledge will be semantically presented and harmonised in the TADDIS ontology for this use case which also will be equipped with semantic searching, linking and reasoning facilities, aiming to provide effectively automated decision-making. The distributed system links the ONDA platform with third-party databases of non-EO data, aiming to provide novel visualisation techniques in a two-way direction with the Edge component, following standard interconnection methods for efficient sharing of heterogeneous data pools, seamlessly using distributed tools and services from linked devices and processing nodes. Machine learning algorithms are optimised to be executed on HPC infrastructures when needed, complementing the ONDA cloud with other HPC environments (BSC).

1.3.2.2 PUC2: Modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona [Lead: UPC, Particip. BSC, ANEK]

Motivation - Need

Air pollution is an important issue for public health, the economy and the environment. The nitrogen dioxide (NO_2) annual air quality limit value set up the European Air Quality Directive (Directive 2008/50/EC) and the particulate matter of less than 10 and 2.5 micrometres in diameter (PM10 and PM2.5) annual limit values recommended by the World Health Organization (WHO) are systematically exceeded in the city of Barcelona[1]. Consequently, awareness of air pollution as a serious matter of concern is growing among the Barcelona citizens, as proved in the "Baròmetre" published in December 2017[2]. According to the last emission inventory published by the City of Barcelona, road transport and ship traffic contribute all together to more than 80% and 85% of the total primary NO_x and PM10 emissions of Barcelona city[3], respectively. In order to evaluate, preserve and improve the status of the urban atmosphere, a proper knowledge of these emission sources and their distribution in time and space is crucial in the implementation of effective emission abatement measures. Currently, an inventory-based data processing approach remains the standard practice for building up emission inventories. This approach mainly consists of the compilation of existing statistics for each pollutant source (e.g. number of ship operations, number of cars passing by a road) and its combination with emission factors derived from measurement campaigns. One of the main limitations of this method is related to the availability of the data (which usually implies combining multiple sources of information with different levels of accuracy) and to the time and effort that it takes to compile it and putting it all together. One example for this is the data gathering process for the calculation of road transport emissions, which implies compiling and combining information of traffic flow (e.g. from traffic count stations), speed (e.g. from GPS data) and composition of the vehicle fleet (e.g. from vehicle registration statistics), among others. As a consequence, this approach results in a very time-consuming process, the losing of robustness in the data and the introduction of uncertainties in the emission results. This limitation can be overcome through combining emission activity and process modelling with the use and integration of near real time data collected from ground-level sensors and monitors. TADDIS approach can provide not only a more efficient and less expensive way to update emission inventories for regulatory or retrospective studies, but also to increase the transparency of the emissions generating process and to improve the representativeness of the emission results.

Objective

The main objective of this use case is **to combine the use of sensors (AIS radio receiving stations) with artificial intelligence techniques as a new approach for modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona**.

Story

[1] ASP, 2018. Agencia de Salut pública. Qualitat de l'aire. Informe 2017. Available at: https://www.aspb.cat/documents/qualitat-de-laire-informe-2017/

[2] AB, 2018. Ajuntament de Barcelona.Baròmetre semestral de Barcelona. Desembre 2017. Available at: https://bcnroc.ajuntament.barcelona.cat/jspui/handle/11703/84172

[3] AB, 2014. Pla per la Millora de la Qualitat de l'Aire de Barcelona (2015-2018). Available at: https://ajuntament.barcelona.cat/ecologiaurbana/ca/que-fem-i-per-que/ciutat-productiva-i-resilient/pla-de-qualitat-de-l-aire-de-bcn

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This objective will be achieved through the development of a new method for data collection and emission estimation that are new in the field of atmospheric science. The method is designed to collect essential geo-localised information to be used as input data for the estimation of very high resolution emissions of shipping traffic activities. The method consists of combining the activity data derived from the messages broadcast by vessel's Automatic Identification Systems (AIS) with data mining and machine learning techniques, to produce accurate, vessel-specific spatially and temporally resolved emissions. It will allow providing emissions data of not only primary pollutants that contribute to air pollution (NO_x, SO_x, PM10, PM2.5), but also greenhouse gases (CO_2).

To achieve these goals, this use case will address the following specific objectives:

- explore the scientific and technological frontiers of sensor-based data for the estimation of ship traffic emissions
- advance the understanding of how artificial intelligence can improve the usability and exploitation of sensor-based data
- implement an emission modelling tool and provision of very high resolution ship traffic emissions
- understand how sensor-based emission inventories are capable of improving the results obtained with traditional inventory-based data processing approaches.
- Fuse additional data sources (e.g. multimedia content from passengers on board of a vessel and CCTV video streams)

Data assets and HPC environment

TADDIS will use as input the position reports generated by the Automatic Identification System (AIS) and the static report yielding the specific information of each vessel. The AIS system consists of an on-board broadcast transponder system to which ships continually transmit dynamic and static data related to the vessel. The system is globally on-board in every vessel with gross tonnage larger than 300 GT, and it provides automatic updates of vessel's information at intervals of a few seconds to a few minutes (i.e. 2 seconds to 3 minutes depending on the vessel's speed, course and state). The data includes both dynamic (e.g. position, speed over ground, heading) and static and voyage related information (e.g. unique identification, destination, ship type and sizes).Original AIS data, which is based on very high frequency radio transmissions, will be collected through a receiving station located at the Department of Nautical Sciences and Engineering at the Barcelona School of Nautical Studies (UPC-BarcelonaTech). The location of the station allows monitoring all the shipping activity within the Port of Barcelona and around 120 nautical miles. The raw AIS radio messages captured by the station will be decoded in order to convert them to a more human-friendly format and derive the following information for each ship and time step:

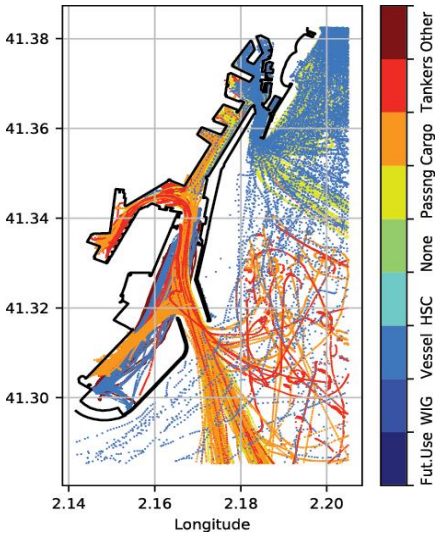

Figure 1.5: Trajectories of the ships according to ship type of AISdata

- Maritime Mobile Service Identity number (MMSI): A unique identification number for each vessel AIS station.
- International Maritime Organisation number (IMO): A unique identifier for each ship.
- Date: The year, month, day, hour and second field of the UTC time when the AIS message was sent.
- Ship and cargo type: description of the ship type and the cargo carried by the ship.
- Latitude, longitude: Geographic position coordinates.
- Navigation status: description of the engine activity (e.g hotelling, maneuvering, cruising).
- Speed Over Ground: real time velocity of the ship.
- Rate of Turn: real time turning velocity of the ship.
- Vessel dimensions: length, beam and draft of the ship.

Once decoded, the AIS information will be combined with the vessel's technical characteristics reported by the IHS Fairplay database (https://ihsmarkit.com/industry/maritime.html), which include technical specifications of all fuel-consuming systems on-board and other relevant technical details for most of the ships considered. The IHS Fairplay holds the largest maritime databases in the world, evolved from the Lloyd's Register of Ships books. The database includes information on the installed power of the main and auxiliary engines, type of fuel consumed, rpm of the main engines and other data directed linked to the emissions calculation. The dataset has already been acquired by the BSC and will be available in TADDIS project.

The TADDIS solution

This use case will provide as a result **a new and sustainable methodology for modelling and monitoring ship traffic emissions, using as input sensor-based activity data** (UPC, BSC) **and non-traditional sources of data** (ANEK, CERTH). The system will be based on a workflow composed by a set of codes developed for the acquisition and cleaning of the sensor-based data, and for the modelling of the emissions. The results of this use case will include

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new datasets enriched with Big Data analytics of the emission results derived from the tool. Although the scope of the use case is the city of Barcelona, the developments performed in the framework of this use case will have the potential capability of being extrapolated to other urban areas equipped with similar technologies and sensors used in the present work. Machine learning techniques will be applied to analyse, clean and improve the original data. Machine Learning and Data Analytics techniques provide methodologies for treating data not only for modelling and forecasting but also correction, prediction of missing values, and detection of outliers. Using such techniques on AIS data prepare data before applying either novel or traditional techniques for data analysis, exploration and understanding, indicating experts the main deficiencies of such data and means to correct or go over it.

Once the AIS data has been processed and cleaned, the geolocalized information will be used for the estimation of vessel-specific emissions at very high spatial and temporal resolution. The estimation methodology will follow the approach proposed by Jalkanen et al. (2012), in which instantaneous emissions are derived from the combination of existing emission factors and the calculation of the engine power and engine load of each vessel at each specific time. Emissions will be estimated for the following pollutants: nitrogen oxides (NO_x), sulphur oxides (SO_x), particular matter (PM10 and PM2.5) and carbon dioxide (CO_2). The emission estimation methodology will be implemented by the BSC with the cooperation of the UPC-BarcelonaTech, which will provide insights for the assumptions related to the use of engines during the ship's manoeuvring and hoteling operations.

As a result of this methodology, we will derive a new dataset of hourly ship traffic emissions at a spatial resolution of 100x100m and covering the whole area that comprises the Port of Barcelona. The dataset will include the total amount of emissions as well as separate results classified by ship type (e.g. cruisers, tankers, fishers). The dataset will be compared against the emission results obtained with the High-Elective Resolution Modelling Emission System (HERMES), an in-house emission tool developed by the BSC that estimates ship traffic emissions according to the methodologies recommended by the European Environmental Agency (EEA) (Guevara et al., 2019). This comparison will allow assessing the level of improvement achieved when using the AIS methodology instead of a more traditional approach. Besides the aforementioned sensors to collect traffic and shipping activity data, this use case will have access to the BSC high performance computing facilities (MareNostrum 4) to run the emission modelling experiments. MareNostrum 4 is the most powerful supercomputer in Spain, one of thirteen supercomputers in the Spanish Supercomputing Network (REAS) and one of the seven supercomputers of the European infrastructure Partnership for Advanced Computing in Europe (PRACE).

1.3.2.3 PUC3: Solar energy monitoring for energy exchange platforms in Greece [Lead: NOA, PMODWRC, IPTO]

Motivation - Need

The United Nations has adopted in 2015 the Sustainable Development Goals (SDGs). One of the main SDGs was clean and affordable energy, pointing towards Investing in solar, wind and thermal power, improving energy productivity, and ensuring energy. In addition, EU has published certain directives (e.g.renewable energy directive 2018/2001/EU) with the main goal to establish a new binding renewable energy target for the EU for 2030 of at least 32% renewables. Solar energy is turning out to be the best replacement for the conventional energy to fight climate change. Power Transmission Operators (TSO) worldwide, such as the Independent Power Transmission Operator - Greece (IPTO -http://www.admie.gr/nc/en/home/) are responsible to provide energy forecasting information to the market platform, which produces the optimal power transmission schedules on a country level. Among the forecast data provided by IPTO is the system load forecast and the forecast of power produced by renewable sources. Such information is produced by IPTO utilizing available renewable energy forecasting applications. Once the market is cleared, the system marginal prices are produced. Inaccurate forecasts may lead to sub-optimal schedules and this has a significant impact on the economic cost of the operation schedules. More specifically, under-forecasts may lead to purchase of expensive services to deal with peaks and over-forecasts may lead to unnecessary capacity being committed. In addition, major changes to the energy sector such as environmental issues and deregulation of the power industry have been major issues for energy related industries.

Solar energy forecasting systems (e.g. the PMODWRC/NOA developed system nextSENSE) require a large number of model data inputs and very high spatial resolution outputs. Earth observation from satellites related data with high resolution spatiotemporal information has to be used in real time making the accurate output of such systems a big data IT problem. In order to upscale such models from national of pan-European European scale well defined IT platforms and systems have to be developed.

Data assets and data providers

Load forecasting is fundamental in utility operation and increasing penetration of renewable sources has caused a significant change in the resource mix making the use of accurate renewable energy availability forecasts necessary. These changes have constituted load forecasting to be a dynamic process that should continuously be improved. Weather and atmospheric conditions are among the predominant factors that affect electrical power consumption and are therefore used as predictors in short-term load forecasting (the weather variables are used differently in long term load forecasting – many important weather variables are hard to predict). Large penetration of solar generation at the

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distribution network has created new challenges for load forecasting, as the negative load from distributed energy sources has to be taken into account. This has created the need to incorporate weather and atmospheric factors such as light intensity or cloud coverage to accommodate for these effects and divert away from the traditional load forecasting models that used only temperatures, humidity or solar energy persistence. In addition, the exploitation of long-term databases for solar park management improvement and mostly the upscale of forecasting systems in a pan-European level requires the use of optimized information technologies that will provide the tools of real time information without reducing the product accuracy.

Table 1.3:The Big Data assets of PUC3

Data needed	Data available	Data Provider	Information (resolution)	Volume/Velocity
Clouds	Cloud optical Thickness	MSG/SEVIRI (provided by NOA) Forecasted cloud scenes (0-3 hours)	Microphysics (5 km, 15 min)	12 Gb/day
Aerosols	Aerosol optical depth	CAMS (open)	3 days forecast (40 km, 1 h)	2.5 Gb/day
Ozone	Total ozone column (TOC)	ESA's OMI through TEMIS (NOA's Ground Segment)	3 days forecast (100 km, 1 d)	50 Mb/day
NO_2	Total NO_2 column	ESA's OMI through TEMIS (open access)	3 days forecast (100 km, 1 d)	50 Mb/day
Albedo	Surface Albedo	Sentinel 2 (NOA's Ground Seg.)	Albedo (60 m, 10 d)	3.5Gb (per 10 days)
Aerosol properties	Aerosol absorption and scattering properties	AERONET, MODIS, AVHHR and TOMS through Aerocom (open access)	Optical properties (synergy of ground-based with satellite data)	3Gb/day
Irradiance	GHI & DNI	BSRN (open access)	Ground-based measurements (1 min)	528 Mb/day
Clouds	Cloud phase & type	Sentinel 4 (NOA's Ground Seg.)	Optical properties (8 km, 1 h)	0.6 Gb/day
Other	Topography data, in situ data	Databases	50m	0.1 Gb/day

The TADDIS solution

Solar irradiance monitoring and forecast affects the load forecasts and it is therefore important for power transmission operators (national or private) and energy related industries, to be provided with the maximum possible accuracy. TEDDIS will support IPTO by providing:

- Forecasts of solar irradiance and solar energy data targeting the maximum penetration of solar farms output into the electrical grid-nowcasting solar energy for efficient energy planning.
- Forecasts of solar energy data in a pan European, N. African and M. East scale (upscaling of the nextSENSE system).
- Novel deep learning architectures towards providing fast and accurate real time solar energy exploitation information
- A solar energy system flexible in redefining solar outputs through co-designing procedures defined by NOA, PMODWRC and IPTO.

The application of theTADDIS developed solar forecasting product to IPTO needs, through the co-design approach, will showcase the technological and economical related benefits of the use of the proposed decision making, big data analytics platform.

The real-time nextSENSE outputs by PMOD/WRC and NOA of the solar energy potential will provide support to the efficient control of: (i) the energy demands and (ii) the electricity distribution by incorporating the produced energy of private and national solar farms (photovoltaic (PV) and Concentrated Solar Power) into the electricity grid. The participation and the co-design of the application and the products by the national (Greek) TSO, IPTO provides the opportunity to transform the IPTO's control system to a smart grid and the realisation of a more efficient and without unnecessary losses transmission operation will become feasible.

Within this use case the solar forecasting experience will be combined with the TEDDIS solution presented in the proposal. This will provide **a solar forecasting system with unprecedent accuracy, spatiotemporal resolution and response time (real time) upscalled in a continental scale**. The system will be based on the basic approach of the developed forecasting system nextSENSE enhanced by utilizing TADDIS related structures and workflows such as: Deep learning pipelines to drive efficient radiative transfer model inversion, DIAS related applications and AI workflows. A detailed description of the methods and models used in the work will be provided in a final scientific report, together with recommendations for future work. Moreover, the results of this use case will include datasets of the input parameters used for the solar energy determination.

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1.3.3 Positioning of the TADDIS project (Technology Readiness Level)

This table positions our key results on the "idea to application" spectrum based on current and expected TRLs.

Key results (modules)	TRL		Justification
	Cur	Exp	
KR01 Virtual platform for AI workflows	5	7	EXUS is going to capitalize upon its internal AI Platform the EXAITE Suite (EXus Artificial Intelligence Technologies). EXUS has developed an internal library of AI tools and predictive models from different H2020 Projects (IN-PREP, AEGLE, WORKINGAGE, DATABIO). EXUS will utilise the existing experience in workflow designing, AI Algorithms development and Big Data Manipulation for developing an easy to use API-centric AI Workflow engine.
KR02 Deep Learning Networks for multimedia data	5	7	CERTH has developed as part of hackAIR H2020 EU project a module using deep learning techniques that identified the existence of sky in images and localized sky regions. In TADDIS, this module will be further improved to perform better and shall include also networks that map sky color to air quality index.
KR03Deep learning for multisensor and multisource EO data	5	8	ExtremeEarth H2020 EU project is developing deep learning architectures for classification of big Sentinel 1 and Sentinel 2 data for polar and food security user cases, respectively. The approach is to develop two different architectures devoted to the separate analysis of multispectral and SAR data. In TADDIS we develop a deep technique that can jointly process multisensor and multisource data for increasing classification accuracy.
KR04 Deep Learning to forecast solar irradiances	5	8	NOA has developed in the context of GEO-CRADLE and e-SHAPE H2020 projects simple machine learning algorithms which simulate a radiative transfer model and nowcast solar energy parameters. TADDIS will improve the service by 1) incorporating deep learning approaches to reduce estimation uncertainties and 2) forecast solar spectral irradiances.
KR05 Data Distribution - Federated Learning	5	7	CERTH has developed and tested in previous H2020 projects (Local4Global and Plug-N-Harvest) a module using Federated Learning techniques for the data distribution as well as the distributed training of neural networks. In TADDIS, this module will be further developed in order to make distributed network training even more robust and private.
KR06 Machine Learning module in HPC and low-power environments	4	6	BSC has experimented and prototyped with machine learning modules for distributed and low-powered environments, with good results on laboratory simulations of an environment. At the end of the project we expect to have matured such technology towards large scale (extended Edge architectures), full performance optimization (fine tuning towards expected production performance) and demonstration ready (integration with the real use case).
KR07 Extreme-scale clustering and similarity search algorithms on cloud and HPC	5	7	Part of the proposed clustering techniques are being designed and developed in the context of the EO Big Data project EOPEN (https://eopen-project.eu/) by CERTH and in the context of TADDIS, they will be adapted to the user requirements and acquired data types, sources and modalities. For the similarity search from multiple modalities, CERTH will be based on VERGE (https://mklab.iti.gr/verge/) and extend the existing technologies to the wider audience of energy, maritime and space sectors, in one unique solution.
KR08 Predictive analytics models	5	7	XLAB has been part of PIXEL H2020 EU project, where AIS data analytics has been developed for small and medium sized ports on large-scale open-source AIS data. Ship traffic in the ports was also analysed by ESA Copernicus Sentinel-2 and commercially available Planet Labs satellite imagery. ML and DL based models have also been developed for renewable energy production. XLAB will exploit already obtained knowledge and technology, adapt and further develop it for the TADDIS objectives and applications.
KR09 a real time solar energy forecast spatiotemporal resolution system	5	8	PMODWRC has developed a nowcasting and short term forecasting solar energy product in the context of the EU funded projects GEO-Cradle and E-Shape respectively. The systems have been demonstrated and within the TADDIS project will be: 1) improved in accuracy and spatiotemporal resolution, 2) accelerate the real time output generation, 3) upscaling in a European-N. Africa-M. East level, 4) produce outputs tailored to TEDDIS end-users.
KR10 TADDIS Intelligent Analytics Platform	5	7	Solutions developed by EXUS range from customizable dashboards to drive business intelligence (BI) to advanced analytics visualizations tailored for the customer data. In IN-PREP also a time-series prediction decision support tool was also developed. EXUS has used dashboard analytics in the H2020 DataBio project (TRL6) for agricultural insights. Through the H2020 RANGER project that EXUS was coordinating Radar & AIS data were fused and an early warning mechanism (TRL 7) was developed for maritime surveillance.
KR11 The TADDIS ontologies	5	7	UoA will lead the development of the TADDIS ontologies to be used in the two use cases. The developed ontologies will be based on existing ontologies for sensor, temporal, geospatial and EO ontologies that are now at TRL 5.

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KR12 New version of GeoTriples-Spark	5	7	GeoTriples (http://geotriples.di.uoa.gr/) has been developed by UoA in previous projects. In its latest highly scalable version, GeoTriples-Spark can transform TBs of geospatial data into RDF. In TADDIS GeoTriples-Spark will be extended for dealing with the diverse data sources of the project while preserving its high performance and scalability.
KR12 New version of JedAI	5	7	JedAI (https://jedai.scify.org/) is an open source, highly scalable toolkit that offers out-of-the-box solutions for any data integration task, e.g., record linkage, entity resolution and link discovery. The latest version of JedAI developed in H2020 big data analytics project ExtremeEarth will work with geospatial data and will be able to scale to TBs of data. In TADDIS, JedAI will be extended to deal with the TEDDIS data collections and formats.
KR13 New version of Strabon	5	7	Strabon (http://strabon.di.uoa.gr/) is currently one of the most functional spatiotemporal RDF stores and it exhibits excellent performance and scalability as shown in (Ioannidis et al. 2019). It is currently reengineered in H2020 big data analytics project ExtremeEarth (http://earthanalytics.eu/) so that it scales to TBs of linked geospatial data. In TADDIS, the latest version of Strabon will be extended in order to deal with the diverse data sources of the project while preserving its high performance and scalability.
KR13 New version of Ontop-spatial	5	7	Ontop-spatial (http://ontop-spatial.di.uoa.gr/) is currently the most well-known system for geospatial ontology-based data access. It exhibits high performance and scalability as shown in (Bereta et al. 2019). In TADDIS, the latest version of Ontop-spatial will be extended in order to deal with the diverse data sources of the project.
KR14 New version of the Autonomous Decision-Making	5	7	A "plug-n-play" Autonomous Decision-Making System, which was recently developed and successfully tested in a variety of European Projects will be revised appropriately towards addressing the key Objectives of the project, towards being able to "offer" the same advantages it offers for "conventional" applications.
KR15 Copernicus data collection module	6	8	The SERCO data collection module of the Copernicus Sentinel data and other satellite data is already tested in a real operational environment, while new features, metadata and analytics remain to come very close to the market.
KR16 Ship emission activity and AIS data collection module	5	7	UPC is developing a methodology to evaluate marine routes, harbour operativity maps and helix erosion during in-port manoeuvring using AIS data. In TADDIS this methodology will be adapted to use other AIS data in order to compute ship emissions.
KR17A Social media crawler	6	8	CERTH's crawlers have been tested in various cases in the environmental, health, news and security domain. TADDIS shall adapt the collecting process of data in social media public and open accounts, to retrieve sky-related content.
KR17B CCTV data collection	5	8	CERTH has developed as part of hackAIR H2020 EU project a module that collected data from several sources including web cameras. In TADDIS, this module will be adapted to cover CCTVs and include also a basic keyphrase selection sub-module.
KR18 TADDIS Big Data Operations Fusion Engine	6	8	TADDIS will use the experience for data manipulation from the in house developed EXUS Analytical Framework (EAF) (TRL 6) of EXUS. Furthermore, EXUS will utilize the knowledge from the ongoing H2020 Projects (RANGER, DATABIO & E2Data) for Big Data collection, pre-processing and visualization (TRL6-7). EXUS was coordinating E2Data and used MapReduce and Data parallelization techniques for 2+ million patients' datasets for significantly accelerating data streaming and code execution (run over GPUs) optimizing Apache Flink via automated processes through the E2Data platform (TRL7-8).
KR19 TADDIS Platform	3	6	Over the years, and based on the market best practices, everis has developed an Integration architecture reference model which will allow the enabling of Hybrid Integration approaches. This is a modular architecture composed by loosely coupled components (like API management, event-driven, third-party integration, etc). Over the years reusable software components were developed in different technologies like Mulesoft or custom development (using Terasoluna or KOA). In TADDIS new Integration components will be added to the Integration platform.
KR20Interactive UIs and Dashboards	3	6	everis has developed the methodology and all the document templates do improve time to market on delivering state of the art UIs and dashboards totally aligned with end users' needs.

1.3.4 Links with research and innovation activities

Project name	Project goal	Possible uptake & advancement	TADDIS partners
ExtremeEarth (http://earthanalytics.eu/)	The ExtremeEarth project develops Artificial Intelligence and Big Data technologies that scale to the petabytes of big Copernicus data, information and knowledge, and applies these technologies in two of the thematic exploitation platforms of the European Space	The systems GeoTriples, JedAI and Strabon developed in ExtremeEarth will also be used in TADDIS, and will be appropriately extended to deal with the diverse data sources of the project while preserving their high performance and	UoA, UniTN

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	Agency: the one dedicated to Food Security and the one dedicated to the Polar regions.	scalability. The deep architecture used for the classification of multispectral images in the Food Security case will be starting point of the multisensor and multisource classification architecture.	
EOPEN (https://eopen-project.eu/)	EOPEN provides EO data analytics services, decision making and infrastructure to support the Big Data processing life-cycle allowing the chaining of value adding activities across multiple platforms.	TADDIS will exploit the open-source outcomes of EOPEN to enrich the EO and non-EO data analytics of the developed platform, with a specific focus on Deep Learning on multisource and multisensory data and predictive analytics in maritime and energy.	SERCO, CERTH, NOA
e-SHAPE (https://e-shape.eu/)	e-shape aspires to provide significant impetus to activities that will enable and accelerate a breakthrough in the European EO sector and the downstream markets that benefit from EO services.	E-shape developments within the pilot on solar energy nowcasting & short-term forecasting system can be used as a starting point for TADDIS.	NOA, PMODWRC
GEO-CRADLE (http://geocradle.eu/en/)	The Access to Solar Energy (SENSE) pilot of GEO-CRADLE took advantage of the free access to Copernicus data and Core services, innovative modelling and state-of-the-art real-time solar energy calculating systems.	GEO-CRALDE has set-up SENSE platform (http://solea.gr/real-time-service), which can be the basis for Use Case 3 integrations.	NOA, PMODWRC
CALIOPE (http://www.bsc.es/caliope/es)	The project develops air quality forecasting system operationally provides public access to air quality forecasts in Spain for the main pollutants (NO2, PM10, O3) for the next 24 and 48 hours.	The tools and methodologies developed under this use case can be used to improve the emission input data used in the system.	BSC
CAMS (https://atmosphere.copernicus.eu/)	The main objective of the CAMS project is to provide anthropogenic emission inventories in direct support of the Copernicus Atmosphere Monitoring Service.	Establish links with other European teams that are using ground-level sensors for estimating emissions	BSC
DAME: Data Alternative for Marine Efficiency monitoring	DAME overcomes the constraints in the development of an on-board fuel data collection scheme	Estimate ship emissions from the Monitoring Reporting and Verification scheme imposed by the IMO to all the vessels.	UPC
HEROINHA: Helix EROsion IN Harbour Areas	HEROINHA estimates the erosion caused by vessels during arrival and departure manoeuvres. This project uses AIS data of a specific vessel to reproduce the manoeuvres using the navigator simulator and later estimate the erosion.	The outcomes of this use case be used to estimate harbour basin occupability and the potential consequences in the seafloor, port infrastructures and water quality.	UPC
PIXEL: Port IoT for Environmental Leverage	PIXEL is building an ICT framework for gathering data from edge IoT devices, data collection at cloud and further processing, and visualisation.	PIXEL ICT framework provides a modular architecture, where several building blocks can be reused in TADDIS (data storage, AIS data analytics, data visualisation, data management).	XLAB

1.3.5 Overall approach and methodology

TADDIS will adopt a user driven approach with the strong involvement of end users in the design and development cycles. The project foresees three development cycles: in the first cycle the user requirements are defined and the scientific objectives and research activities are generated.

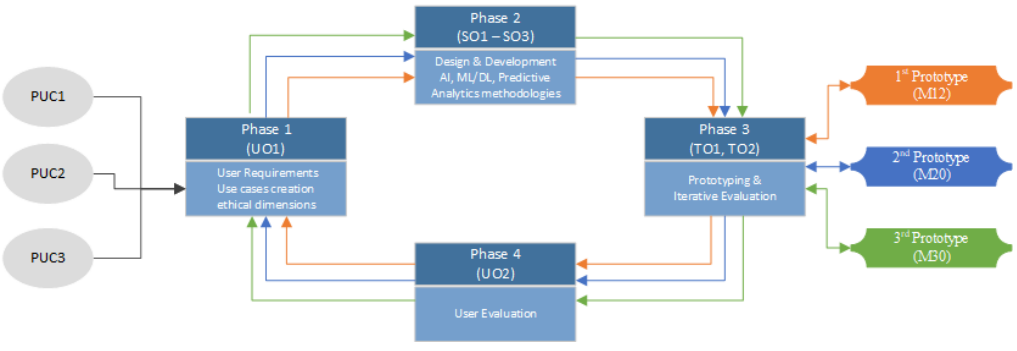

Figure 1.6: The overall TADDIS methodology

The technical architecture is designed and the 1st prototype is developed and evaluated by the end users for the PUCs. The outcome of this evaluation is fed to the 2nd cycle to update the user requirements and proceed with the 2nd

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prototype and evaluation. The final system is integrated during the 3rd cycle and tested for all PUCs.

In order to research and develop the novel Big Data platform, TADDIS confronts the following Scientific (i.e. going beyond SoA), Technological and User Oriented objectives (to ensure a user-driven approach). The methodology for the impact-making objectives is analysed in Section 2.

1.3.5.1 Approach and methodology for the Scientific Objectives (IOs)

SO1. Extreme-scale AI technologies on HPC environment

RA1.1 AI workflows on structured data

Methodology: In order to facilitate the rapid prototyping and deployment of scalable AI algorithms that could be used as a service (AIaaS) as independent serverless functions (cloud & infrastructure agnostic capability), EXUS will develop a virtual platform for designing Machine Learning workflows with simple drag and drop actions. In order to develop the platform three major intermediate steps should be finished: (1) Develop a series of common sub-components (common data conversions, data cleaning, AI Algorithms, statistical function, text mining etc). AI workflows will be developed through the open source Kubeflow or MLflow. (2) Virtual ML Pipeline Designer with edit, save, drag & drop functionalities and interconnection with BIDOFE and other TADDIS tools. The platform should provide the capability to the end user for inserting their own code (e.g. Python or R) or utilizing 3rd party datasets. The workflow management will be done via the Apache Airflow. (3) Containerize, Package and Run the entire workflow as an independent & transferable executable or via an API service. The OpenAPI will be used for developing new APIs for each workflow. Another important functionality is the development of a virtual sensor simulator where data streaming could be represented and reproduced for prototype speed up.

Baseline: EXUS is going to capitalize upon its internal AI Platform the EXAITE Suite (EXus Artificial Intelligence Technologies). EXUS has developed an internal library of AI tools and predictive models from different H2020 Projects (IN-PREP, AEGLE, WORKINGAGE, DATABIO) that can be re-used across various fields (FinTech, AgriTech, Crisis Management etc.). EXUS has the experience in designing and developing Software Components Workflow through the H2020 Projects EMOTIVE (storytelling cultural heritage design software) & MAGELLAN FTI (Mixed reality codeless graphic authoring environment for location-based experiences) that was the coordinator. EXUS will utilize the existing experience in workflow designing, AI Algorithms development and Big Data Manipulation for developing an easy to use API-centric AI Workflow engine.

Key performance indicators: At least 12 AI workflows tested through the project period.

Target value: Development of 1 Virtual Platform for AI workflows designing. Development of at least 20 AI/Data Sub-components.

Tools: Apache Airflow for workflow management, Kubeflow/MLflow for ML pipelines creation, TensorFlow, Python Pandas & NumPy (for Data sub-components creation, vectorization, Feature Engineering), Docker, Kubernetes (for microservices), Jenkins (for rapid deployment), OpenAPI for API Key generation & authentication.

Risks: Open source software limitation, bugs and absence of support. In house AI algorithms are not accurate. Difficulties in integrating designed ML workflows with the rest TADDIS tools.

Contingency plan: Different open source software will be tested before the final adoption from the developed platform. A combination of existing from the market serverless AI functions will be used along with the in house developed algorithms. Proactive collaboration among the partners will facilitate any kind of integration obstacles early in the project starting from the kick-off meeting discussion.

RA1.2 Deep learning in multimedia data

TADDIS exploits images from that are publicly available to provide an estimate of the air pollution level or air quality index by considering deep learning techniques.

Methodology: In TADDIS, we will provide an estimation of air quality index (AQI) by considering images. Specifically, the sources that will be considered are the collected online images from social media that are publicly available as well as images extracted from the video streams of CCTVs mounted on the vessels after applying keyframe selection techniques. Then, a series of SoA image analysis techniques will be applied to them including (1) visual concept detection based on low-level feature generation and classification for detecting images that contain substantial regions of sky,(2) localization of the sky regions within the image to remove non-sky regions, and (3) the mapping of the sky region color to air pollution by considering machine learning models. The algorithms in the processing pipeline can span from classical detection theory to deep learning depending on the desired accuracy and the overall computational performance. Thus, modified deep CNN networks will be tested in all the aforementioned steps included the concept detection, sky localization and color mapping to AQI.

Baseline: In the analysis of images from social media and CCTVs, aqua3S will consider as concept detection baselines the techniques of H2020-ICT-hackAIR and H2020-EO-EOPEN projects and as localization baselines the techniques of H2020-ICT-hackAIR.

Key performance indicators: Accuracy, Precision, Classification efficiency, Detection latency, Frame per second, False and true positive rate (FPS and TPR, respectively).

Target Value: 2-5% improvement in identification accuracy in all scenarios, detection probability over 80%.

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Tools: Computer vision algorithms using existing and open source codes in Python (e.g. Tensorflow), software frameworks such as OpenCV, existing libraries for video segmentation and keyframe selection.
Risks: Insufficient training data that could lead to decreased accuracy. Bad light conditions could decrease the visual results leading eventually to low accuracy detection (inaccurate pollution identification).
Contingency plan: Exploit new benchmark datasets to ensure proper training and testing of the deployed detection models. Deploy post-processing techniques to enhance detection capabilities.

RA1.3 Deep learning in multisensor and multisource Earth Observation data

Methodology: In TADDIS, we will provide a deep network architecture that can integrate multisensor and multi-source EO data for solving automatic classification problems. We will consider architectures that can jointly classify remote sensing data acquired by different kinds of satellites, including multispectral images, SAR images, and other possibly ancillary data. The idea is to leverage on state-of-the-art deep architectures in computer vision and remote sensing and on the experience within the team to define specific techniques that can jointly exploit and model the properties of multispectral, SAR and typical ancillary data (e.g. digital terrain models, cartographic layers). The activity will include: 1) identification and analysis of candidate deep techniques (e.g., based on Convolution Neural Networks, Residual Deep Networks, Recurrent Deep Networks, Convolutional LSTM, Generative Adversarial Networks) considering multisensor architectures presented in the machine learning literature and possible novel solutions; 2) definition and implementation of a deep architecture suitable to the characteristic of the considered kind of data; 3) training of the architecture, test and validation of the classification performances.
Baseline: Currently there are still few studies on deep architectures that can effectively integrate multisensor and multisource EO data and are suitable for operational applications. We plan to start from the deep architecture developed for the classification of multispectral Sentinel 2 images in the ExtremeEarth H2020 EU project and to extend and generalize it to the multisensor and multisource case with proper methodological improvements.
Key performance indicators: Accuracy, Precision, Recall, Error Matrix, Classification efficiency.
Target Value: 3-5% improvement in classification accuracy
Tools: Computer vision algorithms using existing and open source codes in Python, Python machine/deep-learning learning libraries (Scikit-learn, PyTorch, Tensorflow/Keras) and specialized libraries for EO data processing.
Risks: Limited availability of multisensor data sets with related training data. A limited number of training data is critical for the learning of deep architectures in terms of generalization properties of the network.
Contingency plan: Exploit benchmark datasets to ensure proper training, testing and validation of the deployed detection models. Possible use of strategies for using obsolete classification products for generating training data.

RA1.4 Deep learning pipelines to drive efficient radiative transfer model inversion

Methodology: In TADDIS we will provide the forecasting of solar spectral irradiances based on a hybrid approach that combines deep learning and multi-regression function (MRF) modelling techniques to produce instantaneous outputs. We will use real-time and forecasted atmospheric parameters (e.g. clouds, aerosols, gases, etc.) by fusing multi-modal satellite and the Copernicus Atmosphere Monitoring Service (CAMS) products. The real-time models will be validated against ground-based measurements of the Baseline Surface Radiation Network (BSRN), while a sensitivity analysis of the cloud and aerosol effects on surface solar radiation will be performed to ensure reliability under different sky and climatological conditions.
Baseline: Currently, we have developed a series of machine learning algorithms which are able to simulate a radiative transfer model. These systems use as inputs more than 15 atmospheric parameters (e.g. clouds, aerosols, gases, etc.) and produce high spectral resolution irradiances (i.e. global, direct, diffuse, actinic flux and spectrally weighted outputs). An example can be found here http://solea.gr/real-time-service/where we simulate almost 1.5 million pixels every 15 minutes covering Europe and North Africa. The algorithms have been developed in the context of GEO-CRADLE H2020 project.
Key performance indicators: ML accuracy (F-score, etc.), validation accuracy vis-a-vis ground truth data, forecast horizon, spatial resolution.
Target value: 5% improvement with respect to current implemented system, 85% validation accuracy, 3h horizon forecast, spatial resolution bound by CAMS products.
Tools: libRadtran library for the radiative transfer modeling, open source codes in Python (e.g. Tensorflow) for deep learning architectures.
Risks: Lack of sufficient ground-based measurements for training and validation, inherent uncertainty of CAMS input parameters.
Contingency plan: Employ data augmentation approaches to enrich the datasets, explore synergies with ongoing projects to gain access to ground-based data (e.g. Excelsior H2020), and exploit multi-modal satellite data to reduce dependence on CAMS model outputs.

RA1.5 TADDIS Data Distribution Through Federated Learning

Methodology: To ensure good task performance of a final, central learning model, federated learning relies on an iterative process broken up into a distributed set of client-server interactions known as a federated learning round.

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Each round of this process consists in transmitting the current global state to participating nodes, training local models on these local nodes to produce a set of potential model updates at each node, and then aggregating and processing these local updates into a single global update and applying it to the global model-state. We will use this tool so as to submit crucial global – local information through the different communication layers of each use case, addressing critical issues such as data privacy, data security, data access rights and access to heterogeneous data.

Baseline: As the baseline for the Federated Learning approach we will be based on the work proposed in (Kosmatopoulos et al., 2015), describing the secure and private exchange of information between multi – node systems and a central decision layer.

Key performance indicators: Seamless integration of all sensory services and datasets without diffusion of critical information and private datasets.

Target value: Development of secure data distribution tool.

Tools: Open-source data analytics software stack including Apache Hadoop and Apache Spark for data analytics, and in order to support streaming processing of incoming data, frameworks such as Apache Flink are required. Python Pandas (for Data gathering, Data cleaning, Data wrangling, Process missing values), Python NumPy (for Data Normalization/Scaling, Vectorization, Feature Engineering), JSON, XML, CSV, MongoDB.

Risks: Open source software limitation, bugs and absence of support. Model training "poisoning", TADDIS Federated Learning Tool is not integrated properly early in the project.

Contingency plan: Clarify during the first 6 months of the project the integration framework and the methodology that will be followed. Clarify early in the project the open source tools that are going to be used. Ensure the data encryption and the secure filtering in order to avoid malicious actors from corrupting the model.

RA1.6 Modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona

Methodology: Here we leverage modelling of HPC and analytics infrastructures, from Edge to Cloud systems, towards optimization on data aggregation and analytics process on AI workflows, specifically traffic streams towards data collection, as a case of use of continuous data analysis and performance management. Data streams from maritime traffic require processing before being stored or ingested by air quality simulations. Those processing methods are analytics that can be performed near-data or in high performance environments. Understanding the nature of the analytics methods to be used for processing that data (aggregation, correction, enrichment) is key for optimizing the pipeline environments. For this, AI and ML methods will be used to model workloads and environment to improve efficiency of pipelines, deciding how, when and where produce such analytics.

Baseline: Current studies collect data off-line to be pre-processed in supercomputers, without workload optimization, to later use for simulations.

Key performance indicators: Resource usage (i.e. amount of CPU, Memory, Bandwidth per time unit); Energy consumption (derived from resource usage); Accuracy/precision (from predictive analytics)

Target value: Reduction of Resource usage between x2 – x10, depending on aggregation levels. Maintaining of Accuracy/Precision in (x0.8 – x1.0) in resource usage reduction trade-off.

Tools: Apache Spark (+Spark ML, +Spark Stream), Google TensorFlow + Keras.

Risks: Created models can fall below acceptance threshold; Data can be insufficient for modelling; Management overhead is above resource reduction.

Contingency plan: Trade-off between model quality and resources usage for modelling can be studied; Additional datasets can be generated from real hardware, and additional AIS datasets can be retrieved; ML algorithms can fallback to statistical learning methods proven lighter, also learning can become aggregated or offloaded.

SO2. Big Data Predictive Analytics on HPC environment

RA2.1 Data stream clustering and similarity search in extreme-scale data collections

Methodology: TADDIS employs a 7-step approach to evaluate and refine the clustering process: (i) Analysis of the underlying datasets in terms of their modality (raw data measurements, visual content, spatiotemporal data, text), (ii) Assessment, indexing and preparation of raw data. Preparation often includes adding missing values, eliminating outliers, or reducing the parameter space using hashing techniques, combined with domain knowledge. (iii) Prepared data will be represented as a mathematical model to compute the fused similarity between individual items. (iv) The fused similarity measure compares the similarity between pairs of objects. (v) The selected similarity measure is used with a given algorithm. An iterative process is then repeated, aiming to minimise an objective function by validating (vi) and interpreting (vii) the results.

Baseline: For the clustering approach, we consider as a stopping criterion the internal Age estimation of the process (Gialampoukidis et al., 2019). For the similarity search, we consider as a baseline the fusion approach of (Andreadis et al., 2020; Gialampoukidis et al., 2017) where multiple similarities are fused.

Key performance indicators: Normalized Mutual Information (NMI), Adjusted Rand Index, Processing Time and User-based evaluation to demonstrate that developed clustering techniques are beneficial to end users. For the similarity search, mean Average Precision (mAP) and Precision at 10 (P@10).

Target value: Increase by 5% in NMI and Rand, decrease by 15% in processing time, Likert scale 4. mAP increase by 10%, P@10 increase by 5%.

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Tools: Open-source data analytics software stack including Apache Hadoop and Apache Spark for data analytics, and in order to support streaming processing of incoming data, frameworks such as Apache Flink are required. Python and R Open Source libraries (e.g. sklearn, dbscan) are also considered, while their parallel implementations are utilised when available.

Risks: (i) Existing clustering algorithms are not suitable for processing highly heterogeneous datasets used across all use cases in TADDIS. (ii) Annotated data for evaluating clustering may not be available.

Contingency plan: (i) TADDIS will perform a thorough explorative analysis of existing data assets and evaluate the operational capability of existing clustering algorithms during the first months of the project. Thus, the necessity to adapt or develop new clustering algorithms will be identified sufficiently in advance, so that the risk of being not able to cluster available data will be reduced. (ii) Annotated data will be manually annotated, if needed, for a significant amount of data items.

RA2.2 Predictive analytics models

Methodology: Predictive models will be developed to support use-cases for EO applications, maritime emissions and energy demand forecasting. Use-cases deal with different data formats, ranging from satellite imagery of different spatial resolution and types of sensors that will be used for EO applications, as well as energy demand forecasting. Data also includes geospatial time series data from vessels and structured data from vessel databases, as well as different environmental data from the atmosphere. Wide range of different data modalities, quantity and frequency will enable us not only to use state-of-the-art technology in the fields of image processing, time-series analysis and environmental modelling, but also to develop new ones and scale existing to extreme-scale data.

Baseline: Developed methods will be compared to publicly available industrial and academic benchmarks published in the literature, selected according to the defined use-cases and developed methods.

Key performance indicators: Different metrics will be used, according to the classification (AUC, F1 score), regression and time-series forecasting (MAE, RMSE), object detection and segmentation (mean IoU, AP, AR).

Target value: At least 10% improvements in key performance indicators on EO applications and improved running times of the existing methods. Achieve at least 100 x 100m spatial resolution of AIS based vessel emission estimation predictive models. Obtaining similar key performance indicator for extended horizons of 2-3 days for solar energy production forecasting.

Tools: Python visualization and data processing libraries will be used for exploratory data analysis and final report (Pandas, Plotly, Seaborn), together with Python machine/deep-learning learning libraries (Scikit-learn, PyTorch, Tensorflow/Keras) and specialized libraries for EO data processing (e.g. eo-learn).

Risks: Unavailability of all the labeled data for the development of supervised methods.

Contingency plan: Focus on the development of weakly-supervised and unsupervised based approaches and extensive data augmentation procedures.

RA2.3 Solar Energy short-term forecasting from satellite data

Methodology: In TADDIS we will provide solar energy forecasts based on the developed system nextSENSE including TADDIS IT developed tools for the system improvement, optimization, accuracy and spatiotemporal resolution enhancement and upscalling in continental region levels. Basic information used as inputs to the nextSENSE system which is basically a radiative transfer real time algorithm are earth observation satellite based atmospheric data. Several look up tables will be build based on all possible combinations of atmospheric variability (cloud properties, aerosol properties, albedo, solar elevation, trace gases changes in the atmosphere) and speed up, collocation and decision-making algorithms will be used. Main factors of solar energy uncertainty estimations are forecasting of cloud and aerosol changes for particular grids. TADDIS will focus on the improvement of such forecast algorithms using a hybrid approach of cloud motion vector analysis combined with probabilistic methods.

Baseline: Sense nowcasting and nextSense forecasting solar energy systems have been developed and have been demonstrated in various applications. Real time radiative transfer calculations are based on a combination of atmospheric input homogenization techniques, atmospheric forecasting techniques and a neural network approach that provides the real time solar energy product. An example can be found here http://solea.gr/real-time-service/ 15 minutes step results for Europe and North Africa are shown. The algorithms have been developed in the context of GEO-CRADLE and E-Shape H2020 projects under the lead of PMODWRC. Product validation is foreseen using MSG satellite collocated solar radiation measuring stations from the baseline shortwave radiation network.

Key performance indicators: System accuracy and uncertainty, spatial and temporal resolution, processing time.

Target value: 10% improvement with respect to current implemented system, especially for cloudy conditions, 90% validation accuracy, 3h horizon forecast with a 5minutes temporal step, spatial resolution of 5 by 5 km.

Tools: LibRadtran radiative transfer model, SENSE related neural network speed up system, atmospheric libraries, real time satellite reception antenna, Copernicus atmospheric monitoring system data libraries.

Risks: Satellite mission failure, uncertainties of used inputs from satellite based and CAMS sources.

Contingency plan: Using alternative EO satellite data from Sentinel 2, use of surface-based cloud and aerosol optical properties measurements in order to re-evaluate modeling inputs.

RA2.4 TADDIS Intelligent Analytics Platform (TADDIS INAP)

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Methodology: TADDIS will offer rich visual analytics (Business Intelligence Dashboard) with predictive analytics capabilities. All the information that is fused and processed through the BIDOFE platform will be able to be visualized through Time-Series, Pie Charts, Heatmaps, Map-information that could be exported for reporting purposes. The output of the packaged AI workflows and other TADDIS tools could be visualized within the INAP through APIs so that the overall system will be integrated. A set of robust algorithms (near) real time timeseries prediction will be created using existing packages SotA technologies such as the Facebook Prophet or in-house developed Neuro-Fuzzy Timeseries prediction algorithms with increased accuracy. The TADDIS ecosystem of sensor information will be fused through the BIDOFE, streamed through an API to the INAP and then will be stored in a real time or NoSQL database such as (Firebase Real Time Database or MongoDB), from there automatically predictive analytics will run in a different node returning the results of the prediction in a visual graph within INAP dashboard. The overall system will enhance the level of understanding of the users over the data, enhancing their decision-making capabilities.
Baseline: EXUS has also undertaken several projects delivering visual analytics solutions in the Healthcare and Financial verticals. Solutions developed range from customizable dashboards to drive business intelligence (BI) to advanced analytics visualizations tailored for the customer data. More specifically, EXUS will utilize also the experience from the H2020 IN-PREP project and the AI Recommendation Engine that was build therein based on Knowledge Graphs. In IN-PREP also a time-series prediction decision support tool was also developed. (TRL 5) to further extended. EXUS has used dashboard analytics in the H2020 DataBio project for agricultural insights, while is using PowerBI for the EXUS Financial Suite that is offered in Banks in more than 20 countries across the globe. Through the H2020 RANGER project that EXUS was coordinating Radar & AIS data were fused and an early warning mechanism was developed (by EXUS) for maritime surveillance.
Key performance indicators: > 90% of connected sensors to be visualized in TADDIS INAP. > 75% of accuracy in time series prediction. 500+ Alerts & Warnings generated during project period.
Target value: 1 Intelligent Analytics Platform with integrated sub-components
Tools: 1 main tool (Intelligent Analytics Platform) with 2 sub-components: a) Semi-Empirical Risk Assessment Monitoring (SERAM) and b) Real Time Alerting and warning Mechanism (RETAM)
Risks: (1) TADDIS tools are not integrated properly early in the project. (2) Risk assessment for the SERAM tool is not accurate. (3) Near real time series prediction is not fast enough.
Contingency plan: (1) Clarify during the first 6 months of the project the integration framework and the methodology that will be followed so that the architecture of each TADDIS subcomponent is compliant with the INAP. (2) Multiple iterations will be developed creating a semi-empirical risk assessment Monitoring (SERAM) sub-component based on the insights from Key Experts (End User partners, Risk Managers and other related stakeholders identified in the Communication WP). Corrective actions will be applied where necessary (3) Further enhance the computation power of the prediction to be applied over the cloud. Consider using a real time database. Adopt a more scalable architecture with more Apache Spark Clusters.

SO3. High-level semantics and content enrichment from Big Data

RA3.1: Ontology development

Methodology: The TADDIS ontologies, one for each use case, will be developed using the Web ontology language OWL 2 and the ontology development framework Protégé using well-known methodologies pioneered by Semantic Web researchers. The ontologies will be stored in the geospatial and temporal RDF store Strabon, and will also be used by the ontology-based data access system Ontop-spatial for integrating the diverse data sources of the project.
Baseline: Existing ontologies for sensor, temporal, geospatial and Earth Observation data.
Key performance indicators: Number of competency questions to be answered by the ontologies.
Target value: >95% of the questions are able to be answered
Tools: Protégé, geospatial and temporal RDF stores Strabon and Ontop-spatial
Risks: Collected user requirements are not complete so only a partial ontology is developed for some use case.
Contingency plan: Existing ontologies will cover the areas where the TADDIS requirements are not complete.

RA3.2: Ontology population, data harmonisation, fusion and linking of data

Methodology: In order to populate the ontologies developed in RA3.1, we will use the GeoTriples-Spark tool of partner UoA. For the tasks of data harmonisation, fusion and linking of data, we will use the JedAI toolkit of the same partner. Both tools will be extended to deal with the massive and diverse data sources of TADDIS.
Baseline: The systems GeoTriples-Spark and JedAI of partner UoA
Key performance indicators: Amount of data transformed or harmonised/fused/interlinked and time it takes for these tasks to be achieved, quality of results
Target value: At least 1TB of input data transformed into RDF in less than 1 hour, same target values for harmonisation/fusion/interlinking, >90% precision and recall for the harmonisation/fusion/interlinking task.
Tools: GeoTriples-Spark, JedAI
Risks: Expected performance is not achieved

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Contingency plan: The tasks of this research activity (transforming into RDF, harmonizing/fusing/interlinking) are performed in batch mode so lower performance will not adversely affect the progress of the project.

RA3.3: Semantic search and querying

Methodology: The search layer of the TADDIS platform will utilize the power of well-known open source search engine Elasticsearch which offers all the functionalities needed for TADDIS. For the querying layer of the TADDIS platform, we will extend the geospatial and temporal RDF store Strabon, and the geospatial ontology-based data access system Ontop-spatial so that they can deal with the diverse TADDIS data sources.

Baseline: Search engine Elasticsearch, systems Strabon and Ontop-spatial of partner UoA

Key performance indicators: Efficiency and scalability of Strabon and Ontop-spatial

Target value: Strabon and Ontop-spatial scale to at least 1 TB of data and are able to answer queries of interest to TADDIS in minutes.

Tools: Strabon and Ontop-spatial

Risks: Promised performance and scalability is not achieved.

Contingency plan: Commercial systems such as GraphDB are tried as a possible alternative.

RA3.4: TADDIS Autonomous Decision-Making system

Methodology: A self-learning, self-optimizing, goal-driven mechanism is employed towards, enabling each of the -subsystem to act locally while optimizing globally the overall performance. Such a mechanism has the following attributes: *(a) "Plug-n-Play" cooperative autonomy*: State-of-the-art approaches for embedding autonomy and especially cooperative autonomy require a rather "expensive" deployment procedure in order to operate efficiently. Such a deployment procedure involves highly paid and skilled personnel for programming, calibrating and verifying the autonomy decision making mechanisms. Thanks to self-calibration/self-learning attributes embedded within it, TADDIS cooperative autonomy mechanism is able to provide the optimal decisions very fast. TADDIS control mechanism automatically re-programs and re-verifies all different operations in an automatic and real-time manner so as to optimize the overall performance and make sure that user needs are satisfied. *(b) Minimum infrastructure/communication requirements (distributed operations)*: thanks to the attributes inherited from an ingredient embedded within it, the TADDIS control mechanism optimises the operations of the different subsystems in a distributed manner without sacrificing global optimisation performance and to exploit the real-time data available as to self-adjust and self-organise towards providing highly accurate assessments of the different subsystems' decisions and actions without sacrificing, scalability and computational efficiency.

Baseline: The TADDIS Autonomous Decision – Making System is based on the attributes inherited from an ingredient embedded within it, i.e. the Local4Global system (Korkas et al., 2015; 2016).

Key performance indicators: Various test cases will be tested on each use case to evaluate performance before and after the installation of the Decision-Making System.

Target value: Autonomous and self-adaptive Decision-Making System

Tools: Python Pandas (for Data gathering, Data cleaning, Data wrangling, Process missing values), Python NumPy (for Data Normalization/Scaling, Vectorization, Feature Engineering), Matplotlib for Data visualization, JSON, XML, CSV, MongoDB. Python Keras and Anaconda Frameworks. Furthermore, the TADDIS architecture will support a variety of frameworks for batch processing e.g. Hadoop, for streaming processing e.g. Apache Kafka and Apache Flink, for partitioning (e.g., Apache Spark), for microservices (e.g. Docker, Kubernetes), rapid deployment (e.g. Jenkins), API Key generation & authentication (e.g. OpenAPI).

Risk: Open source software limitation, bugs and absence of support. In house AI algorithms are not accurate. Difficulties in integrating designed optimization and autonomous Algorithms with the rest TADDIS tools.

Contingency plan: Different open source software will be tested before the final adoption from the developed platform. A combination of existing from the market serverless AI functions will be used along with the in house developed algorithms. Proactive collaboration among the partners will facilitate any kind of integration obstacles early in the project starting from the kick off meeting discussion.

1.3.5.2 Approach and methodology for the Technological Objectives (IOs)

TO1. Data acquisition & Big Data streams indexing

TA1.1 EO data collection and quality control from the Copernicus and DIAS services

Methodology: The methodology is based on the recent developments of the Copernicus Data and Information Access Services (DIAS), passing expertise and knowledge from the space sector to industrial use cases. The DIAS concept aims at rationalising the access to the large volume of data with the objective to make all Copernicus data available in an attractive ICT infrastructure for the users that wish to develop and operate data processing chains. The ONDA-DIAS platform currently hosts 21.5 petabytes of geospatial data and information, including all the Copernicus Sentinel Missions, products form the Copernicus Services, and data from other satellite missions like Landsat-8 (NASA) and ENVISAT (ESA). The framework is not targeting only at the European distribution of Copernicus data, but aims at being fully compatible with any Big Data application in the IoT domain.

Baseline: The ONDA-DIAS platform from the space sector will serve as a baseline approach for TADDIS.

Tools: ONDA-DIAS extensions for the purposes of TADDIS.

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Risks: Closed data assets do not allow cloud processing on ONDA-DIAS infrastructure.
Contingency plan: Other partners from TADDIS consortium will offer their cloud infrastructure.

TA1.2 Ship emission activity based on real-time AIS data

Methodology: We will use as input the position reports generated by the Automatic Identification System (AIS) and the static report yielding the specific information of each vessel. The AIS system consists of an on-board broadcast transponder system with 27 different messages containing detailed information of the ships (a minimum of 6 fields and a maximum of 16 fields in a message, depending on the message type). The system is globally on-board in every vessel with gross tonnage larger than 300 GT, and it provides automatic updates of vessel's information at intervals of a few seconds to a few minutes (i.e. 2 seconds to 3 minutes depending on the vessel's speed, course and state). The data includes both dynamic (e.g. position, speed over ground, heading), static and voyage related information (e.g. unique identification, destination, ship type and sizes). Compared to other traditional emission estimation methodologies, the use of AIS allows for more accurate estimations of vessels' activities and the improved reliability of emissions and fuel consumption estimations.
Baseline: AIS data will be analyzed using machine learning techniques able to work with big data. The ship emission estimation methodology will follow the approach proposed by Jalkanen et al. (2012).
Key performance indicators: AIS data processing time. AIS corrected data. Pollutant gases and particles emitted by ships in near-real time.
Target value: Near-real time ship emissions
Tools: Original AIS data will be collected through a receiving station located at the Department of Nautical Sciences and Engineering (UPC-BarcelonaTech). The reproduction of the methodology in all European ports can reach a total amount of data of about 2.7GB/h. The IHS Fairplay holds the largest maritime databases in the world which includes information on the installed power of the main and auxiliary engines, type of fuel consumed, rpm of the main engines and other data directed linked to the emissions calculation.
Risks: i) AIS recording system does not work properly; ii) some of the ships not included in the HIS Fairplay DB.
Contingency plan: i) Acquire a new AIS recording system or, alternatively, obtain the data from the Spanish Port Authority; ii) The knowledge of main and auxiliary engines can be obtained from the Nautical Sciences and Engineering Department staff.

TA1.3 Collection of online content (e.g. CCTV information from vessels) and social media data

TADDIS exploits crowdsourcing and CCTVs to gather images in order to provide estimates of air quality index.
Methodology: The collection of online content is performed by submitting topic-specific queries to social media APIs (e.g., Twitter APIhttps://developer.twitter.com/) or Web resources (Tsikrika et al., 2016). In TADDIS we focus on social media platforms as they offer real-time knowledge and on CCTVs mounted on the vessels. Regarding the data provided from social media platforms, after their collection which may consider specific keywords, or geolocation or relevant hashtags, we keep only relevant ones to the target event by considering both the textual and visual information, as it is represented by state-of-the-art methods, such as Word2Vec or Glove for text and visual features for images which are trained on a DCNN (Moumtzidou et al., 2018).
Baseline: The crawling infrastructure will build upon CERTH's tools for crawling social media in disaster monitoring and crisis management (Moumtzidou et al., 2018), already tested in the context of H2020-beAWARE.
Key performance indicators: Precision, recall, F-measure, accuracy, response time, coverage, and efficiency
Target Value: 10% over the baseline (for all indicators).
Tools: CERTH crawlers from the legacy of other H2020 and FP7 projects (http://mklab.iti.gr/results/), Twitter and Flickr Python clients.
Risks: This activity builds on top of mature and well-tested research outcomes. A possible problem that might arise is the lack of content in the specific areas of interest, when citizens have low activity in social media, which will complicate the creation of a suitable training set to be used for training for the machine learning algorithms. In addition, large amounts of social media posts may increase the response time.
Contingency plan: We will exploit historical social media datasets from other areas and adapt them, if needed, to the specific area of interest. The large amount of social media posts is filtered to the relevant ones and limited to the specific area of interest and the specific keyword selection, based on domain-specific knowledge.

TA1.4 TADDIS Big Data Operations Fusion Engine

Methodology: In order to offer in real time data manipulation from heterogenous data sources, a data collection framework must be developed that can collect, parse, integrate and format heterogeneous data of different size, shape, velocity and quality. Towards this TADDIS is going to develop a multilevel data collection framework for distributed processing of high volume and velocity data that will involve the following steps: 1) Creation of connectors via APIs for TADDIS sensors/web interfaces for raw data gathering 2) Development of Data wrangling/Data munging algorithms for transforming and structuring data from raw data form into a unified format (e.g. XML, JSON) 3) Development of Data Cleaning algorithms for filtering of unwanted characters 4) Data enrichment for merging third-party data from an external authoritative sources (3rd Party APIs) 5) Data Validation routines for ensuring data quality 6) Publication of Data to a middleware stack via internal APIs. All TADDIS web services and tools will be using the

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API for consuming data from the Data Middleware Stack. BIDOFE will leverage mature big data technologies, such as Spark, Hadoop, Storm and Flink, and is capable of seamless facilitation of functions for both batch and streaming big data. Algorithms for online similarity matching in streaming data at very high rates will be developed, and will enable complex analytics such as the real-time mining. BIDOFE will offer robust partitioning techniques for data-parallel processing of heterogeneous, multi-modal data. The BIDOFE platform will be capable for data anonymization methods that guarantee privacy via like k-anonymity and l-diversity algorithms. In this manner users' data can be anonymized for privacy-aware mining for research purposes and can be shared openly as Open Data.
Baseline: TADDIS will use the experience for data manipulation from the in house developed EXUS Analytical Framework (EAF) as described thoroughly in Part B 4.1 of EXUS. Furthermore, EXUS will utilize the knowledge from the ongoing H2020 Projects (RANGER, DATABIO & E2Data) for Big Data collection, pre-processing and visualization. EXUS was coordinating E2Data and used MapReduce and Data parallelization techniques for 2+ million patients' datasets for significantly accelerating data streaming and code execution (run over GPUs) optimizing Apache Flink via automated processes through the E2Data platform (TRL7-8).
Key performance indicators: Seamless integration of all sensory services and datasets [> 90% of data to be represented in TADDIS database]
Target value: 1 Big Data Platform
Tools: Python Pandas (for Data gathering, Data cleaning, Data wrangling, Process missing values), Python NumPy (for Data Normalization/Scaling, Vectorization, Feature Engineering), Matplotlib for Data visualization, OpenCV (for Image Data Preprocessing), JSON, XML, CSV, MongoDB. Furthermore, the TADDIS architecture will support a variety of frameworks for batch processing e.g. Hadoop, for streaming processing e.g. Apache Kafka and Apache Flink, for partitioning (e.g., Apache Spark), for microservices (e.g. Docker, Kubernetes), rapid deployment (e.g. Jenkins), API Key generation & authentication (e.g. OpenAPI)
Risks: Legacy sensors may provide interoperability issues. New methodologies in data streaming may be proved faster. Partners have not decided early in the project the sensors that will be use.
Contingency plan: (1) Conduct a thorough bibliographical research from papers, best practices and previous EU projects to provide accurate models. (2) Multiple iterations will be developed creating a semi-empirical risk assessment model based on the insights from Key Experts (End User partners, Risk Managers and other related stakeholders identified in the Communication WP). (3) Communication partner should ensure the adequate identification of experts & stakeholders that will provide critical input to the recommendation engine. (4) Clarify during the first 3 months of the project which sensors will be selected from the partners. Corrective actions will be applied where necessary.

TO2. Platform development and Interactive User Interfaces

TA2.1 TADDIS platform architecture, development and integration

Methodology: Use cases for data consumption definition with end users during functional discussion workshops where the business and IT needs are discovered and highlighted. With these inputs the architecture is defined with all the platform capabilities to ensure functional needs in terms of data processing and visualization. The development will be guided by the development roadmap and be executed according the predefined iterations. Each iteration will provide results that will be tested and integrated. This approach permits to have continuous releases of subsequent versions, allowing continuous learning from feedback and continuous improvement. A reference architecture model will be used as starting point to accelerate the architecture definition process. We will start to define the use cases for data consumption and processing that will be relevant for the architecture definition in terms of integration needs and processing capabilities. Batch and real time processes are foreseen and will define all the components of the platform. The development and integration will be based on agile methodologies that will deliver added value along the project.
Baseline: everis will use its architects experience in similar projects around the globe to ensure the best architecture. This experience will come from everis Lisbon architects and everis' Centers of Excellence and everis' Competency Centers.
Key performance indicators: Holistic architecture 100% integrated with all solution components.
Target value: Solution architecture
Tools: Open source components aligned with all solution components
Risks: Heterogeneous systems to be integrated
Contingency plan: Detailed systems analysis and APIs definitions in early stages of the project

TA2.2 TADDIS interactive UIs & dashboard

Methodology: the interactive UIs and dashboards will be implemented based on a Service Design methodology:*Discovery* - detailed scope survey, identification of usage habits and improvement opportunities and needs;*Understand and Imagine* - design thinking workshops with key users to identify and design current user experience;*Design* – conception and design of the information architecture and wireframes of the respective interfaces and dashboards. Phase where interfaces and dashboards structures and navigation forms are defined; *Build* - design of navigable layouts and prototypes, according to the lines and graphic standards. Phase where the solution/ product is visually shaped; *Development* – development of the interfaces/ dashboards based on the accepted navigable

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prototypes; *Testing* – phase where integration and acceptance testing take place. The interfaces and dashboards are accordingly with the functional and technical requirements defined; *Deliver* – phase where the interfaces and dashboards are delivered to the end users. Training is also considered to the IT and business teams.
Baseline: everis has high experience in Service Design projects and will reuse all templates and proved methodology in this project
Key performance indicators: Intuitive, easy-to-use UIs and dashboards fully aligned with end-user needs, with less than 10% issues reported in the UAT phase.
Target value: UIs and dashboards delivered, user manuals and training provided to end users
Tools: Power BI
Risks: End users will tend to increase functionalities and analysis provided in the dashboards along the project as it is a usual concern in this type of projects. As the dashboards are delivered, more business indicators, dimensions and reports are asked by the end users.
Contingency plan: Define clear scope in the analysis phase regarding the indicators and analysis that will be delivered. Additional, indicators and analysis must be validated and estimated so that can be developed and delivered without additional costs based on minimum effort and high added value can be included.

1.3.5.3 Approach and methodology for the User-Oriented activities

UO1. User Requirements, Use cases creation and ethical dimensions

UA1.1 Use case creation and end-user requirements definition

Methodology: The end users will provide information on their current goals and objectives, as well as on the challenges they face and domains of their interest in order to define a set of use cases. The process to follow is the chain past experience → user story → functional and non-functional requirements → user scenarios → use case definition. The specified use cases will be documented in a pre-defined use case schema in order to ensure their consistency and comprehensiveness. The next step will involve the analysis of the use cases in order to extract a set of user-defined requirements that consider the end users' environments and technical abilities. This user-driven methodology will engage the stakeholders at every stage of the development process and will ensure the definition of reliable functional requirements.
Baseline: Focus groups, workshops and questionnaires.
Key performance indicators: User-defined requirements that are clear and broad enough in order to ensure that all stakeholders' needs are met. At least 15 questionnaires are answered by professionals from at least 5 independent organisations. At least 3 focus groups are implemented. At least 5 user scenarios proposed.
Target value: A set of use cases that are closely mapped to the operational context and accurate user requirements (end-user satisfaction over 3 in a 5-point Likert scale).
Tools: Interviews, questionnaires, focus group discussions.
Risks: User-defined requirements are poorly communicated to the technological partners.
Contingency plan: There will be an early engagement of technological and end user partners and their interactions will continue throughout the project.

UA1.2 Ethical and legal dimensions

Methodology: The TADDIS legal, social and ethical impact assessment will use a mature impact assessment methodology that integrates the fundamental aspects of a Data Protection Impact Assessment - PIA (GDPR, Art. 35) and ISO 29134/WD29134. The impact assessment will (i) map the data flows between the TADDIS platform and services, and between users and services with which they interface, (ii) identify data security, data protection, social and ethical issues and risks associated with these data flows, (iii) consult with relevant project stakeholders and external stakeholders (e.g., technical experts, lawyers, civil servants, privacy advocates, citizens, human rights experts) to validate the risk analysis and suggest additional issues for consideration, and (iv) formulate recommendations and technical requirements and work with project partners to implement them. These include technological data security controls, procedural data access controls or additional features and functionalities to improve the societal acceptance of the system.
Baseline: Issues related to data security, information privacy and protection of personal data will be covered by the impact assessment, and will address both the user experience of the tool as well as the ways in which the information flows used by the tool make the GDPR (2016/679) relevant. The Charter of Fundamental Rights of the EU outlines both rights to Respect for Private Life (Art. 7) as well as rights to the Protection of Personal Data (Art. 8). In addition, the EC is currently re-assessing data security and privacy requirements in relation to Electronic Communications through the Draft Regulation on Privacy and Electronic Communications. Issues related to industrial data sharing will be covered by EU, national and international Copyright Laws and Intellectual Property Protections alongside soft regulatory mechanisms like the EC working documents covering Guidance on Sharing Private Sector Data (SWD (2018) 125 final) and the NIST Cybersecurity Framework. Requirements from each of these will be integrated into the requirements for the TADDIS solution.
Tools: Mature PIA+, ISO 29134/WD29134, GDPR Art. 35 and Art. 29 Working Party Guidance.
Risks: Lack of participation by technical partners.

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Contingency plan: Organise project workshops/meetings specifically focused on data security, privacy and data protection to focus technical partners' attention on these issues and achieve buy-in through participatory methods.

UO2. Pilot deployment, validation and training

UA2.1 Development of the validation scenario and evaluation methodology

Methodology: A systematic breakdown and clear traceability of the user requirements expressed in the use cases will be used to establish an evaluation methodology comprising appropriate test strategies with associated test scenarios, procedures and evaluation metrics. Alongside the evaluation metrics a user satisfaction questionnaire using a 5-point Likert scale approach will be created to gauge the overall user satisfaction of the achieved results. An online KPI monitoring platform will be established in order to assess TADDIS technologies in a coherent way between the different use cases.
Baseline: Evaluation metrics, existing user satisfaction and system usability metrics.
Key performance indicators: Evaluation metrics, User satisfaction metrics, user feedback, system usability metrics.
Target Value: Average user-satisfaction rates of over 3 in a 5-point Likert scale; task completion rates above 85%.
Tools: Robust evaluation plans and user satisfaction questionnaire.
Risks: (i) The evaluation plans might not allow for user feedback to feed into the functional specifications and the overall system design and development. (ii) different maturity levels of the TADDIS technologies.
Contingency plans: (i) There will be early and continuous end user engagement to ensure that key stakeholders are involved in the evaluation process. (ii) the evaluation within the use cases will occur iteratively, and it will converge when all technologies have reached the foreseen TRL

UA2.2 User Training

Methodology: A number of training sessions will be organized for allowing users to get familiar with the technologies and the details of the Pilots. For this reason, prior to each test, a tutorial on the developed system will be provided (with the support of the technological partners) that will allow users to familiarize themselves with the available functionalities.
Baseline: Evaluation metrics and existing user satisfaction for the training processes and system usability metrics.
Key performance indicators: User satisfaction metrics or the training processes, user feedback, system usability metrics.
Target Value: Average user-satisfaction rates of over 3 in a 5-point Likert scale; task completion rates above 85%.
Tools: Qualitative and quantitative user-oriented and system-oriented evaluation metrics for training.
Risks: The users' environment might not be fully reflected by the use cases and/or the developed solutions might not be fully tested.
Contingency plan: Iterative user training sessions will take place in order to ensure comprehensive validation and testing, as well as allow for addressing in later iterations all issues that may arise during the initial stages of evaluation.

UA2.3 Pilot deployment, simulations and user evaluation

Methodology: Pilot use cases that have been described in TADDIS are going to be assessed and exploited within four phases: The first phase includes the system testing, by running simulations with well-established evaluation protocols and finally the big data properties of TADDIS platform evaluation. The second includes the implementation and deployment of the system including co-designing of products tailored to end user needs. The third includes the system output validation using measurement accurate data and the last includes the user training related to the TADDIS developed systems.
Baseline: The three use cases have been chosen in order to serve a diverse field of applications including extreme case analytics on the DIAS cloud infrastructure, and two environmental related (shipemissions and solar energy) applications. The three use cases individually are based on developed systems that provide currently related outputs. TADDIS structure allows the use of individual systems that will be developed in the project in order to address the three use cases, but also the use of common platforms for big data use under common protocols. Edge and cloud testing are linked with real exercises with scenarios simulated within the use cases and involving technical, research partners and end users.
Key performance indicators: Platform big data properties validation scores, use case outputs accuracy and validation scores, results of interviews and questionnaires.
Target value: Successful testing of individual scenarios for each use case concerning platform outputs, accuracy of the three use case outputs compared with thresholds according to the scope of each one.
Tools: ONDA Data Relay Service, KOMPSAT-3 (optical), KOMPSAT-3A (optical) and KOMPSAT-5 (SAR) satellite imagery, MSG atmospheric data, CAMS data, HPC environment, nextSENSE system, libradtran radiative transfer model, in situ (validation) sensors (e.g. BSRN, AERONET, CloudNet), MMSI, deep learning algorithms.
Risks: Satellite failures or satellite-based reception failures, homogenization of common use case's techniques, high spatial resolution data vs uncertainty.

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Contingency plan: Use of alternative satellite sensor data, identify problems and build individual techniques for parts of each use case, use hybrid approaches (e.g. modeling and deep learning) in order to improve the results accuracy.

1.4 Ambition

1.4.1 Advances beyond the State of the Art

SO1. Extreme-scale AI technologies on HPC environment

RA1.1 AI workflows on structured data

State-of-the-art: Qi and Chen (2012) introduced an automated service classification management mechanism to organize web services more efficiently and accurately to meet the needs of users' request by AI Planning. Khalfallah et. al. (2015), introduced executable workflow trees for AI planning encapsulating the actions into abstract workflow Blocks, while Hu (2017) worked towards the integration of ML related SaaS (Software as a Service) web-service modules on PaaS (Platform as a Service) in hybrid cloud infrastructure. A series of empirical based best practices are also reviewed in the literature (Begel et al., 2019).

Beyond state-of-the-art: EXUS will capitalize upon the existing technologies present in bibliography or offered commercially (such as Microsoft Azure ML Studio) by focusing on the transferability, scalability and cloud agnosticism. Existing systems in bibliography in most cases are not following a microservices approach and thus existing development remains siloed. In TADDIS, a thorough containerization will take place in order each sub-component for DataOps and Machine Learning to be autonomous and scalable. In TADDIS, user-friendliness will be blend with the maximum freedom for actions for enhancing the re-usability, the connectivity and the easier integration with other tools. While the overall system will able to handle big data by design being connected with the Big Data Operations (DataOps) Fusion Engine (BIDOFE) working as a whole. At last, it is for the first time that an AI workflow engine not only incorporates datasets, but can act as a simulator for IoT data generation replicating their behaviour (acting as a Digital Twin) as it would be received in raw format from the sensors.

RA1.2 Deep learning in multimedia data

State-of-the-art: There are several initiatives including projects and applications that exploit crowdsourcing data including social media content and CCTVs in order to provide a rough estimate of air quality index. A more recent work on the same field is that of Charitidis, et al. (2018) that investigates the feasibility of estimating current air quality conditions in cities without official air quality monitoring stations based on a statistical analysis of Twitter activity and by applying transfer learning techniques. Other works focus on the use of images collected through crowdsourcing that involve the estimation of air quality from user-generated photos or webcams. Specifically, several studies (Saito, et al., 2015) have shown that the color ratio R/G in digital images can be used to derive information about the aerosol content of the atmosphere. In order to automatically estimate R/G ratio of images, a series of image processing steps is applied that involves visual concept detection for detecting images that contain substantial regions of sky, localization of the sky regions within the image to remove non-sky regions, and mapping of the sky region color to air pollution. The first two steps have been addressed in (Moumtzidou, et al. 2016; Spyromitros-Xioufis, et al. 2018), by considering deep learning techniques such as the use of a fine-tuned DCNN model following the work of Pittaras (2017) for concept detection and Fully Convolutional Networks (FCN) (Long, et al. 2015) for sky localisation. The mapping of sky region color to air pollution considered the use of Santa Barbara DISTORT Atmospheric Radiative Transfer Model (Ricchiazzi, et al. 1998) that simulates the R/G ratios for a set of solar zenith angles and Aerosol Optical Depths.

Beyond state-of-the-art: TADDIS will build upon the methodology described in (Spyromitros-Xioufis, et al. 2018) by using deep learning techniques for the concept detection and sky localization. However, we will proceed with the application of deep learning techniques for the mapping of sky color to air pollution, thus replacing the SBDART model. Several deep learning models will be used, including the fine-tuning of existing networks as well as the development of simple deep neural networks.

RA1.3 Deep learning in multisensor and multisource data

State-of-the-art: AI and deep learning have huge potentialities for the fusion of heterogeneous data (Zhu et al., 2017). This is particularly relevant in the solution of classification problems. Deep architectures have been widely studied in the classification of single source remote sensing images especially from the scientific and research perspectives. Many architectures and techniques have been studied and developed for addressing the peculiarities of different kinds of remote sensing data, including VHR optical images (Ding et al., 2020), hyperspectral images (Hao et al., 2018), SAR data (Chen et al., 2017) and multitemporal data. However, the impact of the large number of contributions in the literature on operational systems is very limited. This is due the lack of appropriate EO processing platforms that host effective deep learning algorithms and to the very critical problem of the availability of training data. In this respect, the few relevant papers that have addressed the problem of data fusion in classification of remote sensing data have focused their experimental validation on small benchmark data sets with customized architecture solutions

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oriented to the combination of specific types of data (e.g. multispectral and hyperspectral images (Palsson et al., 2017), images with point clouds (Zhang et al., 2018a)) often with limited generality and generalization capabilities.

Beyond state-of-the-art: TADDIS will develop a deep learning architecture that can integrate efficiently multisensor and multisource data in the solution of the classification problem. This will be done by initially focusing on the modelling the specific properties of multispectral and SAR data (which are the most widely used one also looking at the Sentinel programme) and considering the possibility to integrate other ancillary data in a flexible way. The goal is to have an architecture that can be: i) modular and flexible to include different data sources; ii) able to use in the learning phase weak labelled samples (Bruzzone, 2019); iii) potentially usable in operational applications. The activity will leverage on the use of the large experience of the proposing team on the considered specific topic.

RA1.4 Deep learning pipelines to drive efficient radiative transfer model inversion

State-of-the-art: The need for improved fastRadiative Transfer Model **(**RTM) as well as critical input parameters nowcasting is increasing as more solar plants come online worldwide. As clouds represent the main solar irradiance attenuator, at least cloud microphysics has to be known for a period of 0 to 6 hours ahead (nowcasting horizon). Till now most of the nowcasting operational products are based in the cloud persistence assumption that means that cloud properties over a specific location are not changing for the next hour (Chow et al., 2015). In addition, studies using ground based solar measurements at specific locations (Schmidt et al., 2017) have been used to identify cloud changes and possible forecasting. Finally, other methods like the nonlinear autoregressive exogenous models (Peronaci et al., 2016) have been used for nowcasting of cloud masking in order to provide predicted images for cloud coverage, and hence, inputs for simulating the surface irradiances. The motion of cloud structures is determined from two consecutive cloud index images. To estimate a vector field which describes the true cloud motion at best, several approaches to this task have been proposed. Maximum Cross Correlation has been used to determine the movement of cloud structures by Beyer et al. (1994), while Bahner et al. (1996) applied a functional analytic method to derive displacement vector fields from satellite image sequences. Cote and Tatnall (1995) developed a neural network based method for tracking features from satellite images and Konrad and Dubois (1992) developed a model in which an estimation criterion for the quality of a vector field is introduced at first. Then, a probabilistic model of motion is introduced and finally a Monte Carlo algorithm is used to search for the most probable vector field.

Beyond state-of-the-art: An accurate RTM exploiting deep learning pipelines is going to be developed as well as a nowcasting computing architecture analyzing cloud motion vector and flow techniques for the critical RTM inputs (i.e. clouds and aerosols) in order to predict the solar radiation with accuracy in support to the renewable energy handling entities and producers. It is not the first time that cloud motion vector techniques have been developed, however, in this project we will try to develop a nowcasting technique that can be successfully combined with fast RTM driven by deep learning pipelines that takes into account various other atmospheric solar attenuation processes based on a complex input dataset and a real time calculation (speed up) technology.

RA1.5 TADDIS Data Distribution Through Federated Learning

State-of-the-art: Federated Learning is a machine learning setting where the goal is to train a high-quality centralized model while training data remains distributed over a large number of clients each with unreliable and relatively slow network connections. The typical clients in this setting are mobile phones or low-computational devices, and therefore, communication efficiency is of the utmost importance. Recently, Federated Learning (and related decentralized approaches) have been proposed in (Shokri&Shmatikov, 2015). In federated learning a model is learned by multiple clients in decentralized fashion. Learning is shifted to the clients and only learned parameters are centralized by a trusted curator. This curator then distributes an aggregated model back to the clients (McMahan, 2016). Clients not revealing their data is an advance in privacy protection, however, when a model is learned in conventional way, its parameters reveal information about the data that was used during training. In order to solve this issue, the concept of differential privacy (dp)for learning algorithms was proposed (Dwork, 2011).The aim is to ensures a learned model does not reveal whether a certain data point was used during training.

Beyond state-of-the-art: We design, implement, and evaluate a practical system for collaborative deep learning that offers an attractive tradeoff between utility and privacy. Our system enables multiple participants to learn neural-network models on their own inputs, without sharing these inputs but benefitting from other participants who are concurrently learning similar models. Our key technical innovation is the selective sharing of model parameters during training. This parameter sharing, interleaved with local parameter updates during stochastic algorithms, allows participants to benefit from other participants' models without explicit sharing of training inputs. Our approach is independent of the specific algorithm used to construct a model for a particular task. Therefore, it can easily accommodate future advances in neural-network training without changing the core protocols.

RA1.6 Modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona

State-of-the-art: Emission modelling is evolving towards AI for data aggregation and completion, in front of current models that, even being precise at large scale, require extra information to discover emission sources for proper air quality simulation. Current approaches top-down (HERMESv3 (Guevara et al., 2019)) compute air quality from global emissions then disaggregate into average profiles to obtain emission generators. But this implies certain

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imprecision that requires AI techniques to be applied on data streams for improvement. Thanks to the Automatic Identification System (AIS) we obtain continuous data on position and other characteristics with which we are able to estimate emissions, based on the STEAM methodology proposed in (Jalkanen et al., 2012). But, as in most of data related real world problems, AIS data may have inconsistencies (Miola & Ciuffo, 2011) that need to be corrected in order to have better estimations, also dealing with continuous processing requires machine learning distribution, that can be performed near-data or close to HPC systems.
Beyond state-of-the-art: Here we plan to build a system leveraging AI (in particular Machine Learning) in HPC and low-power environments, able to gather all the AIS data from the coast and process it, improving the quality of data and produce ship emissions estimates that air quality simulation systems can use. The novel analytics methods will also be available for further cases of use that involve multi-source data processing, in heterogeneous systems from Edge to Cloud computing.

SO2. Big Data Predictive Analytics

RA2.1 Data stream clustering and similarity search in extreme-scale data collections

State-of-the-art: The co-clustering of raw measurements, visual and spatiotemporal information aim to group text messages, images, time-series and any source of data. Traditionally, k-means is an iterative algorithm that assigns individual artifacts to one of k groups based on a given similarity measure. Approximate solutions in nearest neighbour search have improved the efficiency of data clustering, in cases where traditional clustering solutions are not applicable. Such cases originate in clustering, mainly, visual information, where the collection of images scales up to PBs, so parallel processing is employed, using for example Map-Reduce, combined with Hadoop or HDFS (Moise et al., 2013). Efficient solutions appeared later using kd-tree structures in approximate k-means or density-based clustering with variations of DBSCAN that achieve complexity of O(nlogn) or linear computational complexity O(n) (Gan and Tao, 2015). Approximate k-means via cluster closures (Wang et al., 2015) has been proposed to cluster data in an approximate but more efficient way. A review of state-of-the-art technologies in the retrieval of unstructured (multimedia) data has been recently published (Vrochidis et al., 2019), where effective but scalable Big Data methodologies have been reported.
Beyond state-of-the-art: Regarding the co-clustering of data items of similar content, we will be based on an iterative density-based approach (Gialampoukidis et al., 2019) and design the algorithm on cloud and HPC environments, while taking into consideration the nature of the data and the associated modalities. For the similarity search, the algorithm will be based on (Gialampoukidis et al., 2017) and will fuse similarities based HyperLearn (Arya et al., 2019). Tuning will be followed by an evaluation in the significance of each involved parameter and modality, and several directions towards the model simplification will be examined.

RA2.2 Predictive analytics models

State-of-the-art: The amount of captured remote sensing data is increasing at an unprecedented scale, with various public and private satellite constellations being made available. This resulted in an abundance of data, that needs to be processed in an automatic fashion. Copernicus constellation and other higher resolutions products available through ONDA use-case will offer a competitive environment for development of state-of-the-art deep-learning based solutions for gathering insights from satellite imagery. The focus in EO based applications towards gathering operational insights, also in Copernicus constellation can be seen through recent development of specialized EO libraries, that support Machine Learning workflows (https://eo-learn.readthedocs.io/en/latest/)and follows the industry trend in smallsat revolution, that already started to harvest operational insights from vast amount of satellite imagery (https://www.planet.com/products/analytics).Automatic Identification System (AIS), that will be used for ship emission modelling was proposed and mandated by the International Maritime Organization in 2002 International Convention for the Safety of Life at Sea agreement and its main intention was to prevent collisions on the sea. Besides collision avoidance, AIS data is used for many other applications in the maritime domain. This includes fishing fleet monitoring, maritime security, search and rescue, accident investigation, fleet and cargo tracking and many others. AIS data also offers opportunities to develop intelligent maritime systems, as well as broader data analytics solutions that provide global insights for the shipping industry. Most of the existing intelligent solutions based on AIS data are focusing on general traffic analysis and pattern discovery (Lee et al., 2019).The amount of energy produced by photovoltaic pharms is increasing and is already representing a significant part of the total energy production in certain parts of the world (https://www.iea.org/reports/tracking-power-2019/solar-pv). Utilising atmospheric and earth observation data is being utilized for better predictions for trading the produced energy, as well as for better utilization of energy transfer infrastructure (Jang et al., 2016).
Beyond state-of-the-art: ONDA DIAS platform will provide an unprecedented amount of data available for the development, application and scaling of the existing and newly developed state-the-art methods for EO based predictive analytics. The wide variety of different satellites, with different sensor characteristics will provide the means to develop and apply the methods on multiple sensors in comparison with current state-of-the-art, mostly focusing on certain satellite constellation and domain specific problems. In comparison, different use-cases will utilize similar data, which will enable re-use of the developed methodology and methods. Energy demand forecasting

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from PV farms, will utilize atmospheric and EO data from ONDA platforms, while similar environmental EO data will be also used for ship emission estimation. AIS analytics will also be used to develop data driven KPIs, used to calculate vessel waiting times (e.g. berth times, anchorage waiting times) from AIS data, which combined with vessel emission estimation, will provide a much broader perspective towards analysis of vessel traffic and its emissions.

RA2.3 Solar Energy short-term forecasting from satellite data

State-of-the-art: Since the launch of EO satellites, such as MSG, and Sentinel satellite series, nowcasting and Short-term forecasting (STF) techniques have been developed from an image processing point of view. The main advantage of these techniques is the possibility to monitor a lot of meteorological information in almost real time. Such a nowcasting/forecasting system (SENSE/nextSENSE) has been developed and validated (Kosmopoulos et al., 2018) in the framework of the EU-Horizon's 2020 GEO-CRADLE/E-Shape projects leaded by PMOD/WRC with collaboration with NOA. SENSE/nextSENSE are based on the synergy of Neural Networks (NN), Multi-Regression Functions (MRF), Radiative Transfer model (RTM) simulations and real-time satellite (cloud motion vector) and CAMS based retrievals (aerosol forecasting). A NN is trained on a large-scale (2.5 million record) look-up table (LUT) of radiative transfer simulations to convert satellite cloud and aerosol products directly into solar radiation spectra (Taylor et al., 2015). Thus, SENSE is capable of producing high resolution maps (0.05x0.05 degrees, 15 min), databases and time series of solar energy related (Direct normal irradiance used in Concentrated Solar power plants and Global solar radiation used in Photovoltaic applications.

Beyond state-of-the-art: TEDDIS data analytics platforms, AI and deep learning techniques are going to be used here in order to solve a series of issues related with the solar energy forecast accuracy, the spatiotemporal resolution, real time production and the output spatial upscaling. Solar energy forecast improvement is based on the available information of 3D atmospheric parameters that affect the solar radiation reaching the Earth. Use of additional inputs (e.g. 3 dimensional fields of cloud properties, spectral information of aerosol properties and others) can improve such results. However, their inclusion in solar forecasting systems is a current complex IT problem that can be solved with the help of TEDDIS related developments. In addition, the spatiotemporal resolution can be also improved by using big data for various needed inputs (e.g. surface albedo and elevation, cloud properties). Finally, system upscaling for all current models can be currently achieved only including various assumptions on the atmospheric properties. Aiming at continental-plus scales (Europe, N. Africa and M. East) of a high resolution (5 by 5 km output), high accuracy and real time solar energy outputs, is a way forward enhancing the value of the final products and also the potential of maximum solar energy exploitation from end users such as national energy transmission operators (e.g. IPTO).

RA2.4 TADDIS Intelligent Analytics Platform (TADDIS INAP)

State-of-the-art: Data Analytics platforms have been present in bibliography, in other EU projects and at commercial level covering a series of solutions for healthcare, agriculture, earth observation etc. In most cases existing analytics dashboards are not "intelligent" enough, lacking in real time decision support capability (predictive analytics, warning mechanism recommendation engine) and in interoperability and interpretation of large amounts of accurate data. Purohit et. al (2019), suggested decisions that derived from semantic representation were based on weights and rules that produced automatically from the algorithm. However, this methodology is not always the optimal since decisions (especially in disaster management for example) are taken by human based on prior knowledge & expertise and there is an increased distrust from accepting decisions originating from algorithms, given as well the very limited time-frame of taking the decisions; while questions arise on the origin of the data. In the paper of Caroleo, et.al. (2018) the focus was on using knowledge-based decision support system on the cascading effects of crisis situations assessing event times derived from probabilistic simulation models. In the introduced work a combination in decisions from an array of possible scenarios took place supporting decision makers suggesting also the best timing of interventions.

Beyond state-of-the-art: According to our knowledge, it is for the first time that an analytics dashboard will be combined with predictive analytics algorithms (for timeseries prediction in real time), alerting & warning mechanism and a recommendation engine tailored for Big Data operations. More especially the suggested model will follow a semi-empirical model approach where, a set of recommendations based on specific incidents are manually pre-decided from Key Experts and during catastrophic phenomenon (peculiar timeseries spike), those recommendations are automatically correlated with corresponding rule violations. Thus, decision makers (e.g. in disaster management) that will use the TADDIS INAP have an increased perception of trustworthiness for the overall system avoiding the majority of non-accurate recommendations.

SO3. High-level semantics and content enrichment from Big Data

RA3.1 Ontology development

State-of-the-art: Ontology development is now an established area of research and practice. Typically, the Web ontology language OWL 2 is used together with tools like Protégé (https://protege.stanford.edu/) to develop appropriate domain ontologies for the problem at hand. For the purpose of modelling the spatial and temporal data

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of interest to TADDIS, state-of-the-art ontologies include the semantic Sensor Network Ontology (https://www.w3.org/TR/vocab-ssn/), IoT ontologies (https://lov4iot.appspot.com/) , the temporal ontology OWL-Time (https://www.w3.org/TR/owl-time/), the geospatial ontology of GeoSPARQL (https://www.opengeospatial.org/standards/geosparql) , the work of the Spatial Data on the Web Working group (https://www.opengeospatial.org/projects/groups/sdwwg), the work of the Spatial Data on the Web Interest Group (https://www.w3.org/2017/sdwig/) and the work on ontologies for Earth Observation data done by partner UoA in FP7 projects TELEIOS, LEO and Melodies and H2020 projects Copernicus App Lab (https://www.app-lab.eu/) and ExtremeEarth (http://earthanalytics.eu/).

Beyond state-of-the-art: TADDIS aims at developing the TADDIS ontologies which will integrate the massive and diverse data sources of the project using the geospatial ontology-based data access paradigm pioneered by partner UoA (Bereta et al. 2019). These ontologies will be based on the state-of-the-art ontologies mentioned above and will drive the implementation of the use cases of the project. The development of these ontologies will be led by partner UoA which has many years of experience in developing ontologies and applying them to practical applications with a geospatial and temporal dimension.

RA3.2 Ontology population, data harmonisation, fusion and linking of data

State-of-the-art: There are currently a variety of systems that enable the population of ontologies from legacy databases, XML files or other data sources. Typically, these systems utilize the mapping languages R2RML (https://www.w3.org/TR/r2rml/) and RML (http://rml.io/) for encoding data transformations. In the context of geospatial and temporal data that is of interest to TADDIS, there are currently only two such systems: GeoTriples (Kyzirakos et al. 2018) developed by partner UoA and TripleGeo (Patroumpas et. al, 2014). In terms of functionality these two systems are very similar. In terms of performance and scalability which is of importance to TADDIS, a parallel version of GeoTriples has been shown to outperform TripleGeo in (Kyzirakos et al. 2018). Most recently, the latest version of GeoTriples, called GeoTriples-Spark since it has been developed on top of Apache Spark, has been shown to scale to TBs of geospatial data such as these of TADDIS in the H2020 big data analytics project ExtremeEarth (http://earthanalytics.eu/).

Entity resolution constitutes a core task for data harmonization, fusion and interlinking, identifying entity profiles that correspond to the same real-world objects, but are located in different data sources. We can actually distinguish the existing systems into two major categories: one crafted for structured data, which are described by a well-defined schema and one applying exclusively to semi-structured data, which are associated with loose, diverse schemata and are located in XML/RDF repositories or SPARQL endpoints. The former category is mainly represented by Magellan (https://sites.google.com/site/anhaidgroup/projects/magellan) and Dedoop (https://dbs.uni-leipzig.de/dedoop), while the latter is dominated by LIMES (http://aksw.org/Projects/LIMES.html)and Silk (http://silkframework.org/). To help researchers, practitioners and ordinary users in applying entity resolution to any type of data, partner UoA and collaborators have developed the JedAI toolkit (https://jedai.scify.org/). At its core lies a novel end-to-end entity resolution workflow that applies uniformly to structured and semi-structured data. In project ExtremeEarth JedAI is extended to deal with geospatial data and geospatial relation discovery and it is expected to scale to TBs of data such as these of TADDIS.

Beyond state-of-the-art: GeoTriples-Spark can be used to transform geospatial data available in shapefiles, CSV and GeoJSON files. In TADDIS, GeoTriples-Spark will be extended so that it can handle the transformation of temporal and spatiotemporal data from the diverse formats of the data sources of the project, while preserving its high performance and scalability. In addition, JedAI will also be extended to support temporal and spatiotemporal entity resolution which preserving its efficiency and scalability to big data. At the end of TADDIS, we expect both of these systems to be unique internationally in terms of functionality, performance and scalability.

RA3.3 Semantic search and querying

State-of-the-art: Indexing and searching data of various formats is a mature area of research and development with search engines like Google and open source systems like Apache Lucene and Elasticsearch being the state-of-the-art. These systems have their own query languages based on Information Retrieval techniques and they now power the search interfaces of many enterprises worldwide. More recently, Natural Language Processing and Semantic Web researchers have started working on question answering engines so that the full power of natural language is made available to users. In this area, partner UoA has recently developed a question answering engine targeted at geospatial information (Punjani et al. 2018). In the area of semantic querying, work has concentrated on SPARQL query evaluation and the development of RDF stores including commercial ones such as GraphDB (http://graphdb.ontotext.com/). More recently, in the area of geospatial and temporal RDF stores partner UoA developed the system Strabon (http://strabon.di.uoa.gr/) which has been shown to have excellent functionality, performance and scalability in (Ioannidis et al. 2019). Strabon is currently re-engineered in H2020 big data analytics project ExtremeEarth and is expected to scale to TBs of geospatial data (Bilidas et al. 2019). Partner UoA has also recently developed the geospatial ontology-based data access system Ontop-spatial (http://ontop-spatial.di.uoa.gr/) which enables the integration of geospatial data sources and the execution of GeoSPARQL queries on the fly, using

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ontologies and mappings. Ontop-spatial has been shown to outperform competitors systems in terms of performance in (Bereta et al. 2019).

Beyond state-of-the-art: In the context of spatiotemporal data sources of TADDIS, the state-of-the-art in semantic search and querying is represented by the systems Strabon and Ontop-spatial of partner UoA. In TADDIS, the latest highly scalable versions of Strabon and Ontop-spatial will be further extended to deal with the diverse data sources of TADDIS while preserving their efficiency and scalability.

RA3.4: TADDIS Autonomous Decision-Making system

State-of-the-art: Endsley (1995) developed a theory on improved decision making by a better understanding of one's situation and the effect of a decision to act on that situation. Extending this model with goals to be achieved, agent networks can be developed. A next step is the extension with predictive analytics, which evaluates what the effect of an action will be. Even beyond that, prescriptive analytics is creating a collective intelligence: based on evaluating one's situation and one's status in terms of various parameters, an action can be prescribed. Collective intelligence requires continuously sharing data, both by accessing it from other sources and producing relevant data for other sources. A project focusing on analytics and intelligent sensing for demand is EU FP7 project WISDOM, for saving resources like water and energy. The project integrates resource distribution, sensor monitoring and communication facilities which are coupled with software modules including semantic modelling, using ontologies, to serve as intelligent linkages throughout the entire framework.

Beyond state-of-the-art: Given the complexity of interactions and the sheer volume of the resulting data sharing, manageability and scalability within TADDIS can only be ensured if the bulk of the workflow is automatic and self-organizing, running largely autonomously. However, given the importance of correct functioning of TADDIS (i.e. use cases), humans have to be kept in the loop and are involved when and where needed, and moreover, keep track of their preferences and constraints. A major goal is therefore to explore how the workload of participating can be shared dynamically among groups of agents, including humans. TADDIS will explore how rule, situation, task and intention based artificial intelligence modelling can be exploited to assist the humans in the complicated operation environment and communicate via interfaces "knowledge focused triggers" when specific involvement (decision for feedback/feedforward action, assistance, verification) is required. Such smart sharing of workload may improve operational reliability and scalability of the system as a whole. Combining computer and human intelligence will create a holistic system model towards a collective intelligence (Malone et al., 2010).

TO1. Data acquisition & Big Data streams indexing

TA1.1 EO data collection and quality control from the Copernicus and DIAS services

State-of-the-art: The Copernicus Data and Information Access Services (DIAS) allow users to discover, process and download Copernicus data and information. The platforms also provide the ability to combine Copernicus data and information with data from other sources. Thanks to a single access point for the entire, DIAS allows the users to develop and host new applications in the cloud, while removing the need to download bulky files from several access points and process them locally.

Beyond state-of-the-art: The ONDA-DIAS platform has exceeded the nominal DIAS requirements, by hosting one of the largest archives ever built for geospatial data and information. The service offers free and direct access to a cloud-based repository of more than 26,7 million of products, which occupy a volume of 21,5 petabytes stored locally. The new data and products that are acquired and generated by the corresponding entities, will be automatically made available into ONDA on a daily basis, without other delay than the transfer time. Moreover, the infrastructure is data-and-application-agnostic, so any data and algorithms can be integrated. Finally, all the technological innovations coming from the ONDA-DIAS's market-leading Cloud provider, will also be reflected into ONDA-DIAS, to always ensure the most efficient solution for the purpose of TADDIS.

TA1.2 Ship emission activity based on real-time AIS data

State-of-the-art: Air pollution is an important issue for public health, the economy and the environment. The nitrogen dioxide (NO2) annual air quality limit value set up the European Air Quality Directive (Directive 2008/50/EC) and particulate matter of less than 10 and 2.5 micrometres in diameter (PM10 and PM2.5) annual limit values recommended by the World Health Organization (WHO) are systematically exceeded in the city of Barcelona. One of the main important source of air pollution is the maritime traffic activity. This activity can be tracked using AIS System (AIS), but has to be combined with the vessel's technical characteristics reported by the IHS Fairplay database which include technical specifications of all fuel-consuming systems on-board and other relevant technical details for most of the ships considered. Previous works have already shown the utility of AIS data for the estimation of high spatial and temporal resolution maritime emissions China (Li et al., 2018).

Beyond state-of-the-art: Despite the advantages offered by this approach, there are also some shortcomings associated with the AIS data that have been highlighted in previous works (e.g. Miola and Ciuffo, 2011). One of the main limitations are the data gaps associated with the original AIS data (e.g. the frequency at which data is updated, not all of the AIS data fields are fully or correctly populated). With the objective of avoiding the effects of these shortcomings on AIS data, machine learning techniques will analyse, clean and improve the original data.

TA1.3 Collection of online content (e.g. CCTV information from vessels) and social media data

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State-of-the-art:There are several initiatives including projects and applications that exploit social media, such as Flickr tags (Tkachenko et al., 2017), in order to create awareness about emergency situations or any other health related issues. Sangameswar et al. (2017) aim at removing conversational data intermixed with informational data during an emergency event, while Yin et al. (2012) analyse tweets generated during a crisis event, and apply burst detection for identifying early indicators of unexpected event, as well as classification and online clustering methods for filtering and summarising disaster-related information. The features used are the tweets' text itself and other tweet-related information such as mention and hashtag count for the estimation of the informativeness of a tweet. Furthermore, Win et al. (2017) introduced a tweet monitoring system that classifies messages in real-time by using LibLinear classifier and by considering linguistic features, sentiment lexicon based features and especially disaster lexicon based features.

Beyond state-of-the-art:TADDIS will first build a machine learning algorithm that filters-out irrelevant information, following and extending existing approaches and frameworks (Moumtzidou et al., 2018) for the monitoring and reporting of disaster events. The filtering will be based on both textual and visual content, as well as the associated metadata. Moreover, given that the development of efficient models both for the data filtering and air quality estimation of, data augmentation techniques will be developed. Specifically, data augmentation will increase significantly the number of data collected by collecting social media data that are related to keywords related to TADDIS such as 'sky'.

TA1.4 TADDIS Big Data Operations Fusion Engine

State-of-the-art: With the explosion of Big Data from continuous flows provided by sensors, social media and other sources require new Data Workflow Models (DWM) addressing data pre-processing in a more autonomous manner. A timely fusion and analysis of big data, acquired from IoT and other sources, to enable highly efficient, reliable, and accurate decision making and management of ubiquitous environments would be a grand future challenge incorporating computational intelligence (Alam et al. 2017). Increased volume of streaming data demands complex real-time analytics that require fast execution of processing pipelines among heterogeneous event processing engines (Ishizuka et al., 2016). Jabbar et. al. introduced a fusion of three different data models like relational, semantical, and big data based data and metadata to a Resource Description Framework.While Zhao et. al., suggested a multi-source fusion positioning system (MFPS) that utilizes several types of center-server-based positioning sources in contrast to the conventional positioning methods, which use a single positioning source, while data are further compressed before transmission. Until now many applications both at scientific and production level suffer from siloed and computational demanding pre-processes for data handling. TADDIS approach is to follow the latest SOTA data pre-processing techniques, extending them in a more cost-reduced and autonomous manner.

Beyond state-of-the-art: In TADDIS an integrated Data Workflow Model will be developed with different levels of information pre-processing that will run in a seamless and robust manner via batch bot scripts that will run autonomously as the information moves in the data funnel. The different levels will be the following: Level 1: Data wrangling/Data munging Filter for transforming and structuring data from raw data form into a unified format Level 2: Data Cleaning algorithms of unwanted characters Level 3: Data enrichment for merging third-party data from external authoritative sources (e.g. 3rd Party weather API) Level 4: Data Validation routines for ensuring data quality. With the above approach, the data collection and information pre-processing system will have a series of concrete advantages such as: 1) Reproducibility: Docker ensures the environment robustness. 2) Consistence: Via Docker uniformity of the runtime environment is achieved. 3) Traceability: Version controlling of the code and container repository. 4) Portability: Kubernetes orchestrate the different micro-services scaling the application automatically based on the required usage, this means that only the necessary instances are used for the needed time and them automatically shut-off. Thus, a cost reduction for the system administration and operation is achieved. For the veracity and timeliness challenges in big data, TADDIS also addresses data lifecycle and provenance aspects, performing optimizations for efficient provenance querying and annotation computations.

TO2. Platform development and Interactive User Interfaces

TA2.1 TADDIS platform architecture, development and integration

State-of-the-art: Everis has some assets that will leverage the architecture definition and implementation, such as:

everisWinder is a complete web analysis tool, in order to evaluate the current status of the IT architecture of a company, based on the everis digital architecture reference model. The digital architecture reference model is constantly updated according to new technologies, frameworks, vendors, paradigms and everis experience in real projects. everisWinder provides hundreds of evaluation items to analyze different technical architectures (e.g. DevOps, Big Data, Microservices, Cloud, Mobile) for any business sector. The automatic gap analysis is performed through several technical domains (runtime, development, operation, infrastructure and governance).everis' architecture consultants perform the evaluation process together with the client IT staff, leveraging the tool to discover information about the capabilities, functions and business needs in a simple and understandable way. The asset is around 80% prepared to support the Architecture definition activities

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Cosmos is the everis' Integration Platform based on a reference architecture. It includes reusable assets, a reference architecture, and a set of guidelines that can help in the implementation of digital use cases. The reference Integration Architecture model is defined but the integration components will need to be defined dependent on the integration specific requirements and the technology stacks that will be chosen.Regarding **custom development**, everis has two global frameworks for development, one for the development of JAVAEE based systems (named **Terasoluna**) and other for the development of .Net based systems (named KOA). These development platforms (Terasoluna for Java and KOA for .NET) are fully prepared as development frameworks.

Beyond state-of-the-art:The Integration platform components will be orchestrated based on everisWinder and Cosmos to offer a scalable platform, which will be designed and implemented depending on KR01-KR19.

TA2.2 TADDIS interactive UIs & dashboard

State-of-the-art: With the increased technical capacity of the organizations to storage and process data, there's the need to deliver interfaces for data exploitation in a very agile way. Having this in mind and taking into consideration that the UIs must be aligned and well governed avoiding dead ends and rework, EVRPORT developed a methodology that access the current state from a process and data consumption perspective and design new ways of data exploration in a fast and end user aligned way both in technical and functional fields.

Beyond state-of-the-art:With TADDIS,EVRPORT pretends to develop technical assets do accelerate the delivery of the outputs, building configurable data models and configurable UIs and dashboards. EVRPORT pretends to assess the common needs for each client, making possible the development of technical assets with a stable baseline, considering always the necessity for custom development. However, having these technical assets, EVRPORT will focus on the specific needs of each client guarantying differentiation and added value.

1.4.2 Innovation potential of TADDIS

Strengths	Weaknesses
● Highly interoperable platform. ● Multiple modules (KRs) of already good TRL levels ● The consortium is multi-disciplinary with both academic and business expertise in data processing, semantics, knowledge extraction, AI and machine/Deep learning, predictive analytics, optimisation on HPC environments, visualization and extreme scale analytics, allowing a deep understanding of evolving users' needs and scenarios. ● Established collaborations with big-data benchmarking organizations ● Access to large and heterogeneous data sources covering the 4 V's of big data ● ONDA DIAS platform will be enhanced with robust, innovative and accutate technologies for analysis heterogeneous and massive EO-data ● Ability to create and improve SoA prediction models and AI methods on HPC environment	● The consortium shall improve the delivery of value-added-services to specific industries outside the consortium ● Underestimating difficulties in unifying industry standards for benchmarking and measuring performance standards ● Potential performance, interoperability or scalability issues. ● Potential implementation or integration errors. ● Underestimation of the complex task of combining multiple different technologies for the final system

Opportunities	Threats
● Wide use case scenarios to cover multiple technology areas, such as Space, Energy and Maritime. ● Growth of the geospatial industry with untapped opportunities driven by location-enabled analytics ● Strong consortium with high representation of academia, industries and SMEs. ● Large market needs for TADDIS innovations. ● Flexibility for adoption in various application domains. ● Existing customer base of industrial partners. ● Reduced costs due to less diversified development and maintenance of the products/services, when released to the market.	● Unclear policies, GDPR framework, and mechanisms to structure information between actors in the European Big Data Ecosystem and to agree on commercial exploitation of big data and related value-added services ● No adoption by the power operators because of scientific focus of the tool not directly relating to their business environment ● Potential competition or insufficient uptake.

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2 IMPACT

2.1 Expected impact

This section describes the impact of TADDIS on outcomes foreseen in the Work Programme. It also discusses additional impacts and presents Key Performance Indicators (KPIs).

Increased productivity and quality of system design and software development thanks to better methods, architectures and tools for complex federated/distributed systems handling extremely large volumes and streams of data;

The proposed solution is based on a big data multi-tier architecture **(TA2.1)** that allows for an increased productivity and quality of the overall system design and software development. Moreover, employing a hybrid architecture of edge and cloud computing enables to manage the big workloads across all the tiers effectively. This minimises the data transfer and keeps a significant amount of processing load closer to the source (in the edge/fog), thus it reduces the costs for bandwidth, storage and processing capabilities. Concerning Volume, Velocity and Variety, the choice of a multi-tier distributed architecture will solve the problem of linearly scale computer performance and storage to process big data. The distributed architecture will overcome the slowness of querying against a huge, centrally located data set that characterizes traditional non-distributed architectures. In particular:

- Extreme-scale predictive analytics and Deep Learning architectures on the Cloud are employed to cope with the sheer data volumes flowing from edge devices (e.g. vessels or mobile phones from passengers on-board) as well as the rate in which they need to be ingested. Having local processing to understand the used data formats rather than expect the cloud to be aware of all possible incoming data formats enables the variety of data formats flowing into the cloud to be better handled;
- Efficient semantic representation and indexing methods **(RA3.1, RA3.2)** are adopted for the design of a secure and energy-efficient distributed system which allows a minimisation of energy consumption in all processing stages.

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KPIs: 20% reduction in processing power compared to a cloud computing architecture.

Demonstrated, significant increase of speed of data throughput and access, as measured against relevant, industry-validated benchmarks;

Validation activities will be conducted **(UA2.3)** to demonstrate the suitability of the TADDIS platform from various viewpoints, while focusing on demonstrating the significant increase of speed of data throughput and access performed by TADDIS against commercial or current solutions. The involvement of industrial end users, i.e. SERCO, ANEK, IPTO, will ensure the consideration of additional aspects with respect to the actual deployment in specific industrial settings in both the detailed analysis of user needs **(UA1.1)** and the validation of TADDIS solution (**UA2.3**) against user-specific indicators and industry-validated benchmarks. Different approaches of Big Data benchmarking will be adopted (Han et al., 2018) to measure various performance-related aspects with respect to some or all the so-called V characteristics of Big Data (e.g., volume, velocity, variety, veracity, etc). Among them well-known industry-validated benchmarks will be considered such as BigBench (industry-wide effort on creating a comprehensive and standardized Big Data benchmark whose commercial supporters include Intel and Cloudera), Yahoo! Streaming Benchmark (a combined tool to compare Apache Flink, Apache Storm and Apache Spark Streaming to provide an apples-to-apples comparison), TPC-DS (the de-facto industry standard benchmark for measuring the performance of decision support solutions including Big Data systems).

KPIs: 20% reduction in response time (time to get analytics results), data throughput, resources utilisation compared to commercial or current solutions.

Demonstrated adoption of results of the extreme-scale analysis and prediction in decision-making, including AI (in industry and/or society)

With TADDIS, different users from diverse economic sectors will exploit HPDA capable to combine EO data, real-time AIS data, online content from CCTVs and social media, into structured information to make critical business decisions, timely and effectively. Use cases, addressing both industrial and societal challenges, will demonstrate the adoption of the project results, such as decision making and situational awareness tools which exploit: extreme-scale AI technologies on HPC environment **(SO1),** Big Data predictive analytics **(SO2),** and high-level semantics and content enrichment from Big Data **(SO3).** In particular:

In **PUC 1,** the EO downstream industry (such as ocean monitoring, security, agriculture, etc.) will adopt the TADDIS platform and its results to exploit monitoring and analytic services provided by the TADDIS platform on Copernicus data to facilitate their operational and decision making process.

In **PUC 2,** port authorities, city councils, but also shipping companies, SMEs (local fisherman and local recreational business), and environmental-related organisations will employ the TADDIS platform and its results to monitor ship traffic emissions in the city of Barcelona and decide for corrective action if needed.

Finally, in **PUC3**, energy traders and energy producers will adopt the TADDIS platform and its results to exploit energy monitoring supporting solar energy exchange platforms (**IPTO**) in order to create a better plan on the energy storage solutions they need.

KPIs: Adoption of results by at least 3 companies

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2.1.1 Impact on citizens and European societal development

Europe is aiming to become a smart, sustainable and digitally inclusive economy. These priorities are expected to help the EU and the Member States to deliver high levels of employment, productivity and social cohesion. One of the flagship initiatives is "Smart Growth" targeting to improvement of EU's performance in education, research and innovation and digital society. TADDIS aims to address the challenges faced by modern society and its citizens **providing beneficial data-driven services and products** which will facilitate handling and processing of large streams of data. As a consequence, unexpected and unexplored insights in various areas will become much more actionable and will get more attention from management. In addition, TADDIS contributes to societies by **promoting smart and sustainable growth** and **strengthens Europe's role as a global actor** by bringing innovative solutions to the market, which are validated by industrial partners. Moreover, TADDIS **contributes to the Europe 2020 strategy** towards the development of a coherent European data ecosystem which will bring together different types of players and enable their interaction in a Digital Single Market towards innovation by **strengthening the EU's global position in Big Data value chain** (an important research and policy element of the EC), leveraging new market opportunities and business models.

At the same time, the biggest impact of TADDIS will be the direct outcomes of **Big Data and extreme scale analytic services developed within PUCs**, which have an immense potential in saving money, cutting costs, optimizing operations, increasing productivity and increasing the quality of our lives. Some examples of such benefits which TADDIS is to bring about are: better security by constant surveillance and taking proactive action in case of security breach, better response to natural disasters e.g. flood events, cleaner atmosphere by estimating emissions, better management of ship traffic, better management of renewable energy resources, etc.

2.1.2 Impact for global ICT technology, industrial solution vendors and SMEs

It is expected that the large volume of data generated by IoT devices and humans will be explosively increased in the near future. As a response to this reality, TADDIS envisions a key role for Global ICT technology, industrial solution vendors and SMEs. In particular, TADDIS will bring several competitive advantages to Global ICT technology, industrial solution vendors and SMEs. They will acquire competitive advantages based on their business and market segments and will be provided with a unique opportunity to extend their offerings and business advantages towards the handling and processing of Big Data. For this purpose, the advantages offered by TADDIS are:

a) Ability to deal with large streams of raw data from multiple and heterogeneous data sources (EO data, real-time AIS data, online content from CCTVs and social media);
b) Secure and efficient data processing by exploiting existing HPC infrastructure and edge processing capacity;
c) Optimised delivery of value-added data by means of novel predictions, estimations, visualisations and extreme scale analytics for decision making.

2.1.3 Technical and scientific impacts

TADDIS will generate scientific and technical outputs with significant impact to the fields of big data processing, streaming analytics, machine learning, distributed systems, and visualization techniques. During the development of the project an impact assessment model will be developed to estimate the scientific and technical impacts. Being developed by the consortium, these outputs will impact first-hand the involved consortium. Through communication and dissemination, these will also reach out to the scientific/research and ICT communities in the field. Individual TADDIS sub-system developments, which can be applied in different areas and products, thus benefiting other communities outside aforementioned ones, will be directly communicated and disseminated with those wider scientific, commercial and social communities. In the table below, we briefly list an estimation of potential technical/scientific impacts of TADDIS on sector and cross-sector communities.

Expected technical/scientific impacts	**Impact on industry and SMEs**
KR01 Virtual platform for AI workflows	(1) It will facilitate the rapid prototyping and deployment of scalable AI algorithms that could be used as a service (AIaaS) as independent serverless functions within existing cloud architectures (of AWS, GCloud, Azure etc). (2) Measurability of the cost of service for industry/SMEs offering AIaaS solutions
KR02 Deep Learning Networks for multimedia data **KR17A** Social media crawler **KR17B** CCTV data collection	Multimedia data are ubiquitous and the automatic extraction of knowledge out of them using Machine Learning, Computer Vision and Deep Learning techniques is adding value in the media sector, in social media platforms, in security applications. CERTH will further extend their air quality models in the maritime sector, in emission modelling applications, for any type of vessel and cruise ship.
KR03 Deep learning Networks for multisensor and multisource EO data	A tool with the capability to classify multisensor and multisource EO data based on a proper deep learning architecture. The toll is defined on the basis of the properties of multispectral and SAR of Sentinel 2 and Sentinel 1, respectively, but is general and can be used for classifying remote sensing data in different application domain.

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KR04 Deep Learning Architectures to forecast solar spectral irradiances	Forecasting solar spectral irradiances with low uncertainty is an information source that is exploitable by different industries, other than the energy sector. This include the health industry through the assessment of Ultra-Violet exposure, and the agriculture industry through the estimation of photosynthetically active radiation to forecast plant growth, etc. SME's can capitalise on such rich information source, extract the part of the solar spectrum of interest and include these in novel value chains.
KR05 Data Distribution Through Federated Learning	A tool to be used as the basis for platforms that require synergetic model training. The tool enables multiple actors to build a common, robust machine learning model without sharing data, thus addressing critical issues such as data privacy, data security, data access rights and access to heterogeneous data. Its applications are spread over a number of industries including defense, telecommunications, IoT, or pharmaceutics.
KR06 Machine Learning module in HPC and low-power environments	The technology for producing and deploying ML modules in low-power environments will be a valuable precedent for the industry, providing an example also reference of a valid architecture and tuning towards fast and reliable Edge services using analytics and ML training and inference.
KR07 Extreme-scale clustering and similarity search algorithms on cloud and HPC environments	Grouping data of similar content and information retrieval of very large and heterogeneous content, offers effective and scalable solutions in a cross-sectorial way. In TEDDIS, the solutions will be validated mainly in the space, maritime and energy sector, taking advantage of HPC (BSC) and cloud (SERCO) infrastructures. The open-source solution will be a mature and reusable tool for any SME in extreme-scale analytics.
KR08 Predictive analytics models	Enhance productivity and cost-effectiveness, improve quality of products and services, enable creation of new market opportunities, strengthen competitiveness
KR09 a real time solar energy forecast spatiotemporal resolution system for continental domains	Accurate solar energy forecasting has an impact on various industrial stake holders and SME's. Through optimized energy planning the developed tools can be used by companies dealing with national or regional transmission and distribution of electrical power. It also affects SMEs that deal with solar parks construction planning and management. Finally, it directly affects SMEs and bodies dealing with the energy market.
KR10 TADDIS Intelligent Analytics Platform	SMEs can utilize the potential intelligent analytics as Big Data-ready solutions that combine in one place data prediction, visualization, analysis, alerting & decision support capabilities through a recommendation engine. Thus industry & SMEs doesn't need to develop separate platform for visualization and recommendations. The overall system will provide the ability of cutting-edge data-driven decision making in an automated manner from a single solution, reducing cost of development.
KR11 The TADDIS ontologies	The developed ontologies will be deployed in the organizations of the industrial partners of the project (including SMEs).
KR12 New version of GeoTriples-Spark and JedAI KR13 New version of Strabon, Ontop-spatial	GeoTriples-Spark, JedAI, Strabon and Ontop-spatial will be open-source and this will facilitate its take up by industrial organizations (including SMEs) especially the ones participating in TADDIS.
KR14 New version of the Autonomous Decision-Making System	A tool with a wide variety of applications. Capable of fast deployment and implementation in every Decision-Making/Optimization problem because of its plug-n-play, self-tuning and self-healing attributes.
KR15 Copernicus data collection module	ONDA-DIAS is designed to support users at various level of expertise, regardless the thematic application or the data they are dealing with. It is currently supporting a heterogeneous portfolio of actors: students, researchers, public entities, start-ups, SMEs, large enterprises.
KR16 Ship emission activity and AIS data collection module	AIS data use for air pollution purposes has an important social impact due to the rapid computation of emissions. This is useful for several stakeholders including Port Authorities and City Councils but also to shipping companies that can adapt their navigational status in order to minimize their emissions. It also affects SMEs like local fisherman and local recreational business in order to manage their fuel consumption.
KR18 TADDIS Big Data Operations Fusion Engine **KR19** TADDIS Platform **KR20** Interactive UIs and Dashboards	(1) Offering Virtual analogue (Digital Twin) of IoT devices data streaming accelerating the development (and thus reducing the cost) of integrated Edge Computing services for industry/SMEs. (2) Reduce time development and optimization from internal development for industry/SMEs providing an off the shelf robust solution with seamless API-centric integration capable of handling large amounts of Big Data. (3) Ability to conduct DataOps in scalable manner.

2.1.4 Economic impact

It is very common to find Big Data-related technologies and services (covering a wide range of application domains) in the region of innovation triggers, as Big Data is considered one of the key emerging technologies to drive innovation and growth across Europe and worldwide. This can be verified by studies, which have shown that the adoption

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of Big Data solutions can result in economic growth, as well as enhanced competitiveness. Regarding the respective market, the actual deployment and integration of Big Data solutions has not been achieved by many companies, although the need and demand for Big Data technologies is constantly on the rise. This can largely be attributed to the fact that the availability of data, as well as domain expertise in order to create and provide practical solutions, is limited. TADDIS will face this challenge and act as a key player in the Big Data services market, through the provision of an HPDA-based Big Data platform with a novel architecture combining cloud and edge processing and the ability to support decision making and extreme scale analytics, as well as monitoring and short-term forecasting functionalities, enabling the creation of new high impact products, services and tools.

2.1.5 Barriers and obstacles to impact

Table 2.1 lists the potential barriers and countermeasures for maximising this impact:

Table 2.1: Potential Barriers and countermeasures for maximising this impact

Barriers	Issue	Measures to counter barriers to achieve impact
Policy, Ethics and Legislation	The access control, data sharing, and data processing solutions integrated in the TADDIS platform need to take legal requirements set by GDPR, ePrivacy Directive and other domain-specific applicable laws into account. These requirements may impose constraints on the ways in which data anonymization needs to be handled.	The consortium includes ethical and legal experts, experienced in identifying and assessing legal and ethical issues, as well as identifying good practice solutions for mitigating those issues. Furthermore, we address this barrier considering the legal and ethical dimensions in WP2 (Task 2.3). It will examine each of these issues and function as a platform to bring technology developers, legal experts and practitioners together to effectively address existing and emerging legal regulations.
	The user partners might be unlikely to adapt the policies and legislation.	TADDIS approaches this challenge by adapting solutions to the policies and legislation within each partner's information flows, security policies and legislation.
Technological barriers	Volatile, fast developing market of competing analytics and Big Data technologies.	TADDIS will be highly modular, so it can easily extend or be integrated into underlying technologies. Consortium partners are familiar with agile development practices, rapidly adapting development to new requirements and technological developments.
	Fast developing marketplace and novel solutions, might affect uniqueness and SoA of TADDIS	During the lifetime of the project, end-user requirements (WP2), market analysis/exploitation and collaborations activities with other H2020 Big Data-related projects (WP9) will keep the project informed of emerging technical developments.

2.2 Measures to maximise impact

2.2.1 Dissemination of project results

Objectives: The dissemination of project results is highly dependent on the take-up of the developed technologies. Therefore, the TADDIS dissemination plan will allow not only identify the target audiences and determine the dissemination tools, but also evaluate the anticipated impact and identify the exploitation potential and sustainability of the project outcomes. This guarantees the capability of correcting, enhancing, and revising the dissemination strategy, so as to deal efficiently with issues concerning the realisation of the expected impact. All partners will contribute via the channels that are most appropriate to their business sector or research area.

Target audiences: (i) TADDIS Consortium; (ii) Academia, scientific communities and students interested in the fields of big data processing, streaming analytics, machine learning, distributed systems, and visualization techniques; (iii) End users, from different application domains and industries (energy, maritime, transport, etc.), including large enterprises and SMEs interested in exploiting large streams of data to improve or produce more and/or better-quality products, services and tools; (iv) Companies in the Geospatial and Location-based analytic (LBS) sectors (large enterprises providing EO-based applications and services integrating the whole EO value chain, SMEs delivering on EO-based applications and services for downstream services); (v) Technology providers in the High Tech and ICT sectors (large IT vendors providing integrated, industrial grade solutions; SMEs offering specialized products or services around open source software, cloud-computing providers); (vi) Consulting companies providing consultancy for big-data-driven-innovation, and training in data science; (vii) Public authorities, municipalities, societal organisations and the wider public.

Multi-level approach: (i) Raising awareness at all levels of society: The Website, appropriate communication material (presentations, posts, videos), social media accounts, articles in relevant institutional newsletters and non-technical journals, press releases to local media, local science communication events such as the European Researchers' Night; (ii) Approaching, engaging, and collecting feedback from potential industrial end-users via partners' direct links of communication with external EU and national industries, SMEs, research institutes and universities (for educational purposes); (iii) Fostering technology uptake and integration with third-party solutions by bringing the open technologies to the attention of developers, industries, large enterprises and SMEs, placing particular emphasis on thorough documentation and support (e.g., simple tutorials, ready-to-use code snippets); and (iv) Diffusing the

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scientific and technological achievements by publications in highly visible venues, preferably open access. When allowed by data protection and legal constraints, datasets and accompanying code will be provided for reproducibility of presented results.

Instruments: (i) A **public project Website and social media accounts** will include diverse on-line materials for communication, promotion, demonstration, education, and dissemination. Project partners will set up a Website, brochures, roll-ups, articles, and social media accounts. These materials will address the target groups and explain the benefits of TADDIS and potential application. The Website and associated social media accounts will be regularly updated to feature the latest achievements and relevant news (e.g., attendance of events, informative articles, etc.). (ii) **Presentations at academic and industrial venues** by research-oriented partners (conferences and journals) and industrial partners (exhibitions and conventions), as summarised in the table below, in line with the 'green' model for free on-line access. (iii) **A Stakeholder Network** will bring together representatives of stakeholders, in two demonstration workshops, two Open Days and one Conference (Final Dissemination Conference), in which the TADDIS approach and the results will be communicated, discussed, and assessed. (iv) Information and demonstration activities will include Consortium partners' participation in **industry or user community information and demonstration events**, to showcase the TADDIS solutions and present them to potential user stakeholders across Europe.

WP	Venue (Journal, Conference, Exhibition, etc.)
Data acquisition and indexing (WP3)	**Journals:** Int. Journal of Maritime Engineering, Computer Methods in Applied Mechanics and Engineering, International Journal of Naval Architecture and Ocean Engineering, Atmospheric Measurement Techniques, Energy, Atmospheric Chemistry and Physics, Meteorological Applications. **Conferences**: PIANC World Congress, Int. Conf. on Ocean, Occshore and Arctic Engineering, International Association of Maritime Universities, European Geosciences Union.
Extreme-scale machine learning and predictive analytics (WP4, WP5)	**Journals**:, Machine Learning, Journal of Machine Learning Research, IEEE Transactions on Data and Knowledge Engineering, ACM Transactions on Knowledge Discovery from Data, Very Large Databases, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Neural Networks and Learning Systems, Journal of Big Data, Big Data Research, Data Mining and Knowledge Discovery. **Conferences**: ECML, ICML, ICMLA, KDD, SIGMOD, ICDE, EDBT, GEO Workshops, GEO Plenary, GeoInformation for Disaster Management.
Extreme-scale content enrichment (WP6)	**Journals**: Data Mining & Knowledge Discovery, J. of Web Semantics, Expert Systems with Applications. **Conferences**: The Web Conference, Int. Semantic Web Conference, ACL, EAMT, WMT, LREC, RANLP, Interspeech, LocWorld, RecSys, INLG, CHI, NAACL, IJCAI, ECAI, AAAI, EKAW, KR
Use cases, requirements and evaluation (WP2, WP8)	**Journals:**IEEE Pervasive Computing, ACM TSN, ACM TECS, Remote sensing, Solar Energy **Conferences:** IEEE Communications Society forums, IEEE Conference on BigData, ESA Big Data from Space, IEEE Globecom, IEEE VTC, ITS World Congress, EGU, MOBICOM, IEEE Cluster, FiCloud, TRA2020, SIRWEC, Energy meteorology, Radiative transfer, Int. Radiation Symposium, national industry events (e.g. 'Business Breakfast' event organized by the Chamber of Commerce and Industry of Slovenia).

Dissemination indicators: Appropriate indicators to assess the impact of dissemination and communication activities include (see table below): (i) Visits and audience of Website using tools such as Matomo Analytics; (ii) Downloads of publicly available documents, papers, released software, and datasets; (iii) Views, engagement and followers are popular indicators of social media outreach, due to their widespread adoption; (iv) Impact factor/ acceptance, a typical indicator for scientific publications, academic citations, views; and (v) Participation/attendance in workshops and other events, where TADDIS presentations or demonstrations are given.

Tool	KPI	Means of verification	Target value (estimate)
Website	# of visits #of downloads # of audience	Matomo Analytics (or similar)	1000 visits and audience (annual increase of 15%;) 20 downloads(annual increase of 15%)
Social media	# followers # of views # of engagement (comments, likes, favourites and retweets) in Facebook, LinkedIn and Twitter	Social media platform analytics.	700 views(annual increase of 15%;) 350 followers (annual increase of 15%)
Publications	# of publications in scientific journals, industry-led magazines and websites	List of publications	At least 25 publications with at least 15 from them being scientific articles with at least 5 open access publications
Newsletter	# of readers # frequency	List of newsletter subscribers	Bi-annual; at least 100 readers per newsletter (including at least 15 industries)

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Stakeholder network	# of users # diversification	List of users	At least 25 users with at least 4 from each domain from at least 3 countries
Workshops	# of workshops # of participants (by target group)	List of events Reporting by organisers	3 workshops 40 participants
Final Dissemination Conference	# of participants (by target group)	Reporting by organisers	80 participants/ at least 50 industrial stakeholders external to the consortium.

Plan: The TADDIS dissemination plan and activities are addressed in WP9. In the very early stage of the project (by M3 the latest) the project Website will be set up and promotional material (project presentation, communication kit) will be gradually created and published there. In parallel, the complete dissemination plan will be prepared, with contribution from all project partners and in close connection with the exploitation plan, so as to ensure coordinated exploitation and dissemination efforts. The undertaken dissemination actions and their impact will be assessed in regular time intervals and the dissemination plan will be updated accordingly. Specific dissemination activities are foreseen for project partners as follows:

Group	Main dissemination activities	Target audience
Research / Academic	Publication in top tier scientific journals/conferences; Participation and organisation of workshops, conferences, summer schools (e.g., summer schools organized by PMODWRC and WMO), training seminars, demonstration forums and PhD forums; Demonstrations and talks at symposiums for industry; Incorporation of findings and practice in undergraduate/postgraduate courses (e.g., ETH Zurich by PMODWRC, Bachelor and Masters degrees of Barcelona School of Nautical studies by UPC); Contribution to dissemination materials; contribution to policies (e.g., International Energy Agency photovoltaic power system program).	Scientific community, ICT community, SMEs, Co-running projects, Users of AI products, and public sector.
Industry	Internal dissemination within relevant departments and labs; Participation in trade events, fairs, workshops and conferences; Contribution to relevant open standards bodies; Media, outreach, web sites, flyers, posters, and publications; Presentation in several fora, BDVA activities, BD Forum, and on the frame of the AIOTI working group 2 activities.	Internal research and business units, Industrial and technological practitioners.
SMEs	Events, fairs, workshops, conferences, scientific and educational events relevant to each SME's business; Internal presentations; Liaisons with other initiatives and running projects; Contribution to relevant open standards bodies; White papers and technical reports.	ICT community, Industry, Related organisations, General public.

2.2.2 Communication activities

To achieve its objectives, TADDIS will lead its audiences through the following sequence of steps:

- **Awareness**: Audiences need to be aware of current problems and challenges in industrials' operational capacities. By working with umbrella organisations, we aim to mostly build on existing awareness levels.
- **Alignment**: Audiences need to agree that TADDIS will deliver a promising solution. We aim to amplify this alignment through endorsements by credible institutions and by making it easy for interested parties to get information on the approach and newer developments.
- **Engagement**: Audiences need to feel motivated to engage with TADDIS. To succeed this, TADDIS aims to tap into (rather than replace) existing industry procedures in order to facilitate their operational capacity.
- **Action**: Audiences need appropriate incentives in order to take action. TADDIS aims to provide such incentives to industries via directly improving their operational capacity.

A detailed plan of communication activities (described in WP9) will be developed in the dissemination strategy and will seek to engage key stakeholders and the identified target audiences. These activities would depend on the target audience segmentation, insight and analysis. Communications activities for promoting the project and its findings during the period of the grant include: (i) ***Communications Tools***: Website, social media, newsletter, show and printed material; (ii) ***Workshops***: workshops across Europe to trial and fine-tune the TADDIS platform; (iii) ***Network of Interest***: regular meetings/communications with selected stakeholder organisations, (iv) ***synergies*** and ***joint events*** with other H2020 projects (e.g., EOPEN project, funded under EO-2-2017 EO Big Data shift, targeting non-expert EO data users, experts and the SME community), (v) ***contacting*** and ***clustering*** with other ICT-12-2018 and ICT-51-2020 projects, to share knowledge in the common domain of Big Data and extreme-scale analytics.

Tool	Indic. Timing	Core audience	Material
Website	M3	Project partners; Stakeholder Network; Developers; Organisations with relevant	Information about the project; Updates on project's progress; Documents, presentations and training material.

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		interests; Media and general public; Potential end users.	
Social media engagement	M1-M36	Project partners; Stakeholder Network; Developers; Organisations with relevant interests; Media and general public; Potential end users.	(In line with engagement strategy) Interesting data points; Updates and news on relevant topics.
Newsletter& press releases	M3-M36	Stakeholder Network.	Updates on project's progress and developments.
Brochure	M6	For use by project partners in events and meetings	Information about the project and its platform
Tutorial	M18	Event organisers and potential end users	Stories/use cases/videos on platform usage
Posters	M18	Event organisers and project partners	Information about the project and its platform
Presentations	live doc	For use by project partners in events and meetings	Information about the project and its platform

2.2.3 Exploitation of project results and tools

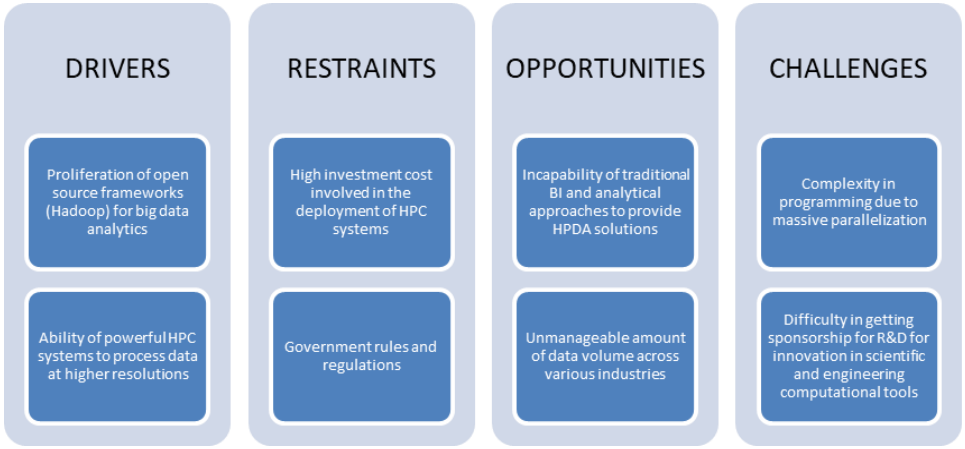
As the TADDIS concept and business model exemplifies, the project addresses diverse industries and customer segments. In order to showcase the growth potential and enable TADDIS's breakthrough tools to reach their full market possibility we provide a preliminary analysis of the respective target markets (namely HPDA, geospatial, maritime and energy) separately and in conjunction with each other. We also provide interesting industry trends and projections on the markets that TADDIS focuses on the HPDA market as we believe that such information provides a need-to-know context for project exploitation.

2.2.3.1 Market Analysis

TADDIS will deliver advanced **data-intensive simulations and analytics** that will bring efficiency and cost effectiveness in fundamental sectors of the economy. Leveraging the exploitation of Copernicus data in PUC1, ship and emission data in PUC2, and energy data in PUC3, the potential markets to be analysed is the intersection between the HPDA market (meant as big data needing the power of HPC), the Geospatial market (EO or Copernicus Market), the maritime market and the energy market since these are the key beneficial industries of TADDIS approach.

HPDA market: Theglobal HPDA Market was valued (https://www.marketwatch.com/press-release/high-performance-data-analytics-hpda-market-size-growth-opportunity-and-forecast-2025-2019-11-12) at USD 26.32 billion in 2016 and is projected to reach USD 196.38 billion by 2025, growing at a CAGR of 25.02% from 2017 to 2025.The global HPDA market is expected to have significant growth rate, attributed to growing SMEs comfort in cloud-based services. According to other market studies (https://www.businesswire.com/news/home/20190812005338/en/Global-High-Performance-Data-Analytics-HPDA-Market) within Europe, which continues to remain an important element in the world economy, Germany will add over US$11.9 Billion to the region's size and clout in the next 5 to 6 years. Over US$8.2 Billion worth of projected demand in the region will come from other emerging Eastern European markets.

Geospatial market: Nowadays, the information requested by the end-users is produced by pursuing innovative solutions that foreseen the integration of multi-source data. In this context, satellite imagery is playing an increasingly important role, being in many scenarios the remote sensing technology with the best ratio between resolution, acquired area and costs. Together with Cloud technology, the data coming from space is reshaping the business models for the Geospatial market According to the GeoBuiz 2018 Report, the cumulated geospatial market (GNSS and Positioning, GIS and Spatial Analytics, Earth Observation) is estimated at US$ 299 Billion in 2017 with a CARG of 13,6% and is likely to touch US$ 439 Billion by 2020. Considering the economic impact of the geospatial industry on the economy, transportation and utilities are the key sectors generating a value impact worth US$ 623.2 Billion and US$603.9.MarketsandMarkets (https://www.marketsandmarkets.com/Market-Reports/geospatial-analytics-market-198354497.html) forecasts the geospatial analytics market to grow from USD 40.65 billion in 2018 to USD 86.32 billion by 2023, at a Compound Annual Growth Rate (CAGR) of 16.3%.



Maritime market: The 2018 total worldwide ocean cruise industry is estimated at $45.6 billion (a 4.6% increase over 2017) with 26.0 million annualized passengers carried. Eurostat (https://ec.europa.eu/eurostat/web/products-

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eurostat-news/-/DDN-20190816-1?inheritRedirect=true) reports that in 2017, the number of passengers starting a sea cruise in the Europe reached 7.0 million, surpassing the previous peak of 6.9 million in 2012. Moreover, according to the Cruise Industry News Annual Report, a fleet of 329 cruise vessels was deployed worldwide in 2017, having a passenger capacity of 525 million berths, and a fleet of more than 340 cruise vessels was expected to be deployed in 2018, with a passenger capacity of more than 550,000 berths. The statistics reveal the promising nature of the industry and a considerable market of which even a small market share that TADDIS could capture would secure business sustainability and longevity, through effective and real-time emission models.

Energy sector: The international Energy Agency market analysis for 2019-2024 and for renewables forecasts (https://www.iea.org/reports/renewables-2019) that renewable power capacity is set to expand by 50% between 2019 and 2024, led by solar PV. This increase of 1200 GW is equivalent to the total installed power capacity of the United States today. Solar PV alone accounts for almost 60% of the expected growth. Power total renewable electricity capacity increase is foreseen on the scale of 14% and Solar PV capacity expected to increase 2.5 over the forecast period, reaching almost 1.2 TW in 2024. The Energy Management System (EMS) market is estimated (https://www.marketsandmarkets.com/Market-Reports/energy-management-systems-ems-market-1189.html) to grow from USD 32.41 Billion in 2016 to USD 76.75 Billion by 2021, at a CARG of 18.8 % during 2016-2021.The rising energy consumption, energy price volatility, and increasing carbon emission percentage across industrial and commercial sector are the driving factors for the growth of the EMS application market. Matching energy supply and demand on the grid has always been tight balancing act and data analytics has a big role to play. By taking advantage of collected big data and advanced big data analytics techniques,the energy production efficiency can be improved, and production costs reduced.

2.2.3.2 Market Outlook

The competitive arena for the outcomes of TADDIS is significantly broad as the project embraces a large part of the big-data value chain, from software for building HPDA solutions to HPDA-based services offered to different sectors. To have a complete overview of the market and competitive landscape it is critical to study the outlook of involved marketplaces to become aware of potential direct competitors of TADDIS, growth prospects and market attractiveness.The following diagram outlines the market dynamics as identified by multiple market reports:

The stakeholders for the **HPDA** market include MHPS-TOMONI (maximising highly digitized power plants by emphasizing collaboration with customers), DELL Edge Gateway 5000 (offering IoT-enabled MicroGrid Energy Management Solution), Intel Enterprise Edition for Lustre Software (offering software for building HPDA solutions), SUSE OpenStack Cloud (offering access to automated pools of high-performance IaaS resources managed from users data centers), Amazon-AWS/Heart (offering broad range of services such as EMR, Elasticsearch Service, Athena), Google Cloud(offering Big Query, CloudDataproc, Tensorflow and Cloud machine Learning products), and many more.Competition is also played at "benchmarking-level" with different industry standard organizations engaged (TPC, SPEC, CLDS) and different approaches such as BigBench, TPC-DS.

The HPDA market (https://www.marketsandmarkets.com/Market-Reports/high-performance-data-analytics-market-39751632.html) comprises a network of players involved in the research and product development; system integrator; software and service provider; distribution and sale; and post-sales services. Key players are Cisco systems (US), SAP SE (Germany), Red Hat Inc. (US), Dell Inc. (US), Teradata Corporation (US), SAS Institute (US), IBM Corporation (US), Hewlett Packard Enterprises (US), Oracle Corporation (US), Microsoft Corporation (US), Intel Corporation (US), Cray Inc. (US), Juniper Networks (US), and ATOS SE (France).

2.2.3.3 Business Model

The consortium envisions to deliver **TADDIS as a near-to-market solution for enhanced analytics and decision-making on tremendous amounts of diverse data streams in space, energy and maritime**. Figure 2.1 demonstrate the Lean Business Model Canvas for TADDIS. The Lean CANVAS depicts the main elements of the business model and how it adds value to the end consumers. Revenues are expected from one off fees for the acquisition and customization of the platform, sales of individual modules, and monthly or yearly support/maintenance/license contracts. Steps for market readiness (proof of concept, prototyping, demonstrations of technological performance and cost effectiveness field trials, validation, requirements, barriers and how to overcome them), will take place during the project.

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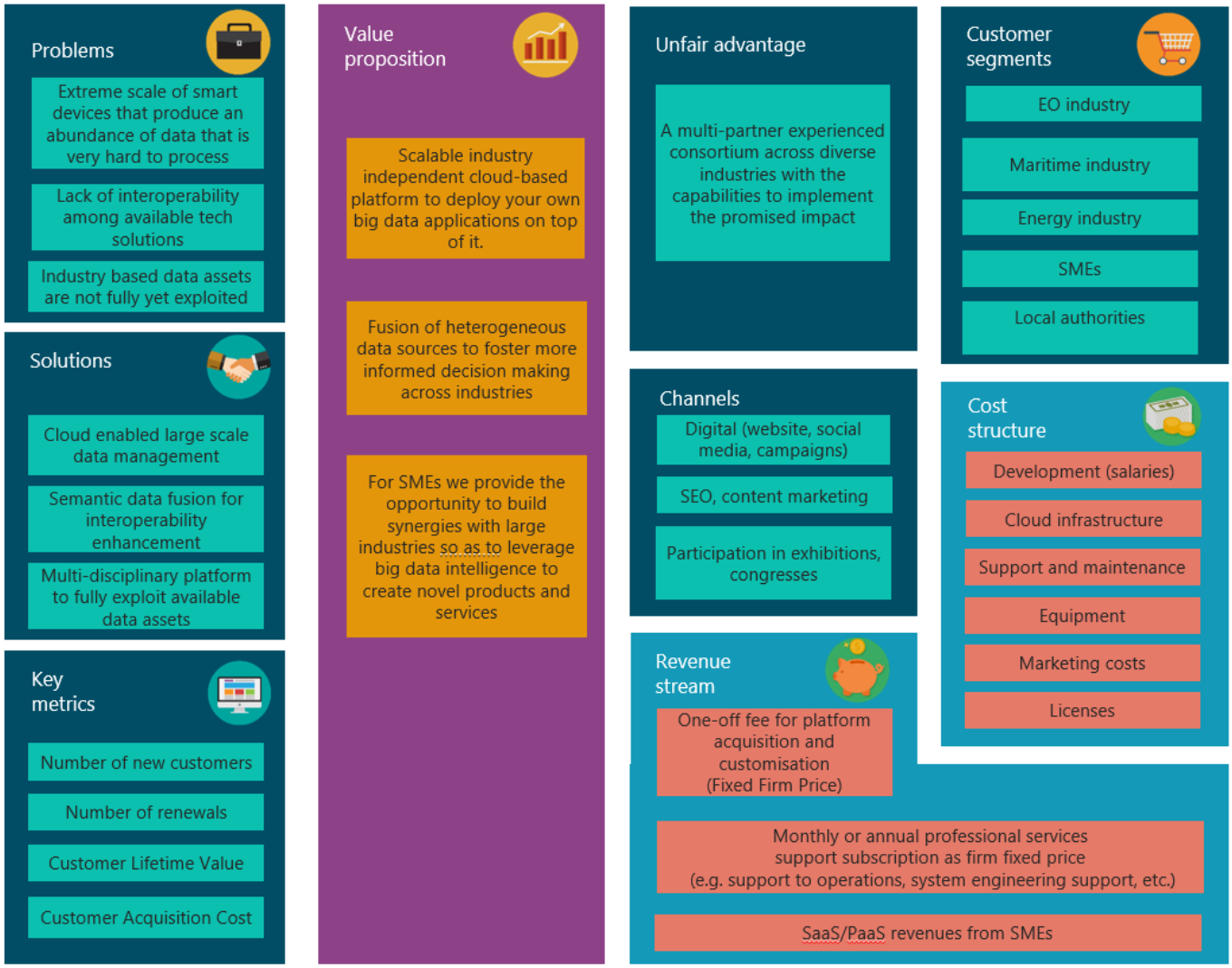

Figure 2.1: Business Model Canvas

2.2.3.4 Exploitable assets and measurable goals

Several existing tools in the market cover individual aspects of TADDIS, but none cover the entire range of solutions offered by TADDIS. The table below provides a tentative vision of project's key exploitable assets:

Exploitable outcomes	Exploitation options & potential customers	License
KR01 Virtual platform for AI workflows	Currently open source solutions offer ML workflows for training and data manipulation or software-based workflows. However existing open source and commercial solutions are not providing an holistic service where the designed solutions can be offered as a service via API as a whole – as AI IaaS (Infrastructure as a Service). EXUS will further examine during the project period the Unique Selling Points of Platform and the potential market uptake starting from the existing client-base in the Banking Sector.	Metered Licence will be offered to commercial clients based on the consumption of the web-service. A billing API will be connected with the commercial client. Limited Academic licence could be provided for research purposes.
KR02 Deep Learning for multimedia data	Air quality estimations can also be performed by visual content using Computer Vision and Deep Learning models that will be exploited in the maritime sector and in other environmental applications that fuse citizen observations.	Open-source (Apache license v2.0)
KR03 Deep learning Networks for multisensor and multisource EO data	The tool can be used for classifying multisensor and multisource remote sensing data in different application domain. The methodology implemented is general and can be exploited in different applications, beyond the space sector.	License agreement (freely available to academic and research institutions)
KR04 Deep Learning Architectures to forecast solar spectral irradiances	The exploitation plan for this product is to create a free service at large scales, for visualisation of different parts of solar spectral irradiances. Specific products can be requested on a fee-basis and depending on the service specifications, offering 1) downscaled information at a local level, 2) specific products tailored to the energy,	Royalties / Research Contracts / Consultancy services

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	health and agriculture sectors, and 3) set-up of an API to provide seamless access to solar spectral irradiances forecasts.	
KR05 Data Distribution Through Federated Learning	Operational and Savings Models Standards, Software Prototype Module, Oriented Knowledge and Application Outcomes/Results	Royalties / Research Contracts / Consultancy services
KR06 Machine Learning module in HPC and low-power environments	Data generated from ML+HPC experiments on devices will be provided as reference for architecture and service developers towards building pipelines and deploying analytics services on the Edge. Methodologies form modelling on the Edge, also testing models will be used as reference for academia and industry.	Open access data on performance and quality metrics from experimentation and prototypes. Open source for valid models towards replication, following academic standards for algorithms publication.
KR07 Extreme-scale clustering and similarity search algorithms on cloud and HPC environments	Multimedia search engines and multimodal analytics platforms will offer this module as an extension to their existing analytics. Similarity search is done using also contextual information and not only the standard metadata.	Open source (Apache license 2.0) for the algorithms; commercial for the costs of HPC and cloud infrastructure (optional).
KR08 Predictive analytics models	TADDIS will provide advanced EO based predictive analytics solutions, primarily based on freely available Copernicus constellation. Gathering insights from AIS data will provide competitive advantage for the ports and shipping industry, as well as tackle societal and environmental issues of the shipping and port industry. Predictive analytics will also provide competitive advantage and improved efficiency of existing and increasing number of new photovoltaic energy production farms[4] and distribution networks.	Open source (Apache license 2.0)
KR09 a real time solar energy forecast spatiotemporal resolution system for continental domains	Transmission and Distribution System Operators, Ministries of Electricity and Renewable Energy, solar energy investors, solar farms management entities.	Open access climatological data and real-time mapping. Access to real-time data after consultation.
KR10 TADDIS Intelligent Analytics Platform	This feature is of high importance for Risk Managers that handling the Common Operational Picture (COP) from Command & Control Centers (C3) for the Physical & Cyber-security of critical infrastructure worldwide. Potential customers are public C3 users (Police, Fire-Brigade, Civil Protection etc) and private Risk Managers & C3 users of critical infrastructure.	Freemium: Free for a specific set of features and for an advanced set of features a paid licence should be obtained. Specific featurers such as alerting & warning notifications will follow the pay-as-you-go model since it would be offered as a service through the cloud. Limited Academic licence could be provided for research purposes.
KR11 The TADDIS ontologies	The TADDIS ontologies can be exploited by companies in the space, maritime and energy sectors that deal with problems similar to the ones tackled by the use cases of the project.	Open source (Apache license 2.0)
KR12 New version of GeoTriples-Spark	GeoTriples-Spark can be exploited by companies in the geospatial and Earth observation sector.	Open source (Apache license 2.0)
KR12 New version of JedAI	JedAI can be exploited by companies specializing in data integration.	Open source (Apache license 2.0)
KR13 New version of Strabon	Strabon can be exploited by companies in the geospatial and Earth observation sector.	Open source (Apache license 2.0)
KR13 New version of Ontop-spatial	Ontop-spatial can be exploited by companies carrying out data integration of geospatial and temporal data using ontology-based data access techniques.	Open source (Apache license 2.0)
KR14 New version of the Autonomous Decision-Making System	Operational and Savings Models Standards, Software Prototype Module, Oriented Knowledge and Application Outcomes/Results	Royalties / Research Contracts / Consultancy services

[4] https://www.iea.org/reports/tracking-power-2019/solar-pv

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KR15 Copernicus data collection module	ONDA-DIAS offer tailored solutions for users at any level of expertise, by providing scalable cloud-based environments and different ways of accessing them. It is currently supporting a heterogeneous portfolio of actors: students, researchers, public entities, start-ups, SMEs, large enterprises.	Copernicus data are provided in a free, full and open basis (open access). The cloud infrastructure for processing EO data, without the need to be downloaded locally has a commercial license.
KR16 Ship emission activity and AIS data collection module	Port Authorities, Ministries of Transport and Energetic Transition, City Councils, Shipping Companies, Shipping Recreational companies, Fisherpersons.	Open access to AIS data and real-time mapping of shipping emissions. Access to real-time data after consultation.
KR17A Social media crawler; KR17B CCTV data collection	Ship owners, cruise ship operators, port authorities, municipalities and local authorities that monitor air quality in urban areas	Open source (Apache license 2.0)
KR18 TADDIS Big Data Operations Fusion Engine	At the moment Data Fusion is rather handled as an internal process from companies that spending large amounts of time & money for developing robust data streaming internal processes. EXUS will examine the offering of an off-the-self solution for DataOps (Data Operations) targeting especially Edge-Computing niche customer segment for IoT devices.	Metered Licence will be offered to commercial clients based on the amounts of data that would be streamed through the platform. A Limited Licence could be offered to academic institutions for research purposes.
KR19 TADDIS Platform KR20Interactive UIs and Dashboards	Section 2.2.3 analyses the potential market, exploitation options and the target customers. The ICT sector covers mainly the HPC and HPDA market, while the proposed applications cover the space, maritime and energy sectors.	Commercial closed license for the use of cloud and HPC infrastructure. A Limited Licence could be offered to academic institutions for research purposes.

In order to achieve its exploitation targets TADDIS sets the following measurable goals in order to ensure that the results are directly exploited by the end users (industry).

Aim	**Performance Indicator**	**Target**
Standalone modules are installed in consortium industries	Number of installations	At least 5
TADDIS platform is installed in European industries	Number of installations	At least 3
Standalone modules are integrated in existing tools of European industries	Number of integrated modules	At least 5
Creation of Open Source products	Number of Open Source products	At least 5
Commercial proposition of data features that use combined data	Number of features	At least 10
Contribution to EU IoT-based Service Economy	Number of datasets which are shared within- and across sector	At least 2 per sector
Collaboration among European industries	Number of industries working together on shared datasets	At least 2
Competition analysis	Number of evaluated competitors	At least 20
IPR management	Number of IP instances logged	At least 30
Market assessment	Number of identified segments	At least 6
New ventures	Number of new spinoffs/start-ups	At least 1
User satisfaction	Sample of minimum 10 questionnaires from end users	>80% positive replies
Standardisation	Number of standards created	At least 1
Standalone modules are installed in consortium industries	Number of installations	At least 5

2.2.3.5 Business plan

TADDIS outcomes are (i) direct, close to market novelties: a highly-scalable platform architecture and modules (ii) indirect, better-trained researchers and developers on prominent ICT domains such as Big Data, IoT, Semantic Web, and improved industry competitiveness through technology transfer and new product/services suites. Through a range of specifically designed activities, TADDIS will guarantee the transfer of project results beyond its life. More specifically, TADDIS's exploitation strategy will explore different business schemes and rely on 3 distinct pillars:

- Direct individual exploitation by partners (i.e. via the creation of new ventures).
- Exploitation of the project as a whole (upon specific agreements between partners).
- Formation of synergies between interested sub-teams of the consortium (i.e. distribution agreements).

Each of these pillars is explained below, however we note the most attention is given to the exploitation of specific components (Section 2.2.3.4) as these are the most prominent part of individual exploitation plans. Within each individual exploitation plan, we state also which companies intend to exploit the TADDIS as a system and a set of other exploitable results is provided, thus showing which company intends to exploit what.

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Exploiting all outputs of the TADDIS project at once can be, due to its mix and match nature, hard. The proper marketing and overall exploitation of such a solution is seldom an easy affair. In our experience, the best results are yielded when specific scenarios are developed (using Lean approaches - e.g. Lean Canvas, etc.). This approach means we shall be developing the exploitation of the full TADDIS as the project goes along.

Exploitation during the project is closely tied with dissemination and collaboration efforts. We will try to exploit the Open Source nature of many commercial and important EU projects and try to push the code, developed in the project, into them, to exploit their impacts. A preliminary market analysis and first business concept has been prepared (Figure 2.1) to assess the overall market potential. More detailed and extensive business plans will be developed in the context of Task 9.2.

2.2.3.6 Financial Plan

TADDIS' mission is to process, distil and combine information from collected large volumes of data from heterogeneous sources in order to provide innovative insights and create commercial value. The suggested business model will be attested and updated throughout the project duration. To ensure sustainability and secure financing beyond project end, we will consider 4 options (i) angel equity (ii) private capital from own sources (consortium), (iii) VCs, and (iv) business incubators and accelerators. A pitch presentation will be delivered as part of WP9to support such efforts. Revenues will be generated largely from SaaS sales, support and maintenance contracts. Costs pertain to: (i) hardware/equipment; (ii) depreciation; (iii) maintenance costs; iv) employee-related and general administrative expenses; v) marketing; vi) customer support.

2.2.3.7 Exploitation plans of each partner

A preliminary part of the exploitation has already been performed through identifying use cases, which will serve as the TADDIS validation point. The individual exploitation plans of partners are presented as follows:

Table 2.2: Individual exploitation plans of the TADDIS partners

Partner	Exploitation Plan
EVR	Everis is a **key player of the ICT industry worldwide**, meaning that we will be the most **concerned about the skills** for sure developed within the project, mainly products and services, as they are part of the core of our business. Everis will make use of their **link to the key global player on the European Artificial Intelligence Strategy with Japan**. We are used to work with them and get the most out of this cooperation, learning and applying the lessons in Europe to increase our European market (which is the most relevant in terms of revenue), being able to exploit TADDIS results in both geographies.
BSC	BSC, as a research center on HPC and AI, also as part of the Universitat Politècnica de Catalunya (UPC), aims at obtaining better knowledge and experience on Edge and Fog computing infrastructures, also on machine learning and AI capabilities on Smart City scenarios. The results of TADDIS will be of great value for subsequent research projects, and for HPC seminars, courses and lectures.
CERTH	CERTH will reinforce its research competencies in the machine learning and knowledge discovery. CERTH is interested in commercialising TADDIS modules through its spinoff company Infalia or licensing developed services to interested clients. Part of CERTH's business plan is to participate in joint spin-offs capable of exploiting its research in new market needs and solutions.
UPC	UPC will use the acquired knowledge to apply AIS data analysis to other fields such as underwater noise contamination and port traffic management (e.g. harbour operativity, queuing management, harbour seafloor morphodynamics). UPC will work with Port Authorities and AIS manufacturers to improve AIS data collection and propose new data collecting systems to be implemented in maritime transport through the International Maritime Organization recommendations.
SERCO	SERCO's proposed exploitation strategy to attract third-parties users to use the TADDIS services focuses on active engagement with the prospective third-parties from the outset of the contract through a user-centered development approach. Using their incumbent knowledge of the community of individuals and organisations who already utilise EO data, gives them a 'head start' in creating a critical mass of interest and need.
NOA	Develop a flagship service for the estimation of solar spectral irradiances, a data layer that can service cross-cutting sectors, including energy, tourism, health and agricultural industries. Within TADDIS we will develop end-to-end processing chains tailored to provide consistent forecasts to the energy sectors, expanding to both the energy exchange markets and TSO energy management services. We also consider this to be a lighthouse application that will attract new customers from the other industries. Finally, we will feed our deep learning models with multi-modal satellite data, forcing a shift to the operations paradigm of the Greek Collaborative Ground Segment (CollGS), towards providing a "Hybrid" data offer and pre-processed (Level2-3) products.
ACCELI	ACCELI is intrerested in testing and commercially exploiting the TADDIS technology and services conceived in the project. TADDIS results will help ACCELI to differentiate itself against competitors by enforcing the technology that originates from experience gained through TADDIS.
XLAB	XLAB's short-term exploitation plan is to provide support for the novel AI capabilities in line with privacy and data protection by design approaches. XLAB's long-term exploitation plan is to integrate the support for the developed technology at TADDIS into solutions and services provided by XLAB's commercialization teams focusing on Big Data and AI. We also plan to work towards a proof-of-concept deployment of the solution in the domain of public administration in Slovenia (e.g., Ministry of Public Administration) and the

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	SMEs in reach through the connections with the ABC Accelerator, the Chambers of Commerce and Industry of Slovenia, and the Technology Park Ljubljana. Long-term exploitation plans also include the integration of the support for the developed technology into existing solutions provided by XLAB to its customers. This equips XLAB with new tools that could be integrated with the existing offering (or as an addition option) to the IT infrastructure orchestrated. The most interesting exploitation (business) model for XLAB would be to provide selling operations and implementation consultancy related to the TADDIS offering.
IPTO	IPTO is a large electricity grid operator that monitors fluctuations in electricity prices and has a specific interest in both PUC1 and PUC2. Based on the outcomes of the TADDIS platform, IPTO will first evaluate the effectiveness of the TADDIS features for its own use and shall engage other European electricity grid operators in adopting the TADDIS technologies.
PMODWRC	The solar radiation/energy forecasting product is going to be a major step of the role of PMODWRC towards solar energy applications and related projects. It opens an opportunity for collaborations and use of the TEDDIS products from meteorological services, energy related public and private bodies and solar park related investment groups. Part of PMODWRC business plan is to participate in spin off opportunities exploiting its research and the developed system to solar energy related stake holders, transmission and distribution operators and solar park (existing and planned) management and planning.
ANEK	ANEK intent to introduce the results of the project into its day to day operative actions using the future developed project's soft application and web services and adapt the platform in its ship fleet. That will increase the ship awareness in an environment of continuous changing field threats and a quick response against it, using interconnected software platforms and various hardware sensors.
EXUS	EXUS's exploitation strategy is to utilize the experience gained through the TADDIS to further develop the in house developed EAF (Exus Analytical Framweork) platform and the EXAITE (Exus Artificial Technologies) Suite for manipulating large amount of data at commercial level in the FinTech sector. By improving the accuracy and performance of its prediction algorithms EXUS will be able to offer AIaaS (Artificial Intelligence as a Service) based solutions to the growing network of sales across 25 countries.
EVRPORT	EVERPORT aims to develop its strong technical capabilities on data visualization as an internal strategy to serve European projects within the everis ecosystem, using technologies as Power BI. Additionally, the experience in such architecture projects will also provide and important footprint to the everis Lisbon office.
UOA	UoA is a public university and participates in TADDIS with the Artificial Intelligence team of the Dept. of Informatics and Telecommunications. Its exploitation strategy in TADDIS is to scale up its flagship geospatial systems GeoTriples, JedAI, Strabon and Ontop-spatial so that they scale to TBs of diverse data from the sources envisioned in the project. The long-term exploitation plan of the team creates a startup that will utilize its systems in geospatial applications.
UNITN	UniTN is a public university and participate in TADDIS with the Remote Sensing Laboratory at the Dept. of Information Engineering and Computer Science. The exploitation strategy consists in enhancing the large experience in remote sensing, machine learning and data fusion toward the development of a multisensor and multisource deep classification architecture. This architecture can be used in many different application domains and thus can enable in mid/long term different spin-off activities.

2.2.3.8 Joint exploitation by groups of partners

Exploiting all outputs of the TADDIS project as a whole can be, due to multi-disciplinary concept and consortium, hard. To strengthen the exploitation potential, in addition to individual exploitation plans, TADDIS expects the development of joint exploitation strategies by groups of partners that can mutually benefit from a cooperative scheme. In particular, we anticipate potential collaborations between industries and technical partners to create new products and services (e.g., between UNITN and SERCO for Deep Learning of EO data; UoA and CERTH for semantic enhancement of Big Data; CERTH and EXUS for AI workflows for Deep Learning pipelines) while existing collaborations with be strengthened (SERCO and CERTH; EVERIS and CERTH; UPC and BSC in the frame of PUC2; NOA, PMOD and IPTO in the frame of PUC3). TADDIS will put forward an effective IPR management (Section 2.2.4.2) with pre-reviewed agreement templates to foster such synergies. Moreover, consortium SMEs (e.g., ACCELLI, EXUS and XLAB) will be encouraged to build innovative business solution on top of TADDIS or identify market opportunities to spin out a component and try to monetize it. Deliverables DX.X and DX.X will provide the reporting and also trigger ideas of possible collaborations.

2.2.4 Data management plan

2.2.4.1 Management of Data

TADDIS users will be asked to sign a Data Processing Agreement before they are granted any access to the project's data. This will ensure them a personal, non-transferable and non-exclusive license for the use of TADDIS data in compliance with applicable data protection legislation. Additionally, all the data collected, produced, and processed throughout the project will be managed in accordance with the guidelines of the EC, which will be further elaborated in several Data Management Plans in a dedicated task Task 1.4.

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Exchange of data among the partners: As a precautionary measure that aims at preventing any personal data exchange within the consortium, other than Personal Data of individuals involved in the Project, it is the partner's intention to introduce the following clause in the Consortium Agreement:

(a) The Parties may share Personal Data of individuals involved in the Project for the purpose of administering the CA or the GA for example, name, business telephone, address, email ("Business Contact Information"). The Parties agree that the Business Contact Information will only be processed to the limited extent required to manage the business relationship between the Parties. Each Party, its Affiliated Entities, and its contractors may, wherever they do business, store and otherwise process such Business Contact Information. Where notice to or consent by the individuals is required for such processing, each Party, as applicable, will notify and obtain such consent.

(b) Each Party confirms that any Background, Results, Confidential Information and/or any and all data and/or information that is provided, disclosed or otherwise made available between the Parties during the implementation of the Action and/or for any Exploitation activities ("Shared Information"), shall not include Personal Data as defined by the General Data Protection Regulation 2016/679 hereinafter referred to as the Data Protection Legislation except Business Contact Information.

(c) Accordingly, each Party who provides or otherwise makes Shared Information available to any other Party, ("Contributor") represents that, as per applicable Data Protection Legislation: (i) it will ensure that, all data and information contained in Shared Information, excluding Business Contact Information, is anonymised such that it is no longer Personal Data, prior to providing the Shared Information to such other Parties; (ii) it has the authority to disclose the Shared Information, if any, which it provides to the Parties under this CA; (iii) where legally required and relevant, it has a legal ground, all licenses and consents, to provide the Shared Information; and (iv) there is no restriction in place that would prevent any such other Party from using the Shared Information for the purpose of this Action and the exploitation thereof. The Parties acknowledge that each Contributor has no obligation to review the Shared Information provided by either Party to determine if the Shared Information contains any additional Personal Data beyond the Business Contact information. However, if either Party becomes aware of any additional Personal Data provided by the other Party, it will delete it or return the Personal Data.

(d) Additionally, each Party shall communicate to the other Parties, without undue delay any anticipated change affecting sections (b) or (c) above. In case any of the Parties are expected to exchange Personal data, then prior to such exchange, such Parties will agree on and enter into data processing agreement, which shall (i) specify which Parties are expected to exchange Personal Data, (ii) reflect such Parties obligations and risks under the Data Protection Legislation and (iii) enable such Parties to comply with their respective obligations under the Data Protection Legislation.

2.2.4.2 Intellectual Property Rights (IPR) strategy

IPR will be handled in line with EC policies regarding ownership, exploitation rights, confidentiality and commercial utilisation of results to other EU funded projects and disclaimer rules. An open strategy has been chosen to foster exploitation. All Consortium partners will bring in their expertise and background knowledge without charging cost and will retain full ownership of the IPR of this expertise and knowledge. Individual license per software module is presented in Section 2.2.3.4. After the project end, a stable version of the TADDIS platform will be licensed free of charge to the end-user partners of the project who will have evaluated its functionalities. Those partners will use TADDIS for the purpose it was created for, without being able to commercialise or disclose confidential information. Additional information regarding the IPR management and Consortium Agreement is provided in Section 3.2.6.

2.2.4.3 Knowledge management

Project knowledge will be encapsulated in documents, publications, presentations and software. The overarching principle is to maximise the positive impact of the project during and after its duration by the widest possible access to this knowledge. The detailed strategy for the management of knowledge follows: (i) *Project Documents:* TADDIS formal documents related to deliverables and milestones will publish their public parts on the Website and systematically archive them in an Open Access repository. Final versions will be publicly released under a Creative Commons license for maximum reuse of their content; (ii) *Project Reporting:* TADDIS will prepare periodic progress reports, required by the EC, and concise summaries after each development's iteration ("sprint"). The reports may contain financial or other sensitive information, so they will not be public as a whole. Sprint summaries will be posted on the Website, while press releases and announcements will present project advances described in the reports; (iii) *Publications:* Publications based on work in TADDIS will be submitted to journals and conferences. There is a specific emphasis on open-access journals, as required by the EC. To realise Open Access publishing, we have reserved a budget of €12,000 which corresponds to approximately 6 open access publications (mainly from CERTH, UoA and UNITN). If partners need to submit their work to publications with a lower level of open-access, requiring parallel publication or an embargo period, this option will be evaluated on a case-by-case basis and benefits will be balanced against the less convenient or delayed access to the result; (iv) *Presentations:* TADDIS presentations will

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be made public through the project Website and posted in a public service like SlideShare. They will all be licensed via a Creative Commons license to maximise knowledge reuse.

3 IMPLEMENTATION

3.1 Work plan — Work packages, deliverables and milestones

3.1.1 Work packages

Table 3.1:List of work packages

WP No	Work Package Title	Lead Partic. no.	Lead Partic. Short Name	PMs	Start Month	End month
WP1	Project Management and Coordination	1	EVR	46.5	1	36
WP2	User Requirements, Use Cases Design and Ethical Dimensions	5	SERCO	50	1	32
WP3	Data Acquisition and Indexing of Big Data Streams	4	UPC	78	1	30
WP4	Extreme-scale Machine Learning/Deep Learning	3	CERTH	114	3	32
WP5	Extreme-scale Predictive Analytics	12	EXUS	86	3	32
WP6	Extreme-scale Content Enrichment	14	UoA	108	1	32
WP7	System Architecture, Integration and Interactive Visualization techniques	13	EVRPORT	77	1	32
WP8	Pilot Implementation, Evaluation and Training	10	PMODWRC	94.5	13	36
WP9	Impact Creation, Dissemination and Exploitation	1	EVR	59	1	36
	TOTAL			**713**		

3.1.2 Overall structure of the work plan

3.1.2.1 Mapping of Innovation Objectives and Activities to WPs

SO1						SO2				SO3				TO1				TO2	
RA1.1: AI workflows on structured data	RA1.2: Deep learning in multimedia data	RA1.3: Deep learning pipelines to drive efficient radiative transfer model inversion	RA1.4: TADDIS Data Distribution Through Federated Learning	RA1.5: Modelling and monitoring ship traffic atmospheric emissions	RA1.6: Deep learning in multisensor and multisource Earth Observation data	RA2.1 Data stream clustering and similarity search in extreme-scale data collections	RA2.2: Predictive analytics models	RA2.3: Solar Energy short-term forecasting from satellite data	RA2.4: TADDIS Intelligent Analytics Platform (TADDIS INAP)	RA3.1: Ontology development	RA3.2: Ontology population, data harmonisation, fusion and linking	RA3.3: Semantic search and querying	RA3.4: TADDIS Autonomous Decision-Making system	TA1.1: EO data collection and quality control from the Copernicus and DIAS	TA1.2: Ship emission activity based on real-time AIS data	TA1.3: Collection of online content (e.g. CCTV information from vessels)	TA1.4: TADDIS Big Data Operations Fusion Engine	TA2.1: TADDIS platform architecture, development and integration	TA2.2: TADDIS interactive UIs & dashboards
WP4						**WP5**				**WP6**				**WP3**				**WP7**	

3.1.2.2 Mapping of User-Oriented and Impact-Making Objectives and Activities to WPs

UO1		UO2			IMO1		IMO2		
UA1.1: Use case creation and end-user requirements definition	UA1.2: Ethical and legal dimensions	UA2.1: Development of the validation scenario and evaluation methodology	UA2.2: User Training	UA2.3: Pilot deployment, simulations and user evaluation	IMA1.1: Disseminating project results	IMA1.2: Synergies with other H2020 Big Data projects and Big Data initiatives	IMA2.1: Analysis of the market for existing solutions	IMA2.2: Exploitation and innovation management plans for the proposed tools	IMA2.3: Sustainability plan for project outcomes and Intellectual property (IP) protection
WP2		**WP8**			**WP9**				

3.1.3 Work package descriptions

WP No	**WP1**				**Start month:**				**1**		**End month:**		**36**			**EVR**
WP title	**Project Management and Coordination**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**46.5**
PMs	**31**	**0.5**	**3.5**	**0.5**	**0.5**	**0.5**	**0.5**	**5.5**	**0.5**	**0.5**	**0.5**	**0.5**	**1**	**0.5**	**0.5**	
Objectives: The aim of this WP is to manage the project to time and budget; to coordinate the activities; to monitor and adjust the implementation plan if necessary; and to monitor the data management activities.																

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Task 1.1 Project Management & Coordination (M1-M36) [Lead: **EVR: 9PMs**; Participants: BSC: 0.5PMs; CERTH: 0.5PMs; UPC: 0.5PMs; SERCO: 0.5PMs; NOA: 0.5PMs; ACCELI: 0.5PMs; XLAB: 0.5PMs; IPTO: 0.5PMs; PMODWRC: 0.5PMs; ANEK: 0.5PMs; EXUS: 0.5PMs; EVRPORT: 1PMs; UoA: 0.5PMs; UniTN: 0.5PMs], D1.1

This task is responsible for carrying out the coordination and planning activities needed to manage and coordinate the project, namely the definition, implementation and monitoring of the appropriate procedures for quality assurance, the implementation of scientific quality assurance, the coordination of activities between the research and technological development work packages, the assessment of work and achievements of the deliverables, the monitoring of the project plan and the related activities, the management of project risks and associated contingency planning, the organisation of the management and technical committee meetings and AB.

Task 1.2 Project Administration, Reporting and Financial Management (**M1-M36**) [Lead: **EVR:9PMs**], D1.3, D1.5

This task is responsible for providing administration and financial management of the project. Administrative activities include the management of intellectual property rights (IPR), the data protection and the generated knowledge, the Management and monitoring of compliance with obligations under the EU Commission Grant Agreement, the formation and management of Project Management Board (PMB) and AB, the establishment and management of intra-project communication and information networks (PMB and AB), the management and monitoring of the resources use and financial expenditures, the maintenance of records and financial accounts compliant with time frames, the compilation of partner inputs to management and contractual reports, the definition, implementation and monitoring of the appropriate procedures for quality assurance and the formal management of reporting to Commission.

Task 1.3 Quality Assurance, Ethical and Risk Management (**M1-M36**) [Lead: **EVR: 7PMs**; Participants: CERTH: 3PMs; XLAB: 2PMs], D1.3, D1.5

The aim of this task is to: i) develop the quality assurance guidelines for research and development carried out within the project; and ii) detect risks and take corrective action as necessary. This task will set up: (a) a quality assurance plan for the project, which will ensure the quality of deliverables and monitor the quality of the technical work; and (b) a shared risk log, containing descriptions, analysis and strategies for reducing risk in the project, which will be maintained by the PM team and regularly updated. The task will be responsible for ensuring that the project's developments are compliant with existing ethical standards and guidelines.

Task 1.4 Data management plan (**M1-M36**) [Lead: **EVR:6PMs**; Participants: XLAB: 3PMs], D1.2, D1.4

This task will aim at monitoring the generated or collected data regarding their privacy and confidentiality, ensuring that the standards used for data generation, use, storage, and share are applied throughout the project, as well as that technical standards are applied for data representation. The task will also determine the data that can and will be shared in the open data initiative. A Data Management Plan will be created within Task 1.4, outlining how the generated or collected data will be handled during the project, as well as after its completion. The Data Management Plan will be provided in M6 (D1.2) and will be updated throughout the task (D1.3, D1.4, D1.5).

Deliverables

D1.1 [Lead: **EVR**; due **M3**; contribution: **MS1**] **Project management and quality assurance plan** will define: (i) the guidelines followed by partners to ensure high quality research, development and reporting; (ii) measures to be taken in case of detected or prognosticated quality flaws; (iii) quality assurance responsibilities.

D1.2 [Lead: **EVR**; due **M6**; contribution: **MS1**] **Self-assessment & data management plan v1** will outline the assessing plan of project objectives, with quantitative measures and indicators where appropriate, summarised through a series of tables. In addition, the report will describe the data requirements for supporting the project's R&D activities, along with a concrete plan of making different sets of data available to the Consortium. In addition, D1.2 will include an IPR plan reporting on the IPR related issues as agreed by all consortium members.

D1.3 [Lead: **EVR**; due **M18**; contribution: **MS3**] **Mid-term review & progress report** will document: (a) the TADDIS objectives; (b) a summary of the project's results in terms of scientific and technological achievements and dissemination actions during the first period; (c) a summary of provided research ethics guidelines and recommendations so as the project's result be compliance with national or EU regulations.

D1.4 [Lead: **EVR**; due **M24**; contribution: **MS4**] **Self-assessment & data management plan v2** will define: (a) a revised assessment plan, based on the experience gained until M24, and monitoring the evolution of project requirements and objectives; (b) the implementation of the plan per objective; (c) an updated data management report specifying the data that are available to Consortium members at the end of the second project year.

D1.5 [Lead: **EVR**; due **M36**; contribution: **MS5**] **Public final activity report** will present: (a) the TADDIS objectives; (b) a summary of the project's results in terms of scientific and technological achievements and dissemination actions; (c) the impact achieved during the project; (d) the final report of the data management and final release of the TADDIS data and access mechanisms to the Consortium members.

WP No	**WP2**					**Start month:**			**1**		**End month:**		**32**			**SERCO**
WP title	**User Requirements, Use Cases Design and Ethical Dimensions**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**50**
PMs	**0**	**4**	**0**	**4**	**13**	**6**	**0**	**12**	**4**	**2**	**3**	**1**	**1**	**0**	**0**	

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Objectives: Three principal objectives underpin this Work Package. Firstly, this WP will aim to engage the end-users in an effective process to design the use cases. Secondly, based on these outcomes the user requirements in terms of technological/research aspects are determined turning them into specifications of the TADDIS platform. Finally, this WP will consider, from an early stage of the project, the ethical and legal requirements of the envisioned platform, formulating the appropriate framework.

Task 2.1 End-user, business requirements and stakeholder engagement (**M1 – M6**) [Lead: **SERCO: 5PMs**; Participants: BSC: 2PMs; UPC: 2PMs; XLAB: 2PMs; IPTO: 2PMs; PMODWRC: 1PMs], D2.1

This task will engage end users to define user requirements for exploiting the Big Data platform and its modules and co-design use cases, by advancing those initially drafted in the proposal. For this purpose, a co-design workshop will be organised between M3 and M5 supported by design-thinking techniques and a set of interviews to engage end users to analyse their needs and therefore the related business requirements for the whole platform, each project outcomes, (including the expected minimum TRL level which to be achieved by each outcome) and the added-value services. Stakeholders will also be engaged and kept informed.

Task 2.2 Pilot use case specifications and design (**M1 – M14**) [Lead: **NOA: 6PMs**; Participants: BSC: 2PMs; UPC: 1PMs; SERCO: 4PMs; IPTO: 2PMs; PMODWRC: 1PMs; ANEK: 3PMs; EXUS: 1PMs], D2.3

The creation of a set of the use case scenarios will be the main goal of this task. Specifically, during this task, under guidance of NOA and the support from SERCO, BSC, UPC, PMODWRC and ANEK will identify (a) the exact extent of the pilot areas; (b) the use cases to be addressed by the project, capturing extremely the interest of the final users in order to collect as many needs as possible – within this activity following items should be defined the problem as a storyline - actors involved - UML diagrams produced.

Task 2.3: Ethical and legal dimensions(M1-M32) [Leader: **XLAB: 10PMs**; Participants: UPC: 1PMs; SERCO: 4PMs; EVRPORT: 1PMs], D2.2, D2.4

This task will consider the ethical and legal requirements both for the developed system and for the ongoing compliance of the project R&D activities. First, we will produce a preliminary guide covering the ethical, societal, and legal issues associated with the development, testing, and the use of the TADDIS system. This work will be done considering relevant international and European legal frameworks governing protection of (personal) data, associated national legislation of those countries where the TADDIS pilots will be run, relevant ethical standards and guidelines for the responsible use of big data and AI, academic publications, and stakeholder insights. Specifically, the work in this task will comprise: (1) The analysis of TADDIS data flows and identification of associated legal and ethical risks; (2) Iterative consultation with relevant (internal and external) stakeholders (e.g., technical experts, lawyers, civil servants, privacy advocates, citizens, human rights experts as well as others) to validate step 1 and suggest additional aspects for consideration; (3) Definition of organizational and technical measures addressing the identified legal and ethical risks; (4) Continuous collaboration with project partners to implement them. Step 2 will initially be achieved through an interactive half-day workshop (in conjunction with the User Requirements workshop - Task 2.1) and will continue with follow-up interviews and virtual interactions. The task will build on these activities to inform the user requirements (WP2) and provide guidance on how to implement the pilot use cases with respect to potential risks and impacts (WP7).

Deliverables

D2.1 [Lead: **SERCO**; due **M6**; contribution: **MS1**] **Use cases and requirements v1**. It will summarize the use cases design as well as user-centric, technological, and business requirements. The document will also report the initial, baseline ethical, and legal requirements.

D2.2 [Lead: **XLAB**; due **M10**; contribution: **MS2**] **Preliminary ethical and legal assessment**. This deliverable will document the initially identified ethical and legal aspects of the TADDIS R&D activities and results and provide a guideline for consortium partners on how to address them throughout the project.

D2.3 [Lead: **PMODWRC**; due **M14**; contribution: **MS3**] **Final use case specification and design**. It will provide the updated PUCs including the respective user, legal, and ethical requirement based on the 1st prototype evaluation.

D2.4 [Lead: **XLAB**; due **M32**; contribution: **MS5**] **Final ethical and legal assessment**. This report will elaborate on the ethical and legal dimensions and impacts of the TADDIS results and trials.

WP No	**WP3**					**Start month:**			**1**		**End month:**		**30**		**UPC**	
WP title	**Data Acquisition and Indexing of Big Data Streams**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**78**
PMs	**0**	**6**	**12**	**14**	**11**	**4**	**0**	**7**	**0**	**0**	**7**	**12**	**0**	**3**	**2**	

Objectives: The main goal of this WP is to collect and index the Massive Amounts of Diverse Data streams of TADDIS.

Task 3.1: Extreme scale data storage and indexing of Earth Observation data (**M1 – M28**) [Lead: **SERCO:11PMs**; Participants: BSC: 3PMs; NOA: 4PMs; UoA: 3PMs; UniTN: 2PMs], D3.1, D3.2, D3.3

TADDIS guarantees the efficient access to huge volumes of data, automation of dataflow through advanced APIs, large economies of scale for storage and computing, Cloud services, and hoc Engineering Services if needed. The recent advances of the DIAS infrastructure are expected to be interoperable, not only with TADDIS use cases and Earth Observation data, but any nature of extreme-scale datasets could be indexed and processed on the cloud. The ONDA DIAS data offer consists of data collections available, both online and offline, through the DIAS data access services (https://www.onda-dias.eu/).

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Task 3.2: AIS data collection (**M1 – M28**) [Lead: **UPC: 12PMs**; Participants: BSC: 3PMs; XLAB: 7PMs; ANEK: 3PMs], D3.1, D3.2, D3.3

Original AIS data, which is based on very high frequency radio transmissions, will be collected through a receiving station located at the Department of Nautical Sciences and Engineering at the Barcelona School of Nautical Studies (UPC-BarcelonaTech). The location of the station allows monitoring all the shipping activity within the Port of Barcelona and around 120 nautical miles. The raw AIS radio messages captured by the station will be decoded in order to convert them to a more human-friendly format and derive the following information for each ship and time step a unique identification number for each vessel AIS station, a unique identifier for each ship, the year, month, day, hour and second field of the UTC time when the AIS message was sent, description of the ship type and the cargo carried by the ship, geographic position coordinates, description of the engine activity (e.g hotelling, maneuvering, cruising), real time velocity of the ship, real time turning velocity of the ship, length, beam and draft of the ship.

Task 3.3: Crowdsourcing data and CCTV indexing of information from vessels (**M1 – M28**) [Lead: **CERTH:12PMs**; Participants: UPC: 2PMs; ANEK: 4PMs], D3.1, D3.2, D3.3

This task will develop an indexing mechanism to collect multimedia data from visual and other multimodal content, which is relevant to the TADDIS use cases. Two main directions are considered: a) video streams from CCTVs on vessels, and b) social data from passengers on-board during the voyage. To that end, an API will be developed to acquire the data from the edge nodes and from online social media platforms, when relevant, for populating a MongoDB (https://www.mongodb.com/) collection. For the social media data, location-based search will be combined with keyword-based search and the results will be fused with visual content from cameras on the ship. On top of the collected multimedia data, AI technologies will be developed in WP4.

Task 3.4 Development of the Big Data Operations (DataOps) Fusion Engine (BIDOFE)(M3 – M30) [Lead:**EXUS**:**12PMs**], D3.4

EXUS will deploy a Big Data collection framework for collecting, parsing, integrating and formatting heterogeneous data of different size, shape, velocity and quality. A 2-Tier data workflow model infrastructure will be developed, that will include i) A distributed server cluster with MapReduce capabilities and microservices set up with Docker, Jenkins and Kubernetes orchestration and ii) TADDIS Open APIs, Software Scripts for data exploitation to 3rd parties. The latter will entail i) connectors via APIs for TADDIS interfaces for raw data gathering; ii) development of Big Data wrangling/data munging algorithms for transforming and structuring data from raw data form into a unified format (e.g. XML, JSON); iii) development of data cleaning algorithms for filtering of unwanted characters; iv) data enrichment for merging third-party data from an external authoritative sources; v) Data validation routines for ensuring data quality; vi) Publication of Data process to a data middleware stack via APIs or Message Brokers (e.g. Through Apache Kafka) that will be consumed from other TADDIS tools. The entire data deriving from TADDIS tools and sensors will be pre-processed and stored to the Data Middleware Stack (DMS). The Big Data infrastructure that will be built can exploit heterogeneous cluster of compute resources for data-parallel processing of high volume and velocity data based on Apache Spark and will offer robust partitioning techniques for data-parallel processing of heterogeneous, multimodal data. For the Data Stream Processing the Apache Flink will be used. The Big Data will offer: (i) online data receiving and storing, (ii) data insights through searching, querying and visualizing metadata and (iii) scaling, tuning, recovering & security.

Deliverables

D3.1 [Lead: **SERCO**; due **M9;** contribution: **MS2] Initial data collection processes**. This deliverable will report on the initial versions of the techniques for data collection from heterogeneous sources (EO and AIS data, multimedia data from visual and other multimodal content) in TADDIS.

D3.2 [Lead: **UPC**; due **M14;** contribution: **MS3] Initial data storage and indexing processes**. D3.2 will describe the initial version of the layer for indexing, storing, replicating and caching all data acquired within TADDIS.

D3.3 [Lead: **CERTH**; due **M28**; contribution: **MS4] Final data indexing processes**. This deliverable is the final report on the techniques for indexing data from heterogeneous sources in TADDIS.

D3.4 [Lead: **EXUS;** due **M30;** contribution: **MS4] Report on Big Data Operations (DataOps) Fusion Engine (BI-DOFE).**Final report which includes the techniques for collecting, parsing, integrating and formatting heterogeneous data of different size, shape, velocity and quality.

WP No	**WP4**				**Start month:**				**3**		**End month:**		**32**		**CERTH**	
WP title	**Extreme-scale Machine Learning/Deep Learning**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**114**
PMs	**0**	**18**	**31**	**0**	**0**	**20**	**0**	**7**	**0**	**1**	**0**	**16**	**0**	**0**	**21**	

Objectives: The main goal of this WP is to encompass the innovative extreme-scale machine/deep learning methodologies for analysis EO and no-EO data in the HPC environment.

Task 4.1: AI workflows on structured data (**M3 – M30**) [Lead: **EXUS:16PMs;** Participants: UniTN: 2PMs], D4.1, D4.5

EXUS with the support of CERTH will develop a virtual platform where users will be able to create Machine Learning pipelines with simple drag and drop functions. In the right panel a series of the most common predefined sub-components will exist that are needed for the creation of the workflow. E.g. Datasets, DataOps (Data Conversions, Data Transformation, Data cleaning etc.), feature selection, common AI algorithms, statistical functions, text analytics. In the left panel a virtual canvas will exist where users will drag and drop components, editing them with the appropriate values and connecting them with arrows for the transmission of information. Regarding input from sensors the platform will have a dual role: i) It will

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offer the capability of creating virtual sensors simulating their generation of data where users could set the type of data, time-rate of measurement and value limits. This ability of the platform is expected to reduce the overall time of complex IoT architectures ii) It will be interconnected with the BIDOFE connecting with data from real sensors, while it will be the basis of the 3 pilot-demonstrations. Users will create their experimental AI workflows either by using existing predefined sub-components or by inserting their own code or executables. This Lego-like virtual platform will bridge the gap between hardware designers, Data Scientists/Engineers, ML Engineers/Scientists and will reinforce rapid development and prototyping. A microservices approach will be followed throughout the entire platform. The Open Source Kubeflow will be used for the creation of Machine Learning Pipelines on Kubernetes portable and scalable while the Apache Airflow will be used as the workflow manager across different DataOps and DevOps. Each "experiment" when finished it would be generated as an autonomous package (it will have its own container) and will have each own API in order to be consumed from other 3rd party services.

Task 4.2: Deep learning in multimedia data (**M3 – M30**) [Lead: **CERTH:14PMs;** Participants: XLAB: 7PMs], D4.2, D4.6

Task 4.2 includes all the relevant activities that are required for developing AI functionalities on top of the multimedia data of Task 3.3. Air pollution will include the analysis of optical information for threat assessment, when the target substances are visible and often lead to colorisation and blurring in parts of videos or images. Deep Convolutional Neural Networks will be mostly investigated while alterations in various architectures will be tested on multimodal data (Moumtzidou et al., 2016).

Task 4.3: Deep learning in multisensor and multisource Earth Observation data (**M3 – M30**) [Lead: **UniTN:16PMs**], D4.2, D4.6

Task 4.3 includes all the relevant activities that are required for developing a deep network architecture that can integrate multisensor and multisource EO data for solving automatic classification problems. The activity will include the following steps: (1) identification and analysis of candidate deep techniques (e.g. based on Convolution Neural Networks, Residual Deep Networks, Recurrent Deep Networks, Convolutional LSTM, Generative Adversarial Networks) considering multisensor architectures presented in the machine learning literature and possible novel solutions; 2) definition and implementation of a deep architecture suitable to the characteristic of the considered kind of data; (3) training of the architecture, test and validation of the classification performances on benchmark data.

Task 4.4: Deep learning pipelines to drive efficient radiative transfer model inversion (**M3 – M30**)[Lead: **NOA:20PMs**; Participants: PMODWRC: 1PMs], D4.4

In this task, under NOA's responsibility, we will design and implement novel deep learning architectures based on big satellite data to solve the inverse problem of a Radiative Transfer Model (RTM). The task will a) develop tools for fusing multi-modal satellite/Copernicus data for nowcasting critical RTM variables; b) advance to a new hybrid approach in which we use deep learning to forecast some of the input parameters of a physical model, such as the RTM; and c) create new mappings for the inverse RTM problem based on deep learning pipelines.

Task 4.5: Federated learning (**M3 – M30**) [Lead: **CERTH:14PMs**], D4.3, D4.7

In this task, under CERTH responsibility, we will design and implement novel federated learning architectures aiming to optimize the data distribution and model's training on multi – node systems. The task will investigate state of the art federated learning techniques in order to enable and facilitate neural network and model training in WP4. Based on the requirements derived from system integration, and each use case, a special focus will be put upon the ideal implementation strategy to distribute individual resources and deployment strategies. Moreover, in this task, we will focus on the smooth and undisrupted data transfer between local and global layers of each use case. The TADDIS Federated Learning Tool will be based on Local4Global Architecture, developed on previous CERTH projects, focusing on the distributed and decentralised information.

Task 4.6: Algorithm optimisation and analytics on HPC environment (**M3 – M32**) [Lead: **BSC:18PMs**; Participants: CERTH: 3PMs; UniTN: 3PMs], D4.8

This task aims at optimizing the project's AI workflows in terms of serial and parallel performance. For this purpose, the following aspects will be targeted: (i) high algorithmic performance; (ii) high sustained serial performance; and (iii) parallel scalability and efficiency. The task will investigate traditional HPC methodologies, such as efficient programming paradigms in conjunction with individualised programming models. Once the threat detection algorithms are developed and initially implemented by Task 4.2, a benchmarking and profiling suite will be developed with the aim to constantly monitor the targeted aspects, given above, for every scale of the application and individual infrastructure. This will include the critical evaluation of the chosen implementation language, the chosen programming paradigms like e.g. vectorisation and object orientation as well as a careful choice of the applied parallelisation paradigm and strategy. Based on the requirements derived from system integration, a special focus will be put upon the ideal implementation strategy to facilitate individual resources and deployment strategies, such as regular local deployments for monitoring or remote deployment on centralized resources.

Deliverables

D4.1 [Lead: **EXUS**; due **M14**; contribution: **MS3**] **AI workflows on structured data v1**. This deliverable will document the initial versions of the AI functionalitiesand techniques enable to create AI pipelines.

D4.2 [Lead: **UniTN**; due **M16**; contribution: **MS3**] **Machine/deep learning methodologies v1**. This deliverable will report the initial versions of the machine/deep learning neural networks for analysis data with multimedia and EO (satellite) content.

D4.3 [Lead: **CERTH**; due **M18**; contribution: **MS3**] **Federated learning tool v1**. This deliverable will describe the initial approaches of federated learning techniques in order to enable and facilitate neural network and model training to handle massive and diverse data.

D4.4 [Lead: **NOA**; due **M22**; contribution: **MS4] Radiative Transfer Model Inversion in TADDIS**. This deliverable describes the innovative hybrid approach enable to deal with the inverse problem of a Radiative Transfer Model efficiently.

D4.5 [Lead: **EXUS**; due **M26**; contribution: **MS4] AI workflows on structured data v2**. This deliverable will document the advance AI methodologies that will be encapsulated in order to create powerful AI workflows.

D4.6 [Lead: **CERTH**; due **M28**; contribution: **MS4**] **Machine/deep learning methodologies v2**. This deliverable will report the advanced versions of the machine/deep learning neural networks for analysis massive and diverse data.

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D4.7 [Lead: **CERTH**; due **M29**; contribution: **MS4**] **Federated learning tool v2**. This deliverable will describe the advanced techniques for federated learning.
D4.8 [Lead: **BSC**; due **M30**; contribution: **MS4] Optimisation algorithms on HPC environment**. This deliverable describes the final version of HPC methodologies enable to optimize the performance of AI workflows.

WP No	**WP5**				**Start month:**				**3**		**End month:**		**32**		**EXUS**	
WP title	**Extreme-scale Predictive Analytics**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**86**
PMs	**0**	**0**	**21**	**0**	**0**	**12**	**0**	**18**	**0**	**12**	**0**	**20**	**0**	**0**	**3**	

Objectives: The main goal of this WP is to encompass the innovative predictive analytics methodologies for analysis extreme-scale data streams on the HPC environment.

Task 5.1: Data stream clustering and similarity search in extreme-scale data collections (**M3 – M30**) [Lead: **CERTH: 18PMs**; Participants: EXUS: 2PMs], D5.4
The purpose of this task is two-fold. Firstly, Task 5.1 groups together highly heterogeneous information of multiple modalities into clusters, where the intra-cluster items have similar content and inter-cluster items refer to different concepts or events. This task will adapt existing or develop new clustering algorithms to allow for a co-clustering of raw measurements, visual and spatiotemporal information, in a density-based approach. Algorithms will be designed on Hadoop and executed on the cloud infrastructure, aiming at linear computational and memory complexity, in order to support the management of Big Data collections. Secondly, Task 5.1 develops an effective but scalable search engine, where complex and multimodal queries are used to retrieve information in Big Multimedia Data collections. The navigation in a Big Data collection is also supported by efficient and effective real-time similarity search to retrieve similar-to-a-query results.
Task 5.2: Predictive analytics models (**M3 – M30**) [Lead: **XLAB: 18PMs**; Participants: CERTH: 3PMs; EXUS: 2PMs; UniTN: 3PMs], D5.1, D5.5
The objective of this is to develop predictive analytics models where vast amounts of heterogeneous data can be efficiently processed to extract meaningful information to tackle specific use case challenges, as well as provide a set of best practices, templates and tools to solve genetic predictive tasks. Exploratory data analysis tools will be developed to extract actionable insights for stakeholders and decision makers and will be used to develop efficient predictive and forecasting methods. Although all relevant predictive models will be considered, the emphasis is on the development of unsupervised approaches, in order to minimise the reliance on manually labelled data. Reliance on manually labelled data is one of the main obstacles for the development of efficient predictive models.
Task 5.3: Solar Energy short-term forecasting from satellite data (**M3 – M30**) [Lead: **PMODWRC: 12PMs**; Participants: NOA: 12PMs], D5.2, D5.6
In this task, under PMODWRC's responsibility, we are aiming to: a) demonstrate the SENSE and nextSENSE (nowcasting/short term forecasting) solar energy system to a pan European and North African Domain in real time in order to demonstrate the operational capabilities of the system and to assess the technical aspects for integrating the system in large domains; b) Evaluate the nextSENSE solar radiation and energy related parameters against solar radiation products (GHI) with in situ (BSRN) ground based station measurements; c) To co-design the solar energy real time outputs with the involved end users (IPTO, ENEL) using real time information on the national (Greek) solar energy demand aiming to the optimization of the solar energy part in the total energy mix.
Task 5.4 Development of the TADDIS Intelligent Analytics Platform (TADDIS INAP) (**M3 – M32**) [Lead: **EXUS: 16PMs**], D5.3, D5.7
EXUS will deploy a dedicated Big Data Analytics Web Platform to TADDIS to monitor in real time insights regarding TADDIS sensors measurement. The platform will provide: i) The capability of time series prediction in real time for different measurements ii) Rich visual analytics with Time-Series, Pie Charts, Heatmaps, Map-information etc. to improve decision making for the three Pilot Demonstrator cases monitoring iii) AI forensics & predictive analytics

Deliverables

D5.1 [Lead: **XLAB**; due **M14**; contribution: **MS3**] **Predictive analytics models in TADDIS v1.** The first approaches of predictive analytics models will be reported in this deliverable.
D5.2 [Lead: **PMODWRC**; due **M12**; contribution: **MS2**] **Solar Energy short-term forecasting models v1**. In D5.2 the short-term forecasting models for solar energy demand along with their evaluation results will be presented.
D5.3 [Lead: **EXUS**; due **M13**; contribution: **MS3**] **TADDIS Intelligent Analytics Platform v1**. In D5.3 will contain the description of functionalities of the Intelligent Analytics Platform.
D5.4 [Lead: **CERTH**; due **M27**; contribution: **MS4**] **Data stream clustering algorithms in extreme-scale data collections.** In D5.4 the advanced approaches for clustering and similarity search extreme-scale data streams will be reported.
D5.5 [Lead: **XLAB**; due **M29**; contribution: **MS4**] **Predictive analytics models v2**. The advanced approaches of predictive analytics models will be reported in this deliverable.
D5.6 [Lead: **NOA**; due **M30**; contribution: **MS4**] **Solar Energy short-term forecasting models v2**. In D5.6 the enhanced short-term forecasting models for solar energy demand along with their evaluation results will be presented.
D5.7 [Lead: **EXUS**; due **M32**; contribution: **MS5] TADDIS Intelligent Analytics Platform v2**. In D5.7 will contain the description of final version of the Intelligent Analytics Platform.

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WP No	WP6					Start month:			1		End month:		32		UoA	
WP title	Extreme-scale Content Enrichment															
Part. No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Name	EVR	BSC	CERTH	UPC	SERCO	NOA	ACCELI	XLAB	IPTO	PMODWRC	ANEK	EXUS	EVRPORT	UoA	UniTN	108
PMs	0	0	24	0	2	8	17	0	0	1	3	14	0	36	3	

Objectives: The objectives of WP6 are to provide the necessary semantic knowledge structures for integration and enrichment of large-scale data coming from different sources (primarily in WP3) as well as data fusion and harmonisation, data interpretation, data management and exploitation of the outcomes of the WP4 and WP5 for effective decision making and Big Data analytics (Task 6.4).

Task 6.1: Development of the TADDIS ontologies (**M1 – M18**)[Lead: **ACCELI**, **6PMs**; Participants: CERTH: 2PMs; SERCO: 1PMs; NOA: 2PMs; PMODWRC: 1PMs; ANEK: 3PMs; UoA: 6PMs], D6.1

In this task we will develop the TADDIS ontologies, one for each use case, based on the user requirements collected in WP2. We will use the Web ontology OWL2, the ontology development framework Protégé and well-known methodologies developed by Semantic Web researchers. The ontologies developed will be utilized in the work done in Tasks 6.2 and 6.3 and in the implementation of the three use cases.

Task 6.2: Ontology population, data harmonisation, fusion and linking of data (**M1 – M24**) [Lead: **UoA: 14PMs**; Participants: CERTH: 6PMs; NOA: 3PMs; ACCELI: 5PMs], D6.2, D6.5

This will include the identification and taking into account various application/domain specific knowledge representation formats, knowledge sharing mechanisms, distributed metadata storage models and metadata interoperability aspects. This task uses the ontological representation of Task 6.1 aiming to map the raw data (WP3) and the extracted knowledge (WP4 and WP5) into an RDF representation. RDF/OWL and linked data and necessary transformations will be exploited towards the flexibility and efficiency of various heterogeneous information models integration and knowledge sharing. Furthermore, this task will utilize the systems GeoTriples-Spark (Mandilaras et al. 2019) and JedAI of partner UoA (Papadakis et al. 2018) which will be extended for the data sources of TADDIS. GeoTriples will be used for transforming data from their legacy formats into RDF when this is appropriate. The most recent version of GeoTriples has been developed in H2020 project ExtremeEarth (co-ordinated by partner UoA) and has been shown to scale to TBs of data such as these of TADDIS. JedAI is currently enriched with geospatial functionalities in ExtremeEarth and we expect it to scale to TBs of geospatial data such as these of TADDIS. The main scientific contribution of this task will be extending JedAI to deal with spatiotemporal data (e.g., AIS data) that are important in TADDIS while retaining the same performance and scalability.

Task 6.3: Semantic search and querying (**M13 – M32**) [Lead: **UoA: 16PMs**; Participants:CERTH: 2PMs; NOA: 3PMs; ACCELI: 6PMs; UniTN: 3PMs], D6.3, D6.6

The objective of this task is to facilitate the management of data repositories of the TADDIS platform while offering expressive search and query functionalities. The semantic search layer will be based on open source search engine Elasticsearch which is well-known to scale to big data. Elasticsearch offers traditional Information Retrieval search functionality (e.g., keyword queries) and will be the basis for the discovery of TADDIS resources according to the specific end-user goals and task in hand. The semantic query layer will be built on top of systems Strabon (Kyzirakos et al. 2012) and Ontop-spatial (Bereta et al. 2019) of partner UoA. Strabon is currently reengineered in project ExtremeEarth and we expect it to scale to TBs of linked geospatial data such as these of TADDIS. Ontop-spatial is also a highly scalable system and will be used to integrate the diverse types of TADDIS spatiotemporal data using ontology-based data access techniques.

Task 6.4 Development of the TADDIS Autonomous Decision-Making system in industrial and societal applications (**M3 – M32**) [Lead: **EXUS: 14PMs**; Participants:CERTH: 14PMs; SERCO: 1PMs], D6.4, D6.7

TADDIS INAP will generate alerts, notifications & recommendations via a dedicated web service based on the data deriving as outcomes from the extreme-scale analytics Users of the system will be also able to export reports and save the shown graphs. User access roles will be created to distinguish admin/manager roles (different view of the system per user type) and improve the overall privacy and security for accessing the offered data. More specifically, the module will be revised accordingly so as to increase its flexibility within the strategy actuation process and fully-autonomously coordinate and optimize user-defined preferences as transformed and translated into optimization problem while in other cases will provide the recommended decisions and actions to the humans/operators/customers who, in turn, will decide whether to apply or customize such decisions and actions. Moreover, Decision Making tool will be tailored to fully adapt autonomy, intelligence and resilience.

Deliverables

D6.1 [Lead: **ACCELI**; due **M18**; contribution: **MS3**] **The TADDIS ontologies**. D6.1 describes the TADDIS ontologies which will be related with the use cases.

D6.2 [Lead: **UoA**; due **M12**; contribution: **MS2**] **Ontology population and data harmonization module v1**. D6.2 will cover the initial ontology population and data harmonization approaches of TADIS.

D6.3 [Lead: **UoA**; due **M15**; contribution: **MS3**] **Initial semantic search and query functionalities**. The deliverable will provide the initial techniques that will be developed in TADDIS for efficient semantic search and query.

D6.4 [Lead: **CERTH**; due **M14**; contribution: **MS3**] **Autonomous Decision-Making system v1**. D6.4 will describe the first version of the autonomous decision-making system.

D6.5 [Lead: **ACCELI**; due **M24**; contribution: **MS4**] **Ontology population and data harmonization module v2**. D6.5 will be an update of D6.2 and will report the final methodologies for ontology population and data harmonization of TADIS.

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D6.6 [Lead: **UoA**; due **M30**; contribution: **MS4**] **Final semantic search and query functionalities**. The deliverable will be an update of D6.3 providing the final versions of semantic search and query functionalities by focusing on the scalability properties and the utilization of diverse types of TADDIS spatiotemporal data.
D6.7 [Lead: **EXUS**; due **M32**; contribution: **MS5**] **Autonomous Decision-Making system v2**.D6.7 will be an update of D6.4 and will include the advanced characteristics and functionalities of the final version of the autonomous decision-making system.

WP No	**WP7**					**Start month:**			**1**		**End month:**		**32**			**EVRPORT**
WP title	**System Architecture, Integration and Interactive Visualization techniques**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**77**
PMs	0	4	6	1	2	1	1	2	0	1	1	5	49	2	2	

Objectives:WP7 objectives include: a) To plan the technological roadmap; b) To specify the entire architecture of the platform; c) To proceed with the integration of the mechanisms and tools (developed in WP3-WP6) comprising the overall TADDIS platform; (d) To specify and develop really interactive user interfaces following a User-Centred approach.

Task 7.1: Technical requirements, platform architecture and technical roadmap (**M1 – M9**) [Lead: **EVRPORT: 7PMs**; Participants:BSC: 1PMs; CERTH: 3PMs; UPC: 1PMs; SERCO: 1PMs; NOA: 1PMs; ACCELI: 1PMs; XLAB: 2PMs; EXUS: 2PMs; UoA: 2PMs; UniTN: 2PMs], D7.1, D7.2

This task includes the design of the technological roadmap for the development of the TADDIS platform. The roadmap will include a draft of the envisioned system architecture, and a technical overview of the different modules (WPs), together with a timeline and dependency map towards the implementation of the system. It will also encompass the testing and evaluation plan towards the delivery of the integrated TADDIS platform. More specifically, this task will define TADDIS technical requirements (D7.1) in compliance with Task 2.1 and Task 2.2. These will be allocated and translated to system design requirements, keeping their traceability.

Task 7.2: Platform development, system integration, deployment and maintenance (**M10 – M32**) [Lead: **EVRPORT: 24PMs**; Participants: BSC: 3PMs; EXUS: 3PMs], D7.3 - D7.5

Within this task, an integration plan will be prepared to guide the integration of the discrete framework's mechanisms and software components developed in WP3-WP6 so as to form the TADDIS platform that will be tested in all pilot use cases (WP8). The technical partners will propose a clear definition of the common data model, information exchange protocols and the components interfaces to ensure the harmonised data flow through all the components of the TADDIS platform. They will also come up with software maintenance policies (code maintenance tools, repositories, including version control systems) applying continuous integration software engineering technologies and methodologies, as well as a software quality evaluation toolset to extract software metrics and detect duplicated code, bugs, etc. The project will follow three cycles, namely the development, the integration and the testing cycle. The first implementation will be completed by M12 with the delivery of the first release of the integrated TADDIS platform. Then, the framework is tested in technical and user-centred terms in the demonstrators (WP8). The feedback provided will be used at the second development and integration cycle for further refinements and improvements till M20. A second evaluation phase will follow, providing feedback for the third and final release on M30 and evaluation on M32.

Task 7.3: Interactive User Interfaces (**M10 – M32**) [Lead: **EVRPORT: 18PMs**; Participants: CERTH: 3PMs; SERCO: 1PMs; PMODWRC: 1PMs; ANEK: 1PMs], D7.3 - D7.5.

Task 7.3 will build on the outcomes of Task 7.2 and work within the context of the reference architecture defined in Task 7.1. A User-Centered Design (UCD) approach will be applied based on five phases: (1) the analysis of the end users' personal background and work context; (2) the specification of requirements; (3) the design of the system; (4) the development of the interactive user interface; and (5) the final evaluation of the design with end users. In particular, in order to get an overall picture of the potential end users and their working environment, context analysis that helps to specify design and usability requirements that the interactive user interface should meet through interviews and meeting with staff from crisis management organisations. In the requirements specification phase, use cases and overall requirements for the Interactive User Interface will be derived from the results of the context analysis and further transformed into a specific qualitative requirement. Then design of a prototype of the GUI in form of paper mock-ups, including the GUI's dialogue structure, its main functionalities as well as a preliminary visualization of the simulation results will take place, which will be then be followed by the development phase (Service Design approach). EVRPORT will lead this task, supported by technical partners and end users.

Deliverables

D7.1 [Lead: **EVRPORT**; due **M8**; contribution: **MS2**] **Technical requirements and platform development roadmap**. This deliverable will detail the technical requirements that will be taken into account during the implementation of the TADDIS platform. It will describe the functionalities that will be supported by the platform. Finally, it will outline the system architecture that will be used for the implementation of the platform prototypes and its operational skeleton.

D7.2 [Lead: **EVRPORT**; due **M12**; contribution: **MS2**] **TADDIS system architecture definition**. This deliverable will encompass all technical aspects to be implemented by the system, as well as a description of the primary and secondary functionalities to be supported by the system. The deliverable also contains a description of the system architecture used to implement prototypes.

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D7.3 [Lead: **EVRPORT**; **due M12**; contribution: **MS2**] **1st Prototype of TADDIS System**. D7.3 describes the combination of all TADDIS modules ready for deployment in the 1st demonstration cycle. The 1st prototype version of TADDIS system will be reported, covering topics specified as objectives of MS2. It will also review the engineering and functional testing and evaluation of the integrated system.

D7.4 [Lead: **EVRPORT**; due **M20**; contribution: **MS3**] **2nd Prototype of TADDIS System**. D7.4 describes the combination of all TADDIS modules ready for deployment in the 2nd demonstration cycle. The 2nd version will report the second prototype covering topics specified as objectives of MS3. It will also review the engineering and functional testing and evaluation of the integrated system.

D7.5 [Lead: **EVRPORT**; due **M30**; contribution: **MS4**] **Final TADDIS System and Interactive User Interface**. D7.5 describes the combination of all TADDIS modules ready for deployment in the final (3rd) demonstration cycle. The 3rd version (final) of the system will be reported covering topics specified as objectives of MS4.This deliverable will also review the engineering and functional testing and evaluation of the integrated system.

WP No	**WP8**				**Start month:**				**13**		**End month:**		**36**		**PMODWRC**	
WP title	**Pilot Implementation, Evaluation and Training**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**94.5**
PMs	0	4	0	13	14	10	8	0	9	14	14	5.5	0	1	2	

Objectives: The objective of this WP are firstly to manage all preparatory actions for actual implementation of the pilot use cases; secondly describe the application-specific and comprehensive validation framework of TADDIS workflow and platform and finally present the end-users training processes.

Task 8.1: Development of the validation scenario and evaluation methodology (**M13 – M36**) [Lead: **SERCO: 5PMs**; Participants:BSC: 1PMs; UPC: 2PMs; NOA: 2PMs; IPTO: 2PMs; PMODWRC: 2PMs; ANEK: 5PMs; EXUS: 1.5PMs; UoA: 1PMs; UniTN: 1PMs], D8.1

In the framework of this task, an application-specific and comprehensive workload will be implemented in order to evaluate the TADDIS platform in terms of the 4V (Volume, Velocity, Variety, Veracity) Big Data properties. All edge and cloud capabilities of TADDIS will be tested via real exercises in which each scenario will be simulated involving technical and research partners and end users. In particular, the system will be tested, by running simulations with well-established evaluation protocols. Interviews and questionnaires will be carried out to identify subjective preferences of decision makers.

Task 8.2: User training (**M13 – M36**) [Lead: **ACCELI: 8PMs**; Participants: BSC: 1PMs; UPC: 2PMs; NOA: 1PMs; IPTO: 2PMs; PMODWRC: 2PMs; ANEK: 3PMs; EXUS: 1PMs; UniTN: 1PMs], D8.5

One of the major outcomes of this project will be the training manual, which will give end-users the possibility to use the TADDIS platform. This manual will be a detailed encounter for the efficient use of the platform. ACCELI will assist the end-user group in devising both class and simulation-based training modules to deliver results, conclusions and concept of operations developed the project. The modules will be trialed firstly with selected and users in order to give accurate feedback to enable the final developed modules to accurately reflect conclusions reached in this project. The material will also be supplied to various capacity building activities, and will certainly bring about effects which will outlast the project timeframe, contributing to the sustainability of TADDIS approach and system.

Task 8.3: Pilot deployment and validation (**M13 – M36**)[Lead:**PMODWRC: 10PMs**; Participants: BSC: 2PMs; UPC: 9PMs; SERCO: 9PMs; NOA: 7PMs; IPTO: 5PMs; ANEK: 6PMs; EXUS: 3PMs], D8.2 – D8.4

This task, under PMODWRC's responsibility, manages all the preparatory actions and the actual implementation for the threepilot use cases in which the first deals with extreme-scale analytics on DIAS cloud infrastructures with open and commercial data, the second with modeling ship traffic emissions and the third one with Solar Energy monitoring for energy exchange platforms. Effort will be given to engage as many end users as possible (even outside the consortium), running main use cases and scenarios for the use, testing and validation, in reference to what was defined in the defined use case design and requirements of WP2. This activity will focus on the definition of the exact implementation scenarios (scripts, duration, timing, geographic context, stakeholders involved, etc.), the implementation management and technical deployment of the PUCs. It will also be checked against the validation scenario and evaluation methodology defined in Task 8.1.

Deliverables

D8.1 [Lead: **SERCO**; due **M14;** contribution: **MS3**] **Validation scenario and evaluation methodology report** illustrates the design of the validation scenaria and the steps of the evaluation methodology and protocols.

D8.2[Lead: **PMODWRC**; due **M16;** contribution: **MS3] Pilots implementation and 1st prototype evaluation report** presents the comparative analysis on the validation results of the 1st prototype.

D8.3 [Lead: **SERCO**; due **M23;** contribution: **MS4**] **Pilots implementation and 2nd prototype evaluation report** presents the comparative analysis on the validation results of the 2nd prototype.

D8.4 [Lead: **UPC**; due **M33**; contribution: **MS5**] **Field demonstrations and final system evaluation**. This deliverable presents the final demonstration that will showcase the TADDIS functionality and pilot implementation. Also, the results of the final system evaluation process are reported.

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D8.5 [Lead: **ACCELI**; due **M36;** contribution: **MS5**] **User training**. This deliverable is composed of TADDIS's training offer and it will include several types of materials and manuals such as on-line application (i.e. videos, simple user guide), accessible by the web site of the project, in order to provide the partners and the targeted user/stakeholders with different degrees of information according to their needs.

WP No	**WP9**				**Start month:**				**1**		**End month:**		**36**		**EVR**	
WP title	**Impact Creation, Dissemination and Exploitation**															
Part. No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Name	**EVR**	**BSC**	**CERTH**	**UPC**	**SERCO**	**NOA**	**ACCELI**	**XLAB**	**IPTO**	**PMODWRC**	**ANEK**	**EXUS**	**EVRPORT**	**UoA**	**UniTN**	**59**
PMs	14.5	5.5	3	1.5	3.5	2.5	7.5	3.5	1.5	1.5	3.5	2.5	1.5	5.5	1.5	

Objectives: The objectives of this WP are to: (i) design a communication and dissemination strategy in order to promote the project's results and increase awareness among the project's stakeholders and the general public, (ii) build awareness and engage stakeholders, (iii) seek collaborations with other relevant EU projects, (iv) recommend the findings of TADDIS to standardisation bodies, and (v) define an exploitation plan and verify the exploitation potential during and after the end of the TADDIS project.

Task 9.1: Dissemination and communication (**M1 – M36**)[Lead: **ACCELI: 6PMs**; Participants: EVR: 2PMs; BSC: 1PMs; CERTH: 1.5PMs; UPC: 1PMs; SERCO: 1PMs; NOA: 1PMs; XLAB: 1PMs; IPTO: 1PMs; PMODWRC: 1PMs; ANEK: 1PMs; EXUS: 1PMs; EVRPORT: 1PMs; UoA: 1PMs; UniTN: 1PMs], D9.1, D9.2, D9.5

To ensure the smooth collaboration and circulation of information within the consortium on the one hand, and the effective knowledge transfer outside the consortium on the other, carefully planned dissemination activities will be carried out throughout the lifetime of the project. These activities will be monitored and revised periodically to make sure they lead to an effective exploitation of the project's outputs and to an increased awareness of the impact of TADDIS technologies on the wider community. Internal dissemination includes: private Website, repository of documents, mailing list and internal periodical meetings. External dissemination activities vary depending on the targeted stakeholder group: (i) academia, scientific communities and students will be reached mainly via publications, presentations at and organisation of relevant conferences, workshops, PhD forums, special sessions, and via social media while a student competition is planned to engage students in topics linked to the project in an entertaining way; (iii) industrial stakeholders and technology providers will be mainly reached via participation in trade events and workshops; (iv) stakeholder groups relevant to the use cases will be targeted via dedicated workshops, research briefings and flyers; finally, (v) societal organisations and the wider public will be made aware of the project's outputs through articles in relevant newsletters and journals, press releases, partners' participation in science communication events, explanatory videos and descriptions on the Website and social media.

Task 9.2: Market analysis, business modelling and exploitation (**M1 – M36**) [Lead: **EVR: 6PMs**; Participants: SERCO: 1PMs; ACCELI: 1PMs; XLAB: 2PMs; ANEK: 1PMs; EXUS: 1PMs], D9.3, D9.4

The task concerns an in-depth analysis of the market for the project exploitable outcomes (see Section 2.2) by looking at different sectors where Big Data and extreme scale analytics are promising or delivering successful results. The task will include the identification of trends of the potential markets, drivers, barriers, and the competitor arena for supporting exploitation and market positioning. The market analysis will look beyond Machine Learning and AI at combined exploitation of cloud and edge computing, IoT and Geospatial intelligence in order to define TADDIS' value proposition. The task will also explore a broad range of business models for smart decision-making driven by Big Data analytics, supporting the sustainability and commercialisation of the project outcomes.

Task 9.3: Standardisation and collaboration with other Big Data projects and stakeholder network (**M1 – M36**)[Lead:**BSC: 4PMs**; Participants: EVR: 2PMs; CERTH: 1PMs; SERCO: 1PMs; NOA: 1PMs; ANEK: 1PMs; UoA: 4PMs], D9.5, D9.6

This task aims to get TADDIS results closer to its future users, gathering inputs from stakeholders, enriching the TADDIS platform and ensuring its consistency to the real needs to be covered. A set of activities will be developed during the project, in which representatives from the different stakeholder groups, to be identified in Task 9.1, will have the opportunity to attend two demonstration workshops organised by NOA and PMODWRC, one Open Day organised by SERCO and target a broader audience, and the presentation of the solution within the frame of the Final Dissemination Conference organised by BSC and UPC. The explanatory videos will take part of the showroom to be deployed on the EVERIS Living Lab. Moreover, the everis Living Lab will be used as a Forum for discussion about how TADDIS can contribute to the standardization on the frame of the technologies to be considered within the project. Several debate tables will be organized for this aim. Participation of relevant experts on the connected fields is foreseen, including standardisation bodies and members of the BDVA.

Task 9.4: Long-term sustainability and intellectual property rights (IPR) protection(**M13 – M36**)[Lead:**EVR: 4.5PMs**; Participants: BSC: 0.5PMs; CERTH: 0.5PMs; UPC: 0.5PMs; SERCO: 0.5PMs; NOA: 0.5PMs; ACCELI: 0.5PMs; XLAB: 0.5PMs; IPTO: 0.5PMs; PMODWRC: 0.5PMs; ANEK: 0.5PMs; EXUS: 0.5PMs; EVRPORT: 0.5PMs; UoA: 0.5PMs; UniTN: 0.5PMs], D9.4, D9.7

The task leverages the input of experienced partners in Big Data research projects and industrial activities engaged in this task, the infrastructures and investments already in place, and the strategic feedback gathered by users and stakeholders, to define an exploitation strategy and the long-term business plan for the project outcomes, selecting from the business models identified in Task 9.2, the most suitable to be adopted for the exploitation of the project results. The business model will be

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chosen by considering the tools developed, the revenue type, the owner, and the financial models. Task 9.4 will define TADDIS value proposition in the European Data Infrastructure chain and make use of CANVAS business model methodology for TADDIS to support partner's decision-making process on different challenges. The TADDIS business model will include a cost model based on a cost assessment for starting operational activities, including Operational Expenditures (OpEx) from EO service suppliers and cloud computing (DIAS), staff, premises, suppliers involved in the delivery chain and necessary Capital Expenditures (CapEx) in the form of equipment. The exploitation plan will include the exploitation strategies at both Consortium and partner level. In addition, this task will ensure that the established rules for use of Intellectual Property Rights (IPR) are taken into account, including dependencies with third-party software, results' ownership and results' protection. EVR will also collect IPR information on project foreground, protection interests and access rights.

Deliverables **D9.1** [Lead: **ACCELI**; due **M3;** contribution: **MS1] Initial dissemination and communication plan**. This deliverable will present the initial dissemination and communication plan of TADDIS, as well as the creation of the project's communication material (project presentation, communication kit), which will be used as part of other dissemination activities.

D9.2 [Lead: **ACCELI**; due **M3;** contribution: **MS1] TADDIS project website**. D9.2 will detail the design and setup of the project's Website, which will provide up-to-date information on intermediate and final project results.

D9.3 [Lead: **EVR**; due **M8**; contribution: **MS2**] **Initial market analysis, industrial requirements, and business models**. A detailed market analysis of the domains of interest for TADDIS, the industrial requirements that will need to be taken into account, as well as the and the potential business models supporting the exploitation in TADDIS will be provided in this deliverable.

D9.4 [Lead: **XLAB**; due **M18**; contribution: **MS3**] **Initial exploitation and sustainability plan**. This deliverable will provide the initial plans supporting the exploitation and sustainability of the project outcomes.

D9.5 [Lead: **BSC**; due **M20**; contribution: **MS3**] **Mid-term dissemination, communication, collaboration and standardisation activities**. D9.5 will provide the updated version of the D9.1, by including the undertaken dissemination, communication, standardisation and collaboration activities as well as references to TADDIS's network of interest.

D9.6 [Lead: **ACCELI**; due **M36**; contribution: **MS5**] **Final report on dissemination, communication, collaboration and standardisation**. This deliverable will provide the final version of the report on the dissemination, communication, collaboration and standardisation activities carried out in the project.

D9.7 [Lead: **EVR**; due **M36**; contribution: **MS5**] **Final exploitation and sustainability plan and IPR report**. D9.7 will describe the final exploitation and sustainability activities of TADDIS, updating the business models described in D9.4 as well as defining IPRs and individual exploitation plans for each Key Result.

3.1.4 Deliverables by date of delivery

Table 3.2: List of Deliverables

Del No.	Deliverable name	WP no.	Lead part.	Type	Dis. Level	Deliv. date
D1.1	Project management and quality assurance plan	1	EVR	R	CO	M3
D1.2	Self-assessment & data management plan v1	1	EVR	R	CO	M6
D1.3	Mid-term review & progress report	1	EVR	R	CO	M18
D1.4	Self-assessment & data management plan v2	1	EVR	R	CO	M24
D1.5	Public final activity report	1	EVR	R	PU	M36
D2.1	Use cases and requirements v1	2	SERCO	R	CO	M6
D2.2	Preliminary ethical and legal assessment	2	XLAB	R	PU	M10
D2.3	Final use case specification and design	2	PMODWRC	R	CO	M14
D2.4	Final ethical and legal assessment	2	XLAB	R	PU	M32
D3.1	Initial data collection processes	3	SERCO	R	PU	M9
D3.2	Initial data storage and indexing processes	3	UPC	R	PU	M14
D3.3	Final data indexing processes	3	CERTH	R	PU	M28
D3.4	Report on Big Data Operations (DataOps) Fusion Engine (BIDOFE)	3	EXUS	R	CO	M30
D4.1	AI workflows on structured data v1	4	EXUS	R	CO	M14
D4.2	Machine/deep learning methodologies v1	4	UniTN	R	PU	M16
D4.3	Federated learning tool v1	4	CERTH	R	PU	M18
D4.4	Radiative Transfer Model Inversion in TADDIS	4	NOA	R+DEM	PU	M22
D4.5	AI workflows on structured data v2	4	EXUS	R+DEM	CO	M26
D4.6	Machine/deep learning methodologies v2	4	CERTH	R+DEM	PU	M28
D4.7	Federated learning tool v2	4	CERTH	R+DEM	PU	M29
D4.8	Optimisation algorithms on HPC environment	4	BSC	R+DEM	PU	M30
D5.1	Predictive analytics models in TADDIS v1	5	XLAB	R	CO	M14
D5.2	Solar Energy short-term forecasting models v1	5	PMODWRC	R	PU	M12
D5.3	TADDIS Intelligent Analytics Platform v1	5	EXUS	R	CO	M13
D5.4	Data stream clustering algorithms in extreme-scale data collections	5	CERTH	R+DEM	PU	M27
D5.5	Predictive analytics models in TADDIS v2	5	XLAB	R+DEM	CO	M29
D5.6	Solar Energy short-term forecasting models v2	5	NOA	R+DEM	PU	M30
D5.7	TADDIS Intelligent Analytics Platform v2	5	EXUS	R+DEM	CO	M32
D6.1	The TADDIS ontologies	6	ACCELI	R+DEM	PU	M18
D6.2	Ontology population and data harmonization module v1	6	UoA	R	PU	M12
D6.3	Initial semantic search and query functionalities	6	UoA	R	PU	M15
D6.4	Autonomous Decision-Making system v1	6	CERTH	R+DEM	CO	M14

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D6.5	Ontology population and data harmonization module v2	6	ACCELI	R+DEM	PU	M24
D6.6	Final semantic search and query functionalities	6	UoA	R+DEM	PU	M30
D6.7	Autonomous Decision-Making system v2	6	EXUS	R+DEM	CO	M32
D7.1	Technical requirements and platform development roadmap	7	EVRPORT	R	CO	M8
D7.2	TADDIS system architecture definition	7	EVRPORT	R	CO	M12
D7.3	1st Prototype of TADDIS System	7	EVRPORT	R+DEM	PU	M12
D7.4	2nd Prototype of TADDIS System	7	EVRPORT	R+DEM	PU	M20
D7.5	Final TADDIS System and Interactive User Interface	7	EVRPORT	R+DEM	PU	M30
D8.1	Validation scenario and evaluation methodology report	8	SERCO	R	PU	M14
D8.2	Pilots implementation and 1st prototype evaluation report	8	PMODWRC	R+DEM	PU	M16
D8.3	Pilots implementation and 2nd prototype evaluation report	8	SERCO	R+DEM	PU	M23
D8.4	Field demonstrations and final system evaluation	8	UPC	R+DEM	PU	M33
D8.5	User training	8	ACCELI	R	PU	M36
D9.1	Initial dissemination and communication plan.	9	ACCELI	R	PU	M3
D9.2	TADDIS project website	9	ACCELI	DEC	PU	M3
D9.3	Initial market analysis, industrial requirements, and business models	9	EVR	R	PU	M8
D9.4	Initial exploitation and sustainability plan	9	XLAB	R	CO	M18
D9.5	Initial dissemination, communication, collaboration, standardisation and TADDIS network of interest.	9	BSC	R	PU	M20
D9.6	Final report on dissemination, communication, collaboration and standardisation	9	ACCELI	R	PU	M36
D9.7	Final exploitation and sustainability plan	9	EVR	R	CO	M36

3.2 Management structure and procedures

3.2.1 Organisational structure and decision making

The TADDIS organisation is designed to allow efficient decision making in a diverse and yet dedicated Consortium for a complex topic involving many stakeholders. The TADDIS **Management Team (MT)** consists of four key roles: the Project Coordinator (PC), the Scientific Manager (SM), the Technical Manager (TM), and the Exploitation and Intellectual Property Rights Manager (E&IPRM). The **Executive Board (EB)** consists of the MT members and one representative of each Consortium partner. This structure facilitates an accountable and transparent mechanism for financial, scientific, and technical progress monitoring. The partner delegate-based EB is a sufficient and cost-effective forum for decision making, robust delivery assurance, and consultation with key stakeholder representatives for dissemination across the board. The MT is supported and consulted by the **Support Team (ST)** and the external **Stakeholder Forums**. The ST consists of the Ethics Officer (EO) and the Support Office (SO). The Stakeholder Forums consists of the Stakeholder Network and an external Advisory Board. Figure 3.1 presents an overview of this organisational structure.

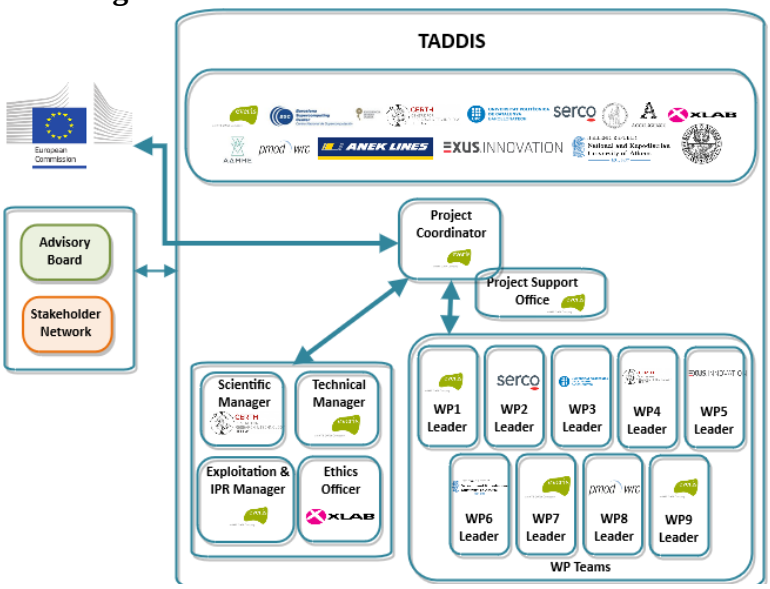

Fig. 3.1: Organisational Structure of the TADDIS Consortium

3.2.1.1 Management Team (MT)

The **Project Coordinator (PC), Miguel Ángel Fuentes (EVR),** is responsible for managing the project and coordinating the plans and activities among Consortium members. The PC represents the Consortium in all formal written and verbal communications with the European Commission (EC). He is to ensure: a) smooth operation of the project; b) that all efforts are focused on the objective; and c) protection and implementation of partners' rights and obligations. He will specifically perform all tasks assigned to him by the Grant Agreement: a) monitor proper action implementation; b) act as intermediary for all communications between the EC and beneficiaries; c) request and review documents or information required by the EC, and verify their completeness and correctness before submission; d) submit deliverables and reports to the EC; e) ensure that all payments are made to beneficiaries without unjustified delay; and f) inform the EC of the amounts paid to each beneficiary, when required under the Agreement or requested by the EC. The PC is the chairman of the EB and its meetings. The **Scientific Manager (SM), StefanosVrochidis (CERTH),** will a) oversee all research aspects; b) advise the PC on scientific and technological issues; c) ensure coordinated and consistent research progress; d) see to research ethics; and e) ensure the quality of scientific results. The **Technical Manager (TM), Hugo Balseiro (EVRPRT),** will a) oversee and coordinate the technical progress; b) advise the PC on technical and technological aspects and possible impacts on project plan; c) oversee the deliverables' quality control; and d) work closely with the WP leaders to ensure the achievement of

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intermediate and final technical results. The **Exploitation and Intellectual Property Rights Manager (E&IPRM), Cristina Muñoz Alcalde (EVR)** will a) act as focal point for monitoring and identifying the exploitation potential of TADDIS; b) ensure maximum market impact by its results; c) ensure that the developed innovations come to a concrete business reality; d) report to the PC and the EB on the exploitation activities and results; e) oversee the protection of partner rights to TADDIS-induced individually- or jointly-owned exploitable results.

3.2.1.2 Executive Board (EB)

The EB is the highest decision-making body in TADDIS. The EB is chaired by the PC, and consists of the MT members (SM, TM, E&IPRM), and one representative per partner organisation. The EB's main responsibility is to ensure correct project implementation in accordance with the Grant Agreement (GA) and Consortium Agreement (CA). The EB monitors the scientific, technical and financial progress of project activities towards the main objectives of the project, and makes fundamental decisions where necessary, in accordance with the project deliverables, milestones, and budget. The EB is hence authorised to make decisions on: 1) *Consortium composition*: corrective measures to defaulting, adding, or replacing partners, partner membership termination, and PC replacement; 2) *CA*: changes to partners' rights and obligations, decision-making procedures, or amendments; 3) *Reporting to the EC*: agreement on the completeness and quality of all formal reports thereto; 4) *Agenda setting*: scientific and technical agenda definition; 5) *Overall project course monitoring*: authorising major deviations in the course, objectives, or financial budgets, and amendments to the GA; 6) *Overall management*: drafting reports, associated documents, and forms following the agreement with the EC, liaising with the MT, AB, and Stakeholder Network, scientific coordination and alignment of WP activities, deliverables, and progress towards the overall TADDIS objectives. The EB will meet in person twice a year and will hold a monthly teleconference. Decisions will, be made by consensus, whenever possible, made by majority vote. If the need for voting should arise, each EB member shall have a single vote. In case of a draw, the PC will have the decisive vote.

3.2.1.3 Support Team (ST)

The **Ethics Officer (EO), Jolanda Modic (XLAB),** will monitor the involvement of users in the PUCs with respect to the fulfilment of ethical guidelines, and, if appropriate, suggest corrective actions. The Project **Support Office (SO)** is the central day-to-day management office, headed by the PC (EVERIS). The SO includes a Financial Controller (FC) and a Project Secretary. The FC assists in monitoring the budget and financial reporting to the EC and is available to the Consortium partners for financial/ budgetary queries during the TADDIS project. The SO's responsibilities include: 1) Developing and maintaining the TADDIS quality and administration infrastructure (quality assessment mechanisms, guidelines and provision of training, etc.); 2) Ensuring timely milestone completion; 3) Issue and problem tracking; 4) Timely and accurate reporting on Consortium activities to the EC; 5) Managing and updating the CA; 6) Providing project management support to partners and WP leaders; 7) Providing administrative support to the EB; 8) Supporting project and Consortium meetings (preparation, agenda, logistics, minutes, templates, proceedings); 9) Managing an on-line TADDIS document repository.

3.2.1.4 Stakeholder Forums

The external **Advisory Board (AB)** will advise the Consortium on scientific, technical, and exploitation issues. All AB members and other external experts shall be required to sign an appropriate non-disclosure agreement prior to participating in any project related meeting, decision or activity.

Table 3.3:TADDIS External Advisory Board

#	Member	Affiliation	Expertise	Relevant WP
1	Pedro Puigdengoles Briones	Ports de Les Illes Balears	Managing director of the Port Authority of the Balearic Islands.	WP2, WP8
2	Antoni Tio Sauleda	Associacio Barcelona Cluster Nautic	Executive president of the Barcelona Nautical Cluster Association.	WP2, WP8
3	Oriol Altisench Barbeito	Col·legi d'Enginyers de Camins Canals i Ports de Catalunya	Director of Mobility Strategic Actions in Barcelona d'Infraestructures Municipals. Coordinator of the Barcelona's Tramway Network at the Urban Ecology Area of the Barcelona City Council.	WP2, WP8
4	Grigoris Antoniou	Univ. of Huddersfield, UK	Expertise in Semantic Web, ontologies, reasoning	WP6
5	John Soldatos	University of Glasgow, UK	Honorary Research Fellow	WP4, WP5
6	Gerardo Gantes Rodriguez	MRCC (SASEMAR) Barcelona	Expert in maritime controller and air pollution detection.	WP2, WP8
7	HoonJoo Yoon	CEO of Sundosoft	Specialized in developing spatial big data platforms, providing GIS fusion system development.	WP3, WP7
8	George Vouros	Univ. of Piraeus	Professor in the Department of Digital Systems	WP6, WP7
9	Philippe Chrobocinski	Project manager in Airbus Defence and Space	Expertise in Big Data system design, platform development and system integration.	WP1, WP7, WP9

In addition, the Consortium will develop a **Stakeholder Network** to strengthen dissemination. Stakeholders Network members may provide guidance or advice on strategic or WP levels, but have no formal decision power.

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3.2.1.5 Work Package Teams (WPTs)

A WPT is responsible for effectively and efficiently implementing the work associated within a specific WP. Each WPT consists of a WP Leader (listed in Table 3.4) and principal investigators from the Consortium partners who are active in the respective WP. The WPT is responsible for: 1) Monitoring the progress towards the WP's deliverables and objectives, according to project milestones; 2) Holding a WPT meeting or teleconference on a frequent basis (determined by each WP Leader) to discuss matters related to the WP progress; 3) Making decisions on WP-related activities; 4) Identifying cross-WP issues, discussing them with parallel WPTs, and raising them when necessary as EB meeting agenda items; and 5) Periodically reporting to the EB on progress, delays, risks, contingencies, corrective measures, WPT-internal or cross-WPT disputes, CA/GA change requests, etc. WP Leaders are the main contacts in all communication between the WPT and EB. As soon as the project begins, each partner will appoint representatives to participate in the WPTs in which it has allocated activities and tasks.

Table 3.4: TADDISWP leaders

Role	Member	Field of expertise
PC, WP1 leader	Ms. Ana Gonzalez Segura (**EVR**)	Wide experience in coordinating EU funded projects, being part of them for more than 5 years at everis.
WP2 leader	Dr. Guido Vingione (**SERCO**)	Wide-ranging background in system engineering, understanding the various Earth Observation Ground Segment systems architecture and interfaces.
WP3 leader	Dr. Anna Mujal-Colilles (**UPC**)	She is in charge of the AIS system at the CEN and has leaded the use of the data for several purposes including ship emissions, underwater noise contamination, ship collisions, etc.
WP4 leader	Dr. Ilias Gialampoukidis (**CERTH**)	Wide experience in Big Data analytics, data fusion, multimedia retrieval, unsupervised and supervised learning in Big Data collections
WP5 leader	Mr. Anaxagoras Fotopoulos (**EXUS**)	He has developed cloud based integrated solutions for real time analytics and data mining from EC & NIH databases.
WP6 leader	Dr. Manolis Koubarakis (**UoA**)	Coordinator and leader of the technical work in three FP7 and H2020 projects (TELEIOS, LEO and ExtremeEarth) in the area of big linked geospatial and Earth Observation data.
TM, WP7 leader	Mr. Hugo Balseiro (**EVRPORT**)	Wide experience in implementing new solutions and integrating systems in the Data and Analytics area, while having been responsible for the definition of several BI and Big Data Architectures in relevant clients.
WP8 leader	Dr. Stelios Kazadzis (**PMODWRC**)	Expert in solar energy applications including the end user/product co-designing processes. Has been involved with system validation procedures and training user aspects in the area of solar radiation measurements and modelling.
E&IPRM, WP9 leader	Ms. Cristina Muñoz Alcalde (**EVR**)	Wide experience in evolving technological innovations into marketable products and in assessing potential products' viability and how to position them in order to maximize their value.

3.2.2 Communication flow mechanism and procedures

The project will be launched by a plenary kick-off meeting that will be the first opportunity to focus on the work plan, refine the common understanding of tasks and build up an operational team spirit among TADDIS partners. A Website will be developed and maintained in order to provide information about the project and the achieved results (e.g. publications, public reports) and serve as the most comprehensive mean of the latest developments and dissemination actions. The communication flow between partners will be maintained with the use of periodic teleconferences, mailing lists, collaborative Web-based shared space (Wiki) and the periodic EB meetings. The SO will be responsible for establishing and managing mailing lists for the Consortium as a whole and for sub-groups working on particular tasks. In addition to a number of whole Consortium meetings, meetings for specific scientific and technical issues will take place. The Consortium may decide to hold a series of joint meetings (intra-WP and cross-WP) in order to speed up the development and integration process. The PC will organise monthly teleconferences with the WP leaders for monitoring the work progress. In the communication strategy, liaison with outside parties, e.g. other relevant EU-funded research projects and consortia active in the field, will be included.

3.2.3 Quality assurance (QA) measures

Quality Assurance procedures will be applied to all activities and will be the joint responsibility of all partners until complete discharge of their obligations under the EU contract. QA aims at establishing documentation, reporting and communication procedures, as well as producing high quality deliverables on time and according to specification. In addition, QA helps in identifying technical and commercial risks, or deviations at an early stage, as well as in realising any necessary remedial actions as soon as possible. The PC will be responsible for producing the QA plan in month 3 of the project that will be maintained for the duration of the project's lifetime and will be accessible by the partners through the project's collaborative platform. For the deliverables, the first level of QA will be exercised by the responsible Task Leader, who will establish a deliverable development plan by identifying the deliverable coordinator, contributors, development procedure, and evaluation process. The PC and the Task Leader will identify 1-2 suitable technical expert(s) (within the Consortium but not involved in the deliverable) to conduct a formal internal peer review with a short report as soon as the deliverable is developed. QA in the project will be assured by:

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a) Quality Assurance Plan that will define the rules and basic support for the co-operation between the partners and establish procedures for documentation, quality control, management decision schemes and control procedures. b) Feedback from annual Commission reviews. Project management will foster an attitude where these reviews are treated as part of the quality assurance, rather than as an adversarial assessment.

Table 3.5:TADDIS list of Milestones

MS No.	Milestone name	Related WP(s)	Due date	Means of verification
MS1	Project setup	WP1, WP2, WP9	M6	MS1 marks the successful initiation of the project and establishing of the project identity. It includes: 1) project management and quality assurance plan; 2) project performance indicators; 3) initial use case scenarios and requirements; 4) legal framework and ethical considerations; 5) initial data management plan and self-assessment plan; 6) initial dissemination and communication plan, communication material and project Website. **Deliverables contributing to MS1:***D1.1, D9.1, D9.2, D1.2, D2.1.*
MS2	1st prototype	WP2, WP3, WP5, WP6, WP7, WP9	M12	MS2 denotes the delivery of the 1st prototype along with the technical requirements and system architecture, initial market analysis, industrial requirements and business models, the TADDIS data collection and indexing processes, preliminary ethical and legal assessment, models for Solar Energy short-term forecasting, ontology population and data harmonization modules. **Deliverables contributing to MS2:***D7.1, D9.3, D3.1, D2.2, D5.2, D6.2, D7.2, D7.3.*
MS3	2nd Prototype	WP1-WP9	M20	MS3 marks the delivery of the 2nd prototype of TADDIS system along with: 1) theTADDIS Intelligent Analytics Platform v1; 2) final use case specification and design; 3) AI workflows on structured data report; 4) predictive analytics models in TADDIS report; 5) autonomous Decision-Making system model; 6) validation scenario and evaluation methodology report; 7) semantic search and query functionalities; 8) machine/deep learning methodologies; 9) pilots implementation and 1st prototype evaluation report; 10) mid-term review & progress report; 11) federated learning tool, 12) TADDIS ontologies; 13) initial exploitation and sustainability plan; 14) initial dissemination, communication, collaboration, standardisation and TADDIS network of interest. **Deliverables contributing to MS3:** *D5.3, D2.3, D3.2, D4.1, D5.1, D6.4, D8.1, D6.3, D4.2, D8.2, D1.3, D4.3, D6.1, D9.4, D7.4, D9.5*
MS4	Final System	WP1, WP3-WP8	M30	MS4 denotes the delivery of the final TADDIS Big Data platform and User Interfaces, along with: 1) the Radiative Transfer Model Inversion in TADDIS; 2) Pilots implementation and 2nd prototype evaluation report; 3) Self-assessment & data management plan v2; 4) ontology population and data harmonization module final version; 5) AI workflows on structured data final version; 6) Data stream clustering algorithms in extreme-scale data collections; 7) Final version of the data indexing processes; 8) Machine/deep learning methodologies final version; 9) predictive analytics models in TADDIS final version; 10) the Big Data Operations (DataOps) Fusion Engine (BIDOFE); 11) optimisation algorithms on HPC environment; 12) Solar Energy short-term forecasting models; and 13) the final semantic search and query functionalities. **Deliverables contributing to MS4:***D4.4, D8.3, D1.4, D6.5, D4.5, D5.4, D3.3, D4.6, D5.5, D3.4, D4.8, D5.6, D6.6, D7.5*
MS5	Project completion	WP1, WP2, WP5, WP6, WP8, WP9	M36	MS5 marks the successful completion of the project. It includes the final versions of the user-driven TADDIS Intelligent Analytics Platform and Autonomous Decision-Making system. It also includes the final ethical and legal assessment, the field demonstrations and final system evaluation, the public final activity report, the user training, the final report on dissemination, communication, collaboration and standardisation, and the final exploitation and sustainability plan. **Deliverables contributing to MS5:** *D2.4, D5.7, D6.7, D8.4, D1.5, D8.5, D9.6, D9.7*

3.2.4 Progress monitoring and reporting

The PC will communicate with the partners on a regular basisto obtain first-hand progress information. The PC will be responsible for delivering the contractually obligatory reports to the EC. Acollaborative Web-based communication and information exchange platform will be used in order to ensure proper flow of information and support internal project control. The platform will be installed within 1 month from kick-off. For each reporting period a report draft will be sent by the PC to the EC. The final report, cost certificates (audit certificates) and other foreseen deliverables will be sent to the EC by the due date given in the GA. Formal reporting procedures will be agreed upon in the CA. Bi-annual progress reports will be provided by WP Leaders and partners to the PC. These reports will allow the PCto monitor project performance, milestones, deliverables, risks, and budget monitoring and

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auditing.Each report will have a defined frequency, format, and table of contents. All reports will be distributed within an amount of timebefore the respective EB and review meetings, agreed upon in the CA.

3.2.5 Risk management

Risk management aims to control and reduce potential risks, focusing on precautionary diagnosis and handling. The MT will report on risk issues to the EB and in a Risk and Contingency Plan with each Periodic Activity Report. Each WPT will maintain a WP Risk Log and report it to the MT and other WP leaders. Cross-WP risks will be handled by all relevant WP leaders together. The MT will supervise risk identification, reduction, and mitigation, and monitor risk communication among WPTs. **Risks related to individual activities are outlined together with their contingency plans in Section 1.3.6.** The risk management methodology will be based upon the **ISO-31000 Risk Management Standard** and the EC risk assessment and management guidelines (http://ec.europa.eu/smart-regulation/guidelines/tool_12_en.htm). The iterative risk management process will consist of risk criteria and critical objectives (schedule, budget, performance, quality, demonstration) identification, risk assessment and treatment, continuous monitoring, and communication. Possible risk causes, impacts, and mitigation plans are summarised in Table 3.6.

Table 3.6: Critical risks for the TADDIS project

Description of risk (indicate level of likelihood: Low/Medium/High)	WP(s) involved	Proposed risk-mitigation measures
Lack of single accountability point (*H*)	All	Appointing the EB as supreme accountable authority (WP1)
IP, copyright, or licensing (*H*)	WP2-8	Binding CA to resolve and clarify IP, licensing, or trade secret sharing.
Incomplete requirements, unrealistic expectations (*M*)	WP2	WP2 will define user requirements and ensure feasibility and agreement of user and technical partners on scope and effort. Missing requirements will be considered after prototype demonstration, subject to partners' capacity.
The scope of use cases is too big/complex or evolves in radically different directions, hindering cohesion *(H)*	WP2	Analyse the objectives of the project and the requirements of use cases. Steer the use cases according to the project. Prioritise the requirements according to importance, value, and work plan. Update the project plan to reflect the new requirements (if needed). Liaison with EC.
Poor system architecture, over-specification ("gold plating"), frequent, unanticipated, or uncoordinated technical or design changes (*H*)	WP7	Continuous review, formulation, and coordination of system requirements and scope, subsystem requirements, user-oriented prioritisation, design change requests, while utilising system architecting and design approaches.
Development issues *(M)*	WP3-WP7	Regular assessment of the technical KPIs will ensure that any delays in developments are identified early enough to enable quick and effective reaction. In case of development issues, hands-on meetings will be held.
Inadequate performance, quality, or results, delayed delivery, lack of agreed acceptance testing and signoff criteria (*H*)	WP3-WP7	Continuous review of progress and results by TM through plenary meetings, integration prototypes (WP7), and pilot demonstrations (WP8). Adoption of design-to-time approachwhereby deliverables are always on-time, on the expense of scope (WP1).
Failure to review project progress in the adequate frequency (*M*)	All	Facilitation of weekly Consortium-wide online meetings in which action items will be assigned and tracked according to the work plan (WP1), in conjunction with monthly progress reports and biannual WP reports.
Inadequate methodical work, and documentation (*M*)	All	Encouraging methodical, systematic work, adoption of best and common practices, and use of conventional tools and techniques (WP1). Facilitation of Consortium-wide documentation procedure (WP1).
Technological limitations of solution reached or exceeded (*H*)	WP3-WP6	Careful review and reduction of technological risks during the development to ensure delivery promised technologies beyond the SoA.
Personal friction between partners, misunderstandings, cultural differences and insufficient communication (*M*)	All	Continuous interpersonal formal and informal communications, creation of a pleasant and collaborative atmosphere (WP1). Facilitation of physical and online meetings, encouraging partner-to-partner sessions (WP1).
Opposition to change, hidden agenda, conflict of goals, lack of executive management commitment (*M*)	All	Clear determination of a Consortium-internal partner disclosure and conflict resolution mechanism. Acquisition of a project charter from each partner's management, to ensure commitment to fruitful participation.
Staff insufficiency, changes in technical delivery competence (*M*)	All	Periodic review of partner staffing to ensure compliance with person-months requests and consumption reports (WP1).

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3.2.6 Consortium agreement and IPR management

In TADDIS, Consortium partners will collaborate towards the achievement of common objectives. An IPR strategy is critical for the project success in order to protect the innovations developed within the project's timeframe. In addition to the approval procedures for documents, publications, and standards contributions, the knowledge management will be described in the GA and CA. Moreover, specific activities within WPs are foreseen for innovation knowledge and intellectual property management, including: (1) IPR applications for new systems and solutions prepared by Consortium partners; (2) information will be disseminated to external bodies and regulatory/standards bodies, only after the necessary steps for ensuring the protection of IPRs have been made. This way, IP will be secured in the interest of the TADDIS partners. The Consortium, in order to ensure that IPR is properly handled and managed, has introduced a dedicated task in WP9 "Impact Creation, Dissemination and Exploitation", namely "Task 9.4: Long-term sustainability and intellectual property rights (IPR) protection".

3.2.7 Innovation and exploitation management in TADDIS

The management structure will foster the process of innovation management. The academic and research partners deliver technological expertise. The industry and SME have a clear understanding of current market opportunities and applicability. The end users and relevant stakeholders provide operational requirements based on everyday experience and understanding of the potential benefit of innovative technologies for extracting valuable knowledge and commercial value from data. In fact, the entire project is driven by well-established requirements. The dedicated exploitation task, led by EVR and supported by all industry and SME partners, focuses on ensuring successful exploitation of project outcomes, harnessing the partners' expertise in concretising business ideas and technological potential up to exploitable products built on agile methodologies. The Stakeholder Network ensures further alignment with potential market needs. In addition, by introducing the E&IPRM into the management structure, TADDIS takes into account the relevance of exploitation management. The E&IPRM will ensure adequate reporting to the PC and EB on ongoing and future exploitation.

3.2.8 Conflict management and resolution of disputes

The CA will contain detailed procedures for resolving potential conflicts. The appropriate WP Leader should identify these potential conflicts and bring them to the immediate attention of the PC. The PC will attempt to resolve them by discussion or by calling an ad hoc meeting. In case of failure, the PC will seek a decision by a majority vote of the EB. In case of non-performance of any of the partners, the PC shall have the power to exclude the offending partner by a vote of unanimity minus one. The provisions of the Grant Agreement guidelines will apply in such circumstances. Any conflicts that cannot be resolved through the principles above will be handled according to the dispute resolution provisions made in the CA. The MT members will make the largest possible use of their proven negotiation skills before using the aforementioned procedures.

3.2.9 Gender issues

The Consortium is well-aware of the efforts in Europe to foster equality for women and for ensuring equal opportunities to minority groups. All TADDIS partners are equal opportunity employers. To the extent possible, TADDIS will abide by the European Technology Assessment Network report, entitled "Science policies in the European Union: Promoting excellence through mainstreaming gender equality". The report provides recommended practices in equal opportunity recruitment, and gender-equality decision-making.

3.3 Consortium as a whole

The TADDIS Consortium consists of 15 partners from 8 countries, 7 academic/research (BSC, CERTH, UPC, PMODWRC, NOA, UoA, UniTN), 5 industry partners (EVR, EVRPRT, SERCO, ANEK, IPTO) and 3 SMEs (ACCELLI, EXUS, XLAB) forming a team with the ideal profile: a) together, they have the overall competence to achieve the TADDIS objectives; b) their competence is complementary and they cover all topics to be addressed in the project (see Section 3.3.1); c) they are fully committed to the tasks assigned to them; d) they form a coherent, resilient team with significant working relations within the Consortium on past projects (see Section 1.3.5). More specifically, CERTH has had very fruitful collaborations with consortium members in various EU projects, e.g., CERTH with EVERIS (in CONNEXIONs), CERTH with SERCO (in EOPEN), PMODWRC with NOA(in e-SHAPE and GEOCRADLE), and UoA with UniTN (in ExtremeEarth), demonstrating consortium's cohesiveness and understanding of each other's competencies.

Figure 3.2: Geographical coverage

3.3.1 Overall competence of the Consortium to achieve the project objectives

All TADDIS partners are experts in their respective fields and have already participated in numerous large scale European and national projects, where they have further strengthened their capacity with respect to the integration of solutions from their field into complex theoretical and practical contexts in the Big Data domain. The global

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competence required for achieving the project objectives and the complementarities among partners can be found below (**L**=leader, **x**=complementary expertise).

Table 3.7: Complementary expertise

Relevant Area		EVR	BSC	CERTH	UPC	SERCO	NOA	ACCELI	XLAB	IPTO	PMOD	ANEK	EXUS	EVRPT	UoA	UniTN
1	Project management and coordination	L		x										x		
2	Data management	L							x							
3	Use case scenarios and requirements		x		x	L	x		x	x	x	x				
4	Ethical and legal and dimensions				x	x			L					x		
5	Data acquisition and indexing			x	L	x			x				x			
6	Deep learning			L			x		x							x
7	Algorithm optimisation and analytics on HPC environment		L	x												x
8	Clustering and similarity search		L										x			
9	Predictive analytics models			x					L				x			x
10	Solar Energy short-term forecasting from satellite data						x					L				
11	Semantic representation, harmonization and reasoning			x			x	x							L	x
12	Decision-making system			x									L			
13	System integration and interfaces			x					x				x	L	x	x
14	Demonstrations and evaluation		x		x	x	x			x	L	x	x			
15	User training		x		x		x	L		x	x	x	x			x
16	Dissemination and communication	x	x	x	x	x	x	L	x	x	x	x	x	x	x	x
17	Market analysis and exploitation	L				x		x	x			x	x			

3.4 Resources to be committed

TADDIS will mobilise 713 PMs (Table 3.8) at the average cost 4,985.44 €/PM, with a right combination of junior and senior profiles. Administrative staff is needed on the partner level (to ensure that the research within the individual sites of the consortium is adequately supported) and on the consortium level. Technical staff is needed to maintain the computer infrastructure and to support the research staff during the implementation of the techniques being developed within TADDIS.

Table 3.8: **Summary of staff effort**

Participant		**WP1**	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**	**WP7**	**WP8**	**WP9**	**PMs**
1	EVR	31	0	0	0	0	0	0	0	14.5	**45.5**
2	BSC	0.5	4	6	18	0	0	4	4	5.5	**42**
3	CERTH	3.5	0	12	31	21	24	6	0	3	**100.5**
4	UPC	0.5	4	14	0	0	0	1	13	1.5	**34**
5	SERCO	0.5	13	11	0	0	2	2	14	3.5	**46**
6	NOA	0.5	6	4	20	12	8	1	10	2.5	**64**
7	ACCELI	0.5	0	0	0	0	17	1	8	7.5	**34**
8	XLAB	5.5	12	7	7	18	0	2	0	3.5	**55**
9	IPTO	0.5	4	0	0	0	0	0	9	1.5	**15**
10	PMODWRC	0.5	2	0	1	12	1	1	14	1.5	**33**
11	ANEK	0.5	3	7	0	0	3	1	14	3.5	**32**
12	EXUS	0.5	1	12	16	20	14	5	5.5	2.5	**76.5**
13	EVRPORT	1	1	0	0	0	0	49	0	1.5	**52.5**
14	UoA	0.5	0	3	0	0	36	2	1	5.5	**48**
15	UniTN	0.5	0	2	21	3	3	2	2	1.5	**35**

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Total PMs	**46.5**	**50**	**78**	**114**	**86**	**108**	**77**	**94.5**	**59**	**713**

The resources to be committed are presented in Table 3.9. Personnel costs covers 71.10% of the requested grant. The travel item covers the travelling expenses related to: (i) project/review meetings, (ii) dissemination events, project workshops and open days (WP9), (iii) testing, simulation and evaluation (WP2) and (iv) travelling costs of AB members. Equipment resources concern mainly IoT/Cloud infrastructure (WP7) and equipment needed for the implementation of the pilots (WP8). Wherever possible, the partners will contribute with their own equipment to a major extent. Furthermore, costs for organising workshops and open access publications are foreseen. Finally, minor costs are required for audits, consumables, workshops and fees for open access journals etc.

Table 3.9:Resources to be committed

Cost Category		**Total**	**Budget %**
Personnel costs		3,554,618.50 €	71.10
Travel		330,000.00 €	6.60
Other direct costs	Equipment	39,000.00 €	0.78
	Other (e.g., workshops, Open Access, Audit)	76,000.00 €	1.52
Indirect Costs		999,904.63 €	20.00
Total Costs		4,999,523.13 €	
Grant Request		4,999,523.13 €	

The "Other direct costs" includes the travel, equipment, event organisation, open access dissemination and other goods and services costs. The travel cost covers the travelling expenses related to: a) project/review meetings; c) dissemination events/ project workshops and open days (WP9); d) testing and evaluation (WP8) and e) travelling of AB members. Detailed justification of the other direct costs of the partners whose sum of these costs exceed 15% of their direct personnel cost is presented in Table 3.10.

Table 3.10: Other direct costs per partner (whose sum of these costs exceed 15% of their direct personnel cost)

Partner	**Cost(€)**	**Justification**
EVRPORT	**Total 35500€**	
Travel	**18,000**€	Team travel and accommodation - Project Meetings (x6), Dissemination Events/ Project workshops (x6) = Total 12 trips @ **€1,500** per trip=**18,000**€
Equipment	**10,000€**	EVRPORT is leading the activities relevant to System Architecture, Integration and Interactive Visualization techniques (WP7), thus equipment costs cover servers (x2) @ **€1,500 = 10,000€**
Other	**7,500€**	Travel costs of AB members, Workshop organisation
ACCELI	**Total 22,000€**	
Travel	**20,000€**	Team travel and accommodation - Project Meetings (x6), Dissemination Events/ Project workshops (x6) = Total 12 trips @ **€1,500** per trip+ Conferences (x1) @ **€2,000** per trip =**20,000**€
Other	**2,000€**	Workshop organisation
UniTN	**Total 28,000€**	
Travel	**20,000€**	Team travel and accommodation - Project Meetings (x4), Dissemination Events/ Project workshops (x8) = Total 12 trips @ **€1,500** per trip+ User Days (x2) @ **€1,000** per trip + Conferences (1x) @ **€2000** per trip =**22,000**€
Other	**8,000€**	Open Access publishing
IPTO	**Total 18,000€**	
Travel	**18,000€**	Team travel and accommodation - Project Meetings (x6), Dissemination Events/ Project workshops (x6) = Total 12 trips @ **€1,500** per trip=**18,000**€

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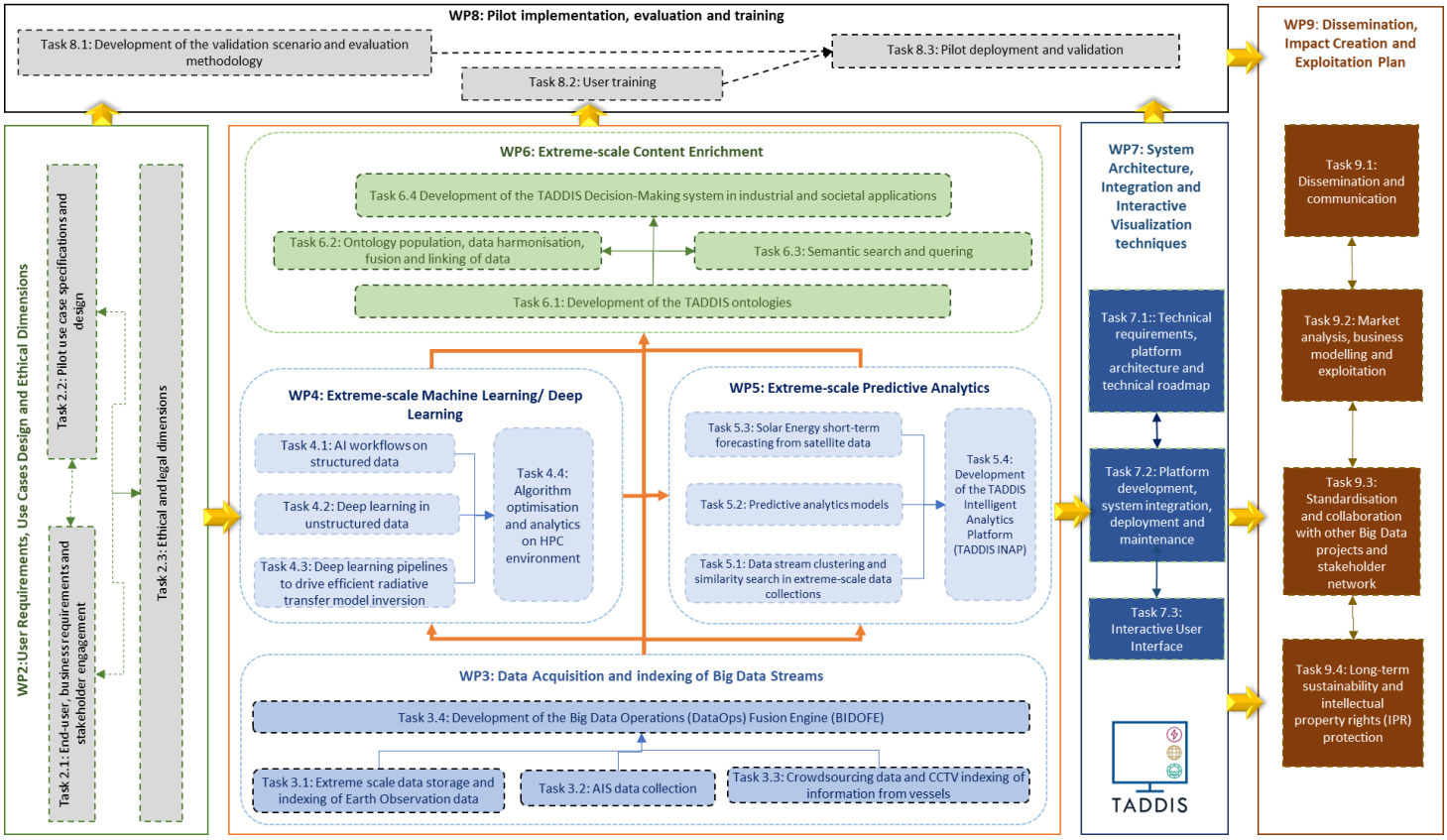
3.5 Project Schedule – Gantt Chart

Workplan	Start	End	Dur	Y1												Y2												Y3											
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1 Project Management and Coordination	**1**	**36**	**36**																																		
T1.1 Project Management & Coordination	1	36	36																																		
T1.2 Project Administration, Reporting and Financial Management	1	36	36																																		
T1.3 Quality Assurance, Ethical and Risk Management	1	36	36																																		
T1.4 Data management plan	1	36	36																																		
WP2 User Requirements, Use Cases Design and Ethical Dimensions	**1**	**32**	**32**																																		
T2.1 End-user, business requirements and stakeholder engagement	1	6	6																																		
T2.2 Pilot use case specifications and design	1	14	14																																		
T2.3 Ethical and legal dimensions	1	32	32																																		
WP3 Data Acquisition and Indexing of Big Data Streams	**1**	**30**	**30**																																		
T3.1 Extreme scale data storage and indexing of Earth Observation data	1	28	28																																		
T3.2 AIS data collection	1	28	28																																		
T3.3 Crowdsourcing data and CCTV indexing of information from vessels	1	28	28																																		
T3.4 Development of the Big Data Operations (DataOps) Fusion Engine (BIDOFE)	3	30	28																																		
WP4 Extreme-scale Machine Learning/Deep Learning	**3**	**32**	**30**																																		
T4.1 AI workflows on structured data	3	30	28																																		
T4.2 Deep learning in multimedia data	3	30	28																																		
T4.3: Deep learning in multisensor and multisource Earth Observation data	3	30	28																																		
T4.4: Deep learning pipelines to drive efficient radiative transfer model inversion	3	30	28																																		
T4.5: Federated learning	3	30	28																																		
T4.6 Algorithm optimisation and analytics on HPC environment	3	32	30																																		
WP5 Extreme-scale Predictive Analytics	**3**	**32**	**30**																																		
T5.1 Data stream clustering and similarity search in extreme-scale data	3	30	28																																		
T5.2 Predictive analytics models	3	30	28																																		
T5.3: Solar Energy short-term forecasting from satellite data	3	30	28																																		
T5.4 Development of the TADDIS Intelligent Analytics Platform	3	32	30																																		
WP6 Extreme-scale Content Enrichment	**1**	**32**	**32**																																		
T6.1 Development of the TADDIS ontologies	1	18	18																																		
T6.2 Ontology population, data harmonisation, fusion and linking of data	1	24	24																																		
T6.3 Semantic search and quering	13	32	20																																		
T6.4 Development of the TADISS Autonomous Decision-Making system in industrial and societal applications	3	32	30																																		
WP7 System Architecture, Integration and Interactive Visualization techniques	**1**	**32**	**32**																																		
T7.1 Technical requirements, platform architecture and technical roadmap	1	9	9																																		
T7.2 Platform development, system integration, deployment and maintenance	10	32	23																																		
T7.3 Interactive User Interfaces	10	32	23																																		
WP8 Pilot Implementation, Evaluation and Training	**13**	**36**	**24**																																		
T8.1 Development of the validation scenario and evaluation methodology	13	36	24																																		
T8.2 User training	13	36	24																																		
T8.3 Pilot deployment and validation	13	36	24																																		
WP9 Impact Creation, Dissemination and Exploitation	**1**	**36**	**36**																																		
T9.1 Dissemination and communication	1	36	36																																		
T9.2 Market analysis, business modelling and exploitation	1	36	36																																		
T9.3 Standardisation and collaboration with other Big Data projects and	1	36	36																																		
T9.4 Long-term sustainability and intellectual property rights (IPR) protection	13	36	24																																		
Milestones									MS1						MS2								MS3										MS4						MS5

3.6 Pert Diagram



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TADDIS: AI TECHNOLOGIES AND SEMANTIC DATA FUSION FOR ENHANCED ANALYTICS AND DECISION-MAKING ON TREMENDOUS AMOUNTS OF DIVERSE DATA STREAMS IN MARITIME, ENERGY AND SPACE

Work programme topic addressed

ICT-51-2020: Big Data Technologies and Extreme Scale Analytics

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ict-51-2020

Coordinator

Ana González Segura, EVERIS Spain, SLU, Spain, ana.gonzalez.segura@everis.com

Part. no.	Participant organisation name	Part. short name	Country
1 (CO)	Everis Spain, SLU	EVR	Spain
2	Barcelona Supercomputing Center	BSC	Spain
3	Information Technologies Institute, Centre for Research and Technology Hellas	CERTH	Greece
4	Polytechnic University of Catalonia	UPC	Spain
5	SercoItaliaSpA	SERCO	Italy
6	National Observatory of Athens	NOA	Greece
7	Accelligence	ACCELI	Cyprus
8	XLAB razvojprogramskeopreme in svetovanje doo	XLAB	Slovenia
9	Independent Power Transmission Operator	IPTO	Greece
10	Physikalisch-MeteorologischesObservatoriumDavos/World Radiation Center	PMODWRC	Switzerland
11	ANEK Lines SA	ANEK	Greece
12	Exus Software LtD	EXUS	United Kingdom
13	EverisPortugal SL	EVRPORT	Portugal
14	National and Kapodistrian University of Athens	UoA	Greece
15	University of Trento	UniTN	Italy

No	AB Name	AB Institution
1	PedroPuigdengoles Briones	Ports de Les IllesBalears
2	Antoni Tio Sauleda	AssociacioBarcelonaClusterNautic
3	Oriol AltisenchiBarbeito	Canals i Ports de Catalunya
4	Grigoris Antoniou	University of Huddersfield
5	John Soldatos	University of Glasgow
6	Gerardo Gantes Rodriguez	MRCC Barcelona
7	HoonJoo Yoon	SundosoftLtD
8	George Vouros	University of Piraeus
9	Philippe Chrobocinski	Airbus Defence and Space

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4 Members of the consortium

4.1 Participants

4.1.1 EVERIS Spain, SLU (EVR)

Organisation type:	Large enterprise	**Web:**https://www.everis.com/global/en

Profile of the organization (short description):

Everis Spain (based in Madrid, Spain) is part of the Everis Group, multinational large industry that offers its clients comprehensive business solutions covering all aspects of the value chain, from business strategy through to systems implementation. It is active in the sectors of Telecom, Banking, Healthcare, Industry, Insurance, Media, Public Sector and Utilities. Everiswas established in Spain in 1996 as DMR Consulting, its name until October 2006. It started operating in Spain with the opening of an office in Madrid and Barcelona soon followed by expansion in Europe and Latin America. At present, the company has different offices in Spain, as well as in Argentina, Andorra, Belgium, Brazil, Chile, Colombia, Netherlands, Italy, Luxemburg, Mexico, Morocco, Peru, Portugal, UK, and USA. Currently, Everis has over 19,000 employees in 27 offices in 16 countries and its annual turnover is 1,030 Million Euro. In January 2014, became part of NTT Data group, which enables everis to offer a wider range of solutions and services through increased capacity as well as technological, geographical, and financial resources, establishing the 5th worldwide ICT Company integrated by more than 110,000 employees and with presence in 50 countries.

As ICT provider, everis is organised by sectors, from the business point of view, and we count on several technological key lines (Artificial Intelligence to be underlined). Thanks to our dual nature, both technological and business oriented, we can act as facilitators, providing a common place for technology solutions and their potential end users.

The company gathers experts on projects management, preparation and implementation of business and exploitation plans, software development and dissemination, as well as a wide range of technological knowledge, put at the innovation activities disposal. In addition, everis has proven expertise in identifying business benefits and change processes, without forgetting business strategy development under co-creative spirit together with our partners and clients, as well as the management decisions required to achieve these objectives. This focus provides a methodological framework that guarantees that investments and projects are evaluated in line with business results. Our professionals are experts in applying this approach to the whole range of services we offer to our clients. This way, we ensure the investment on TADDIS will end on new product/services on the market.

From the **technological perspective**, everis counts on **everis**Technology, transversal unit to assist to the rest of area for defining and implementing complex technological architectures. It includes several **key lines**, subjects identified as **core technologies** which will **transform the traditional IT business**, implying our present and future **value proposal to our clients**.

Everis Artificial Intelligence (everis AI) is the key line with the following services and assets:

- *Digital Intelligence & Advanced Analytics*: Exploiting new sources of data for supporting **strategic decision making**. Using methods, models and advanced analytical technics to improve knowledge and business intelligence, **predicting and measuring** its impact on business.
- *EverisBigData Technology*: Our experience in large projects allows us to offer a **Big Data´s Architecture Reference Model**, functional and technological, as well as any kind of advice on its implementation, integration and governance
- *AI Accelerators*: Portfolio of **innovative analytical solutions and components** to address specific use cases. The continuous monitoring of trends and market solutions allow us to select the best alternatives according to criteria of functional envisioning and evolved technologies

everis IA team has ability for promoting the generation of cognitive solutions, using cutting-edge technology that explores the value and knowledge implicit in the data. AI act as a lever to improve services for customers / users, supported by the current technological structures and integrated in the management and operation processes.

Within our Unified Business Analytics platform, the Cognitive Applications Development Centre (CADC) has developed **everisMoriarty** (www.everismoriarty.com) (together with ITAINNOVA), one of the **most advanced workbench in the world** for the **creation of cognitive applications** based on the factorization of analytical models,

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as shown on the **Gartner report "Market Trends: top Five Buyer Expectations of Intelligent Automation in Data and Analytics Services"**, on march 2017, being part of **Gartner Magic Quadrant**. The CADC mission is to drive solutions using state-of-art technology that exploit data and knowledge, and**create cognitive enterprises and services**. This tool gives possible to **reduce by 40% the development and deployment of software analytics** by reusing analytical and cognitive services on a continuous integration cycle. It is also the base of the **citizens profiling**, so advanced user profiling strategies can arise and provide a better knowledge about the users and clients. We are full members of the Big Data Value Association (BDVA).

everis IoT (https://www.everis.com/spain/es/whatwedo/technology/IoT) works together with clients under an open innovation concept, in order to provide IoT services. everis counts on **areas along the whole IoT value chain**, from **business models** (pay per use, sensors integration scenarios, prevention use cases, etc.) to **knowledge areas** on infrastructures, technologies and IoT solutions. Our team is dedicated to various services lines to create Smart Solutions. everis IoT counts on **four strategic action fields**: Smart Cities, Industry 4.0, Utilities & Logistics and Digital Life. Moreover, **Everest Group** in the report "IoT services PEAK Matrix Assessment and Market Trends 2017: Have You Taken the Plunge in IoT Yet?" where it analyzes the latest trends in the market of IOT services in the race for digital transformation, places NTT DATA, thanks to the Key Line everis IoT, in a relevant position within the **"Magic Quadrant" of IoT**, which compares the power and relevance in terms of IoT of more than 18 IT service providers.

everis Artificial Intelligence team has ability for promoting the generation of cognitive solutions, using cutting-edge technology that explores the value and knowledge implicit in the data. AI act as a lever to improve services for customers / users, supported by the current technological structures and integrated in the management and operation processes.

everis Cloud (https://everis.cloud/en/) is the **expert offer of cloud solutions and services** by everis Group, and is also the **method** used so that organizations can obtain all the advantages of Cloud working in a faster, more effective manner. This model makes **easier and more effective the advantages of cloud adoption** in any organization. Cloud is the key word for **digital transformation**, including not only technological changes but also cultural, financing and processes design changes. Everis acts as Sherpa to **help clients to transform into cloud**, by using methodologies, tools, assets and experiences in hybrid cloud environments.

everis Blockchain is the **Technological Key Line** devoted to the **study, development and implementation of Blockchain based technologies, products and services**. Everis experiments and **prototypes practical use cases** around blockchain. **Everis has been forging a path for implementing blockchain**, demonstrating both the viability of the technology while providing a mechanism to measure business impact.

Moreover, everis offers an **end-To-end solution for Knowledge Management** (Smart Knowledge Management - SKM), over a complete technological platform, based on techniques of **Artificial Intelligence and ontologies** in order to have an intelligent management of the Knowledge.

As a global knowledge management tool, it covers the whole lifecycle of the value chain content information. It takes into account all sources of knowledge, both **structured and non-structured data** and extracts the information corresponding to the ontology modelling, storing it in the form of triples in a **graph database**. Relationships and inferences are generated in a graph database to enrich, connect and give value to the knowledge of the contents. All this knowledge is made available to users through a **website customized for each user** that allows searches in **natural language**, and allows navigation complete by the ontology.

Users can perform the "end-use" of this knowledge through a **front profiling** for each user, computer, or area, where they can make queries in **natural language**. In any case, access to the knowledge of the system, have a REST API that can provide service to any other component, as web users, or other applications. The scope of the proposed solution includes to the REST API connector.

The technical solution of **Artificial intelligence is based on processes Text to Knowledge**, generation of multidimensional arrays of profiling of users (and other entities) and recommendation algorithms.

The modular and scalable architecture design in which is configured system, allows the substitution of components between alternatives and other suppliers. In this way, **algorithms and NLP processes, profiling and IA recommendations** might be implemented with solutions from other IA vendors as the graph database. All the components of the architecture are connected via API, allowing a great flexibility to fit every customer's need.

This internal initiative is developed by a team formed by staff legally linked to Everis Aragón, SL and Everis Spain SLU. This formality makes necessary to include Everis Aragón as linked third party in the project.

Main Tasks to be involved:

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Everis will serve as the Coordinator of the project, leading **WP1,**and will oversee all the activities and contributions of partners in tasks in **WP1**. Besides, everis has a wide experience in developing and commercializing technological solutions in different sectors. Therefore, the important market capabilities of everis will contribute to the exploitation activities, leading **WP9** devoted to exploitation, covering market analysis, business modelling and exploitation activities **(T9.2)** and long-term sustainability and intellectual property rights (IPR) protection activities **(T9.4).**

Main achievements relevant to the call:

- **Citizens' sentiment analysis to assist government decisions**: The Project was developed with the purpose of demonstrating how new technologies can be used to obtain the views or general feeling of citizens and assist decision -making in government. Through an application the citizen's comment the treatment received in the different institutions, these are analysed by a sentiment analysis algorithm, which provides results on the general sentiments of the treatment received by citizens in each of the administrations. Finally, the officials of the administrations government officials visualize the results using a web tool.
- **Development of Text Ming solutions** for the Insurance Sector, with the aims to introduce a document ingestion and Text Mining technologies (J2EE, OCR, Tokenization, Entity resolution, Solr, Mysql) and also profiling of Customers using social networks (J2EE, Crawling, Clustering, Sentiment Analysis, Entity extraction, categorization, Solr, Apache Tomcat).
- **European Retail Bank**: reduced its Operational Risk through Predictive analysis of the Business impacts related to business processes and IT platforms performance (Business Apps & Infrastructure). Beyond the Operational Risk we everis provided a comprehensive view that correlated business processes & employees KPIs with the related applications and infrastructure events. Implemented with a LAMBDA architecture based on fully Big Data Open-Source architecture (Cloudera Hadoop, MongoDB, Spark, EsperTech).
- **Multinational Corporate, Commercial & Retail Bank**: improved their Credit and Market Risk Management through enrichment with market feeds Semantic Analysis (based on Ontologies), providing real-time and predictive assessment. The market feeds sources were fully customisableand also the language sources for sentiment analysis in order to flexible targeting different geographical markets. In order to adjust to the specific models, the platform offered a flexible Algorithm repository. Implemented with a solution based on fully Big Data Open-Source architecture and our Platform for Rapid Prototyping of Smart Solutions in Big Data based on Artificial Intelligence Analytics (MoriartyTM). everis provided a cutting edge approach based on onthologies and semantic web analysis.
- IoT Cognitive System Project: Development of a cognitive surveillance system for the Guadalajara Police (Mexico), in order to support their activities on 4.5 Million people. Agents position, incidents and webcams are some of the data sources, analysing spatial temporal sequences, user types, crime prediction and anomalies detection, among others.

Participation in relevant EU projects:

everis has already participated in several European funded projects undertaking a wide range of activities such as technological development, industry reports and surveys, business plans, commercialisation programs, integration developments and Coordination management. Some of them have received the Excellence mark once finished. The most relevant projects are explained below:

- **POLYCARE** (European Commission, coordinator). The POLYCARE is a H2020 project that aims to develop and test a comprehensive care model (health and social) focusing on chronic patients (acute phases), supported by the use of information technologies and define the methodology of action among all the involved stakeholders in patient care: health, social, informal caregivers and even the patient. In addition the developed system will be adapted to the different realities of the functioning of health and socials services within the participating countries of the project.
- **SOCATEL** (European Commission): SOCATEL is an H2020 project funded under the call CO-CREATION-04-2017, aiming at creating a multi-modular and multi-stakeholder platform, providing through it a community and user-friendly environment, especially for elderly people. This way, they can participate on the process of provision of social services that will be offered in a more efficient way, thanks to the involvement of the final users of these services via co-creation processes. Interoperability and DSM objectives on digital inclusion compliance are part of the approach of SOCATEL project.
- **IAADAPTA** (European Commission): It is a CEF project funded under the call CEF-TC-2016-3, aiming at integrating, using and extending Automated Translation for CEF approved DSIs. IAADAPTA consortium delivered a scalable and highly secure platform for the provision of automated translation services that integrates, uses and extends the Automated Translation platform. Moreover, it helped foster the adoption of

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the Automated Translation Building Block by easing the integration of automated translation into crossborder European digital services, serve as a successful use case for future implementations.

- **DeepHealth** (European Commission, coordinator): The main goal of the DeepHealth project is to put HPC computing power at the service of biomedical applications with DL needs and, through an interdisciplinary approach, apply DL techniques on large and complex biomedical datasets to support diagnosis and to generate insights into complex diseases in a scalable and efficient way.
- **PROVENANCE** (European Commission): PROVENANCE is an H2020 project that will develop an innovative content verification monitor, combining blockchain and multimedia analytics technologies, with the aim of facilitating personalised solutions for content verification in social networks and web. This tool will provide a higher control of the social networks contents by the users, allowing the increase of of trust, openness and participation. The final result will include the development of an observatory for the fairness of the information and best practices in social networks

On the other hand, client-driven projects give everis deeper expertise not only on the technological solutions to be developed but also on the particular needs from clients, so TADDIS results can be well market oriented.

Personnel Involved:

Cristina Muñoz Alcalde (female): Industrial engineer, graduated from the University of Zaragoza in 2013. She works as an internal Product Management Consultant in everis Innovation Department, assessing potential products' viability and how to position them in order to maximize its value. She has used lean start-up methodologies to evolve technological innovations into marketable products, minimizing risk and rework along their life cycle. She has also experience as a Product Manager in other software development companies, as well as managing European Projects in the area of sustainability and bioplastics, where she has been involved in 6 different projects.

Gustavo Casanova Esteban (male): His passion and expertise in Finance and Innovation makes him to currently conduct the emerging technologies research and advisory on strategy and finance of innovative ventures and assets in everis. Proven track record of delivering top consulting and financial services and expertise designing and analyzing financial and operational models. Previously start-up CFO, VC analyst, Banking consulting and unsuccessful entrepreneur. 15 years in Financial Management, Banking Industry consulting, M&A and Venture Capital.

Ms. Elvira NarroArtigot (female) : Innovation Manager at EVERIS at Supported Smart Innovation department of the company for the past 2 years and SME instrument evaluator. She coordinates the participation of everis on National and European R&I projects, as part of the innovation boosting strategy inside the company and provides support on the internal management and following of different H2020 projects. 6 years' experience in project management of interactive television and mobile technologies, and managing R&D projects. Some references: Centro de Salud Virtual interactivo (Spanish Ministry of Economy) pursues the innovative elements of automation systems integration, videoconferencing, tele-assistance sensors measuring vital signs for several hospital systems and technologies: mobile (phonegap (Android, iOS, Windows Phone) and Interactive TV (HbbTV), Raia-Learning (Project of the Ministry of Industry): platform training (interactive TV, mobile, PC) with augmented reality objects and 3D playback and otherwise integrating an intelligent agent modifying course depending on student and student type (emotional, sympathetic, unsympathetic, etc).

Mr. MarcialValmorisco (male): Innovation Counsellor at EVERIS. He has previously worked during 10 years at ISDEFE as Head of R&D and Innovation Department, as well as coordinator of national and European Projects. He currently is Member of Committee of Traffic Air Management USA/Europe, Management Committee of Logistop Platform, EUROCAE working group 75 Traffic Alert and Collision Avoidance Systems (TCAS) and Advisor Committee of the Central-European Aeronautical Research Initiative Project.

Ms. Ana Gonzalez, PhD. (female): Solutions Knowledge expert at everis, she currently belongs to the Supported Smart and Innovation unit, devoted to the promotion of the innovation in the company. In particular, her main expertise is the preparation of different National and European R&I proposals and the management and coordination of funded projects. Despite having a strong background in health (having been part of the Health Innovation department for four years) she has participated in several projects in different areas (ICT, banking, cybersecurity, education, etc.). She obtained her Physics degree and PhD in Medicine from the University of Valencia "Estudio General" (UVEG). She has been working on R&D projects for about 8 years and after that, she has coordinated several ones, both form the LLP and Erasmus + program and also from H2020 program.

Significant Infrastructure and Equipment:

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Everis is a company with extensive possibilities in deploying all the resources necessary for the optimal development of their projects. everis will make available for all the consortium the following resources:

Everis Living Lab: Born with the aim of creating an ecosystem around the Open Innovation process, incorporating public administrations, companies, researchers and general public. User-centred, it provides tools for exploration, co-creation, experimentation and evaluation of innovative ideas, scenarios, concepts, technologies and methodologies for real life use cases. One of the greatest advantages of **Living Labs** is the mitigation capacity of real life mistakes, and the fast absorption of results from the "**quadruple helix**" (universities/research centers, industry, governments and society). This is mainly because the living lab is a space where results feed themselves and where a dynamic balance between all parties is reached.

everis headquarters in Madrid where multiple meeting rooms are available if required during project meetings or trainings. Furthermore, everis has offices in different countries along Europe. In case problems arise with the hosting partners by the time of a project meeting, everis could provide infrastructure support in those cities.

4.1.2 Barcelona Supercomputing Center (BSC)

Organisation type:	Research	**Web:**https://www.bsc.es/

Profile of the organization (short description):

BSC is at the service of the international scientific community and of industry that requires HPC resources. Our multidisciplinary research team and our computational facilities –including MareNostrum– make BSC an international centre of excellence in e-Science. Since its establishment in 2005, BSC has developed an active role in fostering HPC in Spain and Europe as an essential tool for international competitiveness in science and engineering. The centre manages the Red Española de Supercomputación (RES), and is a hosting member of the Partnership for Advanced Computing in Europe (PRACE) initiative. We actively participate in the main European HPC initiatives, in close cooperation with other European supercomputing centres. With a total staff of more than 500 R&D experts and professionals, BSC has been successful in attracting talent, and our research focuses on four fields: Computer Sciences, Life Sciences, Earth Sciences and Computer Applications in Science and Engineering.

Most of BSC's research lines are developed within the framework of European Union research funding programmes, and the centre also does basic and applied research in collaboration with leading companies such as IBM, Microsoft, Intel, Nvidia, Repsol and Iberdrola. The centre has been extremely active in the EC Framework Programmes and has participated in seventy-nine projects funded by it. BSC is a founding member of HiPEAC, the ETP4HPC and participates in the most relevant international roadmapping and discussion forums and has strong links to Latin America. Education and Training is a priority for the centre and many of BSCs researchers are also university lecturers. BSC offers courses as a PRACE Advanced Training Centre, and through the Spanish national supercomputing network among others. The quality of our investigation has been recognized by the Spanish government with the Severo Ochoa Excellence Centre grant for cutting edge Spanish science.

The BSC-CNS Computer Sciences Department focuses on building upon currently available hardware and software technologies and adapting these technologies to make efficient use of supercomputing infrastructures. The department proposes novel architectures for processors and memory hierarchy and develops programming models and innovative implementation approaches for these models as well as tools for performance analysis and prediction.

BSC has been a pioneer in research relating to Fog- Computing, starting from 2015 with an initial collaboration with Cisco to explore the new paradigms of Edge and Cloud computing. The collaboration resulted in contributions to define the Fog-Computing references for industry and academia. Since 2015, BSC has been working closely with Cisco and IBM research groups exploring new architectures for Fog, Edge and Cloud computing in different projects and joint research agreements.

Main Tasks to be involved:

BSC will lead activities related to algorithm optimisation and analytics on HPC environment **(T4.5)**. More specifically, the team willbe responsible of model optimization for large scale data processing algorithms and will work on the use of scalable programming models for extreme scale analytics.BSCwill also support technical activities of WP3, WP7 and WP8. BSC will also be responsible for standardisation and collaboration with other Big Data projects and stakeholder network **(T9.3)**, while they will take part in rest WP9 activities dealing with impact creation, dissemination and exploitation.

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Main achievements relevant to the call:

- **PATRONS**: Emission Models and Patterns through Machine Learning Analytics at Barcelona (PATRONS @ BSC) is a 5-year project funded by the Severo Ochoa Programme (GA SEV-2015-0493) awarded to the Barcelona Supercomputing Center. PATRONS @ BSC involves research on Time Series Modeling, Data Processing from Sensor Networks, Distributed and Edge Computing, targeting Environmental Models and Pollution Pattern Mining on cities. Also has the objective to maximize the collaboration between current research activities between the Earth Sciences and Computer Sciences Departments at BSC. PATRONS @ BSC aims to discover the precise relations between different types of emissions, from road traffic to maritime traffic in coastal cities, environmental and weather factors, and the resulting pollution and air quality. The methods and tools used for such purpose correspond to data mining and machine learning, from Stream Mining to Deep Learning techniques, oriented towards distributed computing using frameworks like Apache Spark and distributed DataBases like HBase and HIVE.
- **CALIOPE**. The air quality forecasting system CALIOPE (http://www.bsc.es/caliope/es) operationally provides public access to air quality forecasts in Spain forthe main pollutants (NO2, PM10, O3) for the next 24 and 48 hours

Participation in relevant EU projects:

- **HiEST**: Holistic Integration of Emerging Supercomputing Technologies (hiest.bsc.es) is a 5-year project funded by an ERC Starting Grant (GA 639595) awarded to Dr. David Carrera. HiEST involves research in Adaptive Learning Algorithms, Task Placement and Scheduling Algorithms, Data Placement Strategies and Software Defined Environments, and has the objective to maximize positive synergies between current research activities in the Computer Sciences Department at BSC. Hi-EST will develop advanced learning technologies to automatically model the performance characteristics of data centre workloads. The techniques developed at HiEST can be reused in TADDIS to improve performance of workloads.
- **CAMS_81**. The main objective of the project is to provide anthropogenic emission inventories in direct support of the Copernicus Atmosphere Monitoring Service (CAMS, https://atmosphere.copernicus.eu/)

Personnel Involved:

Dr. David Carrera (male) is the Head of the DataCentric Computing research group at the Barcelona Supercomputing Center (BSC). He was awarded an ERC Starting Grant in 2015 (‘HiEST’, 2015-2020), a prestigious ICREA Academia award in 2015 (2015-2020) and an ERC Proof of Concept grant in 2017 ('Hi-OMICS'). He was awarded a medal in the Agustín de Betancourt prize for young researchers in 2018 by the Spanish Royal Academy of Engineering. In 2018, a project led by Dr. Carrera was selected by the MIT-Spain "la Caixa" Foundation Seed Fund program that promotes border research in collaboration between Spanish institutions and the Massachusetts Institute of Technology (MIT). In 2010 he received an IBM Faculty Award for his activities in the field of data-centre resource management for Big Data workloads.

He has led a number of projects funded by the industry (over 2.5M€ in the last 10 years), in particular with Intel, Microsoft, Cisco and IBM. He is co-founder and Scientific Director of the start-up Nearby Computing SL, established in 2018 and seed-funded by the largest wireless network operator in Europe through an industrial partnership. He is co-author of 3 filed patents (one in the field of Cancer Genomics, two more in the area of Edge Computing, currently in industrial exploitation). He’s associate professor at the Computer Architecture Department at UPC, currently on extended leave.

Dr.Jordà Polo (male) received a M.S. from the Technical University of Catalonia (UPC) in 2009, and a Ph.D with honors from the same university in 2014. He currently leads a team of Ph.D students and postdocs at the Barcelona Supercomputing Center (BSC), doing research in software-defined infrastructures and data-centric architectures, proposing new models and algorithms for placement of jobs and data in future data-centers. More recently he has also been working on accelerating genomics workloads, and is a co-author of a patent on computational genomics methods. As part of this research, he has been leading projects and collaborations with both industrial and academic partners, including IBM Research, Intel, and MIT.

Dr. Marc Guevara (male) holds a B.S. in Industrial Engineering (Polytechnic University of Catalonia, Spain, October 2010) and a PhD in Environmental Engineering (Polytechnic University of Catalonia, Spain, December 2014). He is a postdoc researcher with 9 years’ experience in the areas of emission and air quality modelling. In 2010, he was enrolled as support engineer at the Earth Sciences Department of the Barcelona Supercomputing Center (BSC), and in 2014 moved to the emission working group coordinator position at BSC. His main expertise includes high resolution atmospheric emission modelling, air quality modelling, geographic information systems and

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environmental impact assessment. He coordinates the development of the in-house HERMES emission model, which is the emission core of the Spanish CALIOPE operational air quality system. He is co-chair of the Emissions Working Group of the Forum for Air quality Modelling (FAIRMODE) community. He has coordinated the development and implementation of an air quality forecast system for the Mexico City's Environment Secretary. He coordinates the Service Evolution work package of the Copernicus CAMS_81 – Global and Regional emissions service and participates in the Copernicus CAMS_50 – Regional production. He has participated in the Spanish air quality-related CALIOPE-And project, the FP7 Framework programme APPRAISAL and the PAISA project (CGL2016-75725-R). He has coauthored 19 papers in international scientific journals (Scopus 12h-index and 311 Citations), 4 book-chapter and several communications to International conferences. He is currently co-directing 1 PhD thesis.

Dr. Albert Soret (male) holds a PhD in Environmental Engineering from the Polytechnic University of Catalonia (Barcelona). He is head of the Services group at the Earth Sciences Department of the BSC. The group host ~24 engineers, physicists, social scientists, economists, communication experts, and air quality/climate researchers who try to bring the latest developments in earth sciences to the society. He is a postdoc researcher with 14 years of experience in the areas of Air Quality and Climate. His main expertise includes emission modelling, meteorological modelling, air quality modelling and climate services. His research facilitates technology transfer from local, national to international levels to advance sustainable development in key sectors such as energy, urban development, infrastructure, transport, health, and agriculture and water management. He is the principal investigator of the S2S4E project (EC-H2020). Member of the External Advisory Board of Clim2Power (ERA4CS). Work Package leader within Clim4Energy (Copernicus), VISCA (H2020) and MAGIC (Copernicus) and he is also involved in EC-FP7 and H2020 projects and CAMS contracts: NEWA, EUPORIAS, SPECS, IMPREX, PRIMAVERA, CAMS95 and APPRAISAL. He coordinated the development of an air quality forecast systems for Southern Spain-Andalucia and Canary Islands. He has participated in the Spanish air quality-related CALIOPE for the Spanish Ministry and the air quality forecast system for the Mexico City's Environment Secretary. His work has resulted in 11 peer-reviewed publications, five chapters in books, proceedings, and reports, more than 50 contributions to conferences/workshops/seminars. He is the supervisor of several postdocs and three Ph.D. students.

Significant Infrastructure and Equipment:

BSC hosts the MareNostrum supercomputer (a general-purpose block with 3,456 homogeneous nodes, total of 165,888 cores, and a cluster with three emerging technologies: IBM Power9 processors with NVIDIA Volta GPUs, Intel Knights Hill processors, and 64bit ARMv8 prototype machines). Although this infrastructure can be used for BSC internal research activities, it cannot be committed to external parties without the agreement of an access committee.

4.1.3 Information Technologies Institute, Centre for Research & Technology Hellas (CERTH)

Organisation type:	Research	**Web:**https://www.certh.gr

Profile of the organization (short description):

The Centre for Research and Technology-Hellas (CERTH), founded in 2000, is the only research centre in Northern Greece and one of the largest in the country. CERTH has important scientific and technological achievements in many areas including: Energy, Environment, Industry, Mechatronics, Information & Communication, Transportation & Sustainable Mobility, Health, Agro-biotechnology, Smart farming, Safety & Security, as well as several cross-disciplinary scientific areas. Today CERTH consists of the following five institutes: (a) Chemical Process & Energy Resources Institute (CPERI), (b) Information Technologies Institute (ITI), (c) Hellenic Institute of Transport (HIT), (d) Institute of Applied Biosciences (INAB), (e) Institute of Bio-Economy and Agri-Technology (iBO). In the CREST proposal CERTH participates through ITI.

CERTH is essentially a self-supported Research Centre generating an average annual turnover of ~25M€ coming from: (a) >30% from bilateral industrial research contracts, (b) >60% from competitive research projects, (c) <10% as government institutional funding. More than 700 people work at CERTH with the majority being scientists. CERTH has received numerous awards and distinctions such as the European Descartes Prize, the European Research Council (ERC) Advanced Grant, Microsoft International Contest Prize, the Trading Agents Competition Award and many more. In addition, CERTH is listed among the Top-20 of the EU's Research Centres with the highest participation in FP7 competitive research grants and is currently among the leading organisations in Greece in securing H2020 funding. CERTH has participated successfully in more than 1200 competitive research projects

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(with a total budget exceeding 450M€ and involving more than 1100 international partner organizations) financed by the EU, leading industries from USA, Japan and Europe, and the Greek Government via the General Secretariat of Research and Technology (GSRT). CERTH's research results (more than 350 publications per year) have significant scientific impact (about 7100 heterocitations/year). Four spin off companies have been already launched through CERTH's research activities.

Information Technologies Institute (ITI)

The Information Technologies Institute (ITI) of CERTH was founded in 1998 as a non-profit organisation under the auspices of the GSRT, with its head office located in Thessaloniki, Greece. Since 2000 it has been a founding member of the GSRT-supervised CERTH. ITI's areas of research relevant to CREST include deep learning methods, semantic multimedia analysis, Image and Signal Processing, Computer & Cognitive Vision, Pattern Recognition and Machine Learning, Human Computer Interaction, Virtual and Augmented Reality, Artificial Intelligence, Multimedia, Database and Information Systems and social media analysis as well as Security and Surveillance applications. CERTH-ITI is also an active member of the European Cyber Security Organisation (ECSO), i.e., the contractual counterpart to the European Commission for the implementation of the Cyber Security contractual Public-Private Partnership (cPPP).

The participating teams are:

1. The Multimedia Knowledge and Social Data Analytics laboratory (MKLab), has significant experience and scientific expertise on the technical aspects of CREST, namely semantic integration of heterogeneous resources, semantic reasoning, discovery and mining of heterogeneous multilingual and multimedia Web resources, including resources on the Surface and the Dark Web, social media monitoring, as well as on the processing and analysis of the multimodal data extracted from them. MKLab also has a wide experience in statistical machine learning based methods, semantic reasoning, analysis and interoperability, content and service representation, multimedia forensics, topic/event/community detection, and visual analytics.

   The team has also related experience in the security area, through coordinating H2020 SEC-DRS IA beAWARE "Enhancing decision support and management services in extreme weather climate events", technically managing H2020 SEC-BES IA ROBORDER "Autonomous swarm of heterogeneous robots for border surveillance", scientifically managing H2020 SEC-FCT RIA CONNEXIONs "Interconnected next-generation immersive IOT platform of crime and terrorism detection, prediction, investigation, and prevention services", and its leading roles in H2020 SEC-FCT RIA PROPHETS "Preventing Radicalisation Online through the Proliferation of Harmonised toolkits", H2020 SEC-FCT IA TENSOR "Retrieval and analysis of heterogeneous online content for terrorist activity recognition", and FP7 SEC CP-FP HOMER "Homemade explosives (HMEs) and recipes characterisation", as well as its participation to the EDA-funded project MEDUSA dealing with multisensor data fusion. MKlab has also participated to the surveillance tasks of TRECVID for many years and has established internal collaborations with the Hellenic Police (http://mklab.iti.gr/content/press-article-cooperation-iti-certh-hellenic-policeforensic-sciences-subdivision-northern-gr), the Belgian Federal Police, and Mossos d' Esquadra.

   In recent years, the team has coordinated and participated in more than 60 European and National research projects in the areas of multimedia processing, information extraction, and social media monitoring and analysis. More specifically MKLab currently coordinates the H2020 SEC-DRS IA beAWARE, H2020 ICT RIA ChainReact, H2020 ICT IA Envisage, H2020 ICT IA InVID, H2020 ICT RIA MAMEM, H2020 INSO RIA MOVING, and H2020 ICT RIA V4Design. In addition MKLab is the technical manager in H2020 SEC-BES IA ROBORDER and H2020 EO RIA EOPEN, the scientific manager in H2020 SEC-FCT RIA CONNEXIONs, and it has leading roles in SEC-FCT RIA PROPHETS, H2020 SEC-FCT IA TENSOR, H2020 IOT IA ACTIVAGE, H2020 ICT RIA DigiArt, H2020 IA EMMA, H2020 ICT RIA hackAIR, H2020 ICT PROFIT, H2020 ICT RIA ReTV, H2020 ICT STEP, H2020 ICT RIA SUITCEYES. MKLab has also successfully coordinated the FP7 ICT STREP MULTISENSOR, FP7 ICT IP Dem@Care, FP7 ICT IP WeKnowIt, and FP7 ICT IP SocialSensor, and has participated in FP7 SEC CP-FP HOMER, H2020 ICT KRISTINA, FP7 ICT Live+Gov, FP7 ICT REVEAL, FP7-ICT i-Treasures, FP7 ICT STREP WikiRate, FP7 ICT IP LinkedTV, FP7 ICT ForgetIT, FP7 ICT PERICLES, FCT ICT USEMP, and FP7 ICT STREP PESCaDO.

   The team also exploits the results of European projects through its spin-off companies Infalia (www.infalia.com) and Carealia (www.carealia.gr).

2. The CERTH/ITI involved research team, namely ConvCAO (www.convcao.com), which employs a high-quality scientific group of personnel for data privacy and decision support. The research team of Prof. Elias Kosmatopoulos (ConvCAO) has coordinated the FP7 ICT project AGILE (on reconfigurable/self-tuneable

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control of large complex systems), PEBBLE (on control and optimization of positive-energy buildings), the FP7 ICT project LOCAL4GLOBAL on control for systems-of-systems such as blocks-of-buildings and the H2020 project PLUG-N-HARVEST on control of Buildings with Multifunctional External Shells.

Main Tasks to be involved:

CERTH will be the leader of **WP4** dealing with extreme-scale machine learning activities, covering the tasks related to the deep learning in unstructured data **(T4.2)** and federated learning **(T4.4).**In addition, CERTH will be responsible for crowdsourcing data and CCTV indexing of information from vessels **(T3.3)** and data stream clustering and similarity search in extreme-scale data collections **(T5.1)**. In addition, CERTH will be contributing to a number of technical tasks led by other consortium members, particularly in WP3, WP5, WP6 and WP7 alongside with the dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

- Gialampoukidis, I., Chatzilari, E., Nikolopoulos, S., Vrochidis, S., & Kompatsiaris, I. (2019). Multimodal Fusion of Big Multimedia Data. *Big Data Analytics for Large-Scale Multimedia Search*, 121.
- Gialampoukidis, I., Vrochidis, S., Kompatsiaris, I., & Antoniou, I. (2019). Probabilistic density-based estimation of the number of clusters using the DBSCAN-martingale process. *Pattern Recognition Letters*, 123, 23-30.
- Vrochidis, S., Moumtzidou, A., Gialampoukidis, I., Liparas, D., Casamayor, G., Wanner, L., ... &Simeonov, B. (2018). A multimodal analytics platform for journalists analysing large-scale, heterogeneous multilingual and multimedia content. *Frontiers in Robotics and AI*, 5, 123.
- G. Vingione, G. Scarpino, L. Marzell, T. Pettengell, I. Gialampoukidis, S. Andreadis, S. Vrochidis, I. Kompatsiaris, B. Valentin, L. Gale, W.-K. Lee, W. Lee, M. Gienger, D. Hoppe, V. Sitokonstantinou, I. Papoutsis, C. Kontoes, F. Baruffi, M. Ferri, H. Yoon, A. Karppinen and A.-M. Harri, "EOPEN: Open interoperable platform for unified access and analysis of earth observation data", *Proc. of the 2019 conference on Big Data from Space (BiDS'19)*, doi:10.2760/ 848593, pp. 1–4, Munich, Germany, 2019.
- E. B. Kosmatopoulos, I. T. Michailidis, C. D. Korkas and C. Ravanis, "Local4Global Adaptive Optimization and control for System-of-Systems," 2015 European Control Conference (ECC), Linz, 2015, pp. 3536-3541.doi: 10.1109/ECC.2015.7331081
- • S. Baldi, I. Michailidis, E. B. Kosmatopoulos and P. A. Ioannou, "A "plug and play" computationally efficient approach for control design of large-scale nonlinear systems using cosimulation: a combination of two "ingredients" ", in IEEE Control Systems, vol. 34, no. 5, pp. 56-71, Oct. 2014, doi: 10.1109/MCS.2014.2333272

Participation in relevant EU projects:

- **H2020 ICT 779962 V4Design (https://v4design.eu/)** Visual and textual content re-purposing FOR(4) architecture, Design and video virtual reality games
- **H2020 EO RIA 776019 EOPEN (https://eopen-project.eu/)** Open interoperable platform for unified access and analysis of Earth Observation data
- **H2020 ICT 8254080 SODALITE (https://www.sodalite.eu/**) SOftware Defined AppLication Infrastructures managemenT and Engineering
- **H2020 ICT 825079 Mindspaces** (**http://mindspaces.eu/**) Art-driven adaptive outdoors and indoors design
- **H2020 DT ICT 824964 DIH^2 (http://dih-squared.eu/**) A Pan-European Network of Robotics DIHs for Agile Production

Personnel Involved:

Dr. Stefanos Vrochidis (male) received the Diploma degree in electrical engineering from Aristotle University of Thessaloniki, the MSc degree in radio frequency communication systems from University of Southampton, and the PhD degree in electronic engineering from Queen Mary, University of London. He is a senior researcher with CERTH-ITI. His research interests include multimedia analysis, computer vision for robotics, web and social media mining, semantics, information retrieval, multimodal analytics, decision support, as well as security applications including crisis management, fight crime and terrorism and border surveillance. Currently, Stefanos Vrochidis is the Project Coordinator of H2020 ICT V4Design, the deputy Project Coordinator of H2020 SEC beAWARE, the Technical Manager of H2020 EO EOPEN, and the Scientific Manager of H2020 SEC CONNEXIONs. He also participates as WP and task leader in H2020 SEC TENSOR, H2020 SEC ROBORDER, H2020 SEC PROPHETS

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and H2020 ICT hackAIR. Dr. Vrochidis was the Scientific Manager and acting Project Coordinator of the FP7 project MULTISENSOR, the Interaction Coordinator of The European Network on Integrating Vision and Language (iV&L Net), and has successfully participated as WP and task leader in many other European and National projects (e.g. KRISTINA, HOMER, PESCaDO, PATExpert, ELU) and co-authored more than 115 related journal and conference publications.

Dr. Ioannis (Yiannis) Kompatsiaris (male) is a Senior Researcher (Researcher A') with CERTH and head of the Multimedia Knowledge & Social Media Analytics lab. His research interests include semantic multimedia analysis, indexing and retrieval, social media and big data analysis, knowledge structures, reasoning and personalization for multimedia applications, eHealth and environmental applications. He is the co-author of 80 papers in refereed journals, 38 book chapters, 8 patents and more than 250 papers in international conferences. He has participated in 26 EC funded projects, in 6 as the co-ordinator and he has been the co-organizer of various international conferences and workshops and has served as a regular reviewer for a number of journals and conferences. He is a Senior Member of IEEE and member of ACM.

Dr. Ilias Gialampoukidis (male) received the Bachelor degree in Mathematics and the M.Sc. in Statistics and Modelling from the Aristotle University of Thessaloniki, where he also received a PhD degree in Mathematics, with a special interest in applied mathematics, time series analysis, stochastic modelling, and network analytics. He has been awarded the "Aristeia" Postdoctoral Fellowship 2016 from the Aristotle University of Thessaloniki, Greece, and the 2nd prize of the Copernicus Thessaloniki Hackathon in 2019. At the moment, Dr. Ilias Gialampoukidis is an interdisciplinary postdoctoral researcher at CERTH-ITI and he serves as a Work Package leader in H2020 EO EOPEN (http://eopen-project.eu/), and in H2020-DRS-aqua3S (https://aqua3s.eu/) and as a task leader in H2020-beAWARE (http://beaware-project.eu/). He has served both as a reviewer and as rapporteur of the COST Association evaluations. His research interests involve information retrieval, Big Data analytics, multimodal fusion, supervised (deep) and unsupervised learning, and social media analytics. He has co-authored more than 40 publications in international journals and conferences.

Gerasimos S. Antzoulatos(male) received his B.Sc. Degree in Mathematics in 1999 and a M.Sc. Degree in "Computer Mathematics and Decision Making" of the University of Patras in 2002. Since January 2018 he works as a Research Associate at the Information and Technologies Institute of the Centre for Research and Technology Hellas (CERTH/ITI).His research interests include Computational Intelligence methods and their application to Machine Learning, Business Intelligence and Predictive Analytics. He worked as lecturer at many departments at Higher Technological Educational Institute of Patras and as a Consultant in Data Research & Consulting Company S.A.. From 2015 until 2018, he worked in the research and development department of I2S SA where his main duties include design, development and evaluation of Data Analytics technologies and tools in Aquaculture and maintenance field. Also, he was a member of a research team working on two prestigious Horizon2020 projects, BlueBRIDGE and AquaSmart.

Pf. Elias Kosmatopoulos (male),received the Diploma, M.Sc. and Ph.D. degrees from the Technical University of Crete, Greece, in 1990, 1992, and 1995, respectively. He is currently an Associate Professor with the Department of Electrical & Computer Engineering, Democritus University of Thrace, Greece and a Collaborative Academic Partner with the *Information Technologies Institute (ITI) under the Centre for Research and Technology Hellas (CERTH)*. He has recently been involved in 7 FP7 ICT projects, being the project coordinator in 5 of them. His research interests lay in the areas of smart adaptive/learning control and optimization techniques for cyber physical systems, including also respective real-life applications.

Dr. Christos Korkas (male) received the Diploma and Ph.D. degrees from the Department of Electrical and Computer Engineering, Democritus University of Thrace, Xanthi, Greece, in 2013 and 2017, respectively. He is currently a postdoctoral researcher with the Centre for Research and Technology Hellas, Information Technologies Institute, Thessaloniki, Greece. During the past years, he has been involved in 7 EU FP7 and H2020 funded IP Research and Development projects. His research is mainly focused on distributed optimization and control of large-scale complex systems with unknown dynamics.

Significant Infrastructure and Equipment:

Through its involvement in the aforementioned projects, MKLab has built an infrastructure of considerable computational capacity (100+ cores, 600+GB RAM, 40+ TB storage) and developed a sophisticated distributed architecture for data collection and indexing, as well as a variety of cutting-edge data mining and retrieval algorithms. The team is therefore in excellent position to support a wide range of data collection, mining and indexing needs within research and innovation projects.

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4.1.4 Polytechnic University of Catalonia/UniversitatPolitècnica de Catalunya (UPC)

Organisation type:	Research	**Web:**https://www.upc.edu

Profile of the organization (short description):

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

UniversitatPolitècnica de CatalunyaBarcelonaTech (UPC), is a public institution dedicated to higher education and research, specialised in the fields of architecture, engineering and technology. It is one of the biggest universities in Spain, with over 30.155 students, 30 departments and 226 research groups. It is the UPC's mission to create knowledge, innovate, develop technology and make this technology available to society. With this mission in mind, it works to drive innovation and become the preferred technology partner of companies and institutions.

The UPC is close to the people who make up the university community, to prospective students, researchers, entrepreneurs, institutions and companies. Projects focused on development cooperation, sustainability, volunteering and the promotion of scientific culture that are launched by students and teaching and administrative staff every year offer proof of this desire for proximity and passion for service, which the UPC expresses in accordance with the principles of participation, transparency and equal opportunity.

The UPC hosts the Barcelona School of Nautical Studies (FNB), which is the only Nautical School in Catalunya, and also the oldest in Spain.80% of the researchers teaching in FNB work in the Department of Nautical Sciences and Engineering (CEN), which is the only department that provides training in the areas of naval, maritime and nautical engineering in Catalonia. CEN is a dynamic, modern research and teaching department that has high-end facilities and a multidisciplinary team of more than 75 experts in the fields of naval and maritime engineering and the nautical sciences.

CEN conducts research actively in the fields of marine engineering and naval architecture focusing viability study of marine transport chains, compared with the road alternative. It is involved in exploring new tools and areas, to promote sea transport from different points of view like the operational, legal and economical, sides.

The following activities define the main research lines developed during the last 10 years:

- Analysis of costs and the environmental impact of maritime routes based on optimization algorithms (specifically in short sea shipping lines), in order to reduce road congestion and pollution. The route optimization algorithm considers, among other things, the meteorological conditions of the route, ship's costs and polluting emissions.
- Analysis of the characteristics of ship manoeuvring (distance from the pier wall, distance from the propellers to the bottom, use of the stern or bow thruster) and obtaining a formulation that allows the ship's physical characteristics to be related to the evolution of the erosion generated in the docks to be able to anticipate the damages in the structures.
- Sustainability of maritime transport

Main Tasks to be involved:

UPC will lead **WP4**, namely Data Acquisition and Indexing of Big Data Streams. In addition, UPC will be contributing to a number of technical tasks, particularly in WP2, WP7, and WP8 alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

- Llull, T., Mujal-Colilles, A., Castells, M., Gironella, X., Composite methodology to prevent ship propeller erosion (2019). *Ocean engineering*. p. 106751:1-106751:11
- Mujal-Colilles, A., Bagés, C., Fonollosa, J. (2020) Maneuvering operativity maps using AIS data, *Accepted for the Proc. of the 5th International Conference on Maritime Technology and Engineering in* Lisbon 2020
- Castro, T., Fonollosa, J., Mujal-Colilles, A. (2020). Numerical modeling of underwater noise induced by shipping traffic in the Balearic Sea. *Accepted for the Proc. of the 2020Oceans conference in* Singapore, 2020.
- Usabiaga, J.J.; Castells, M.; Martinez, F. J.; Ölcer, (2013) A simulation model for road and maritime environmental performance assessment. Journal of Environmental Protection Vol. 4, num. 7, p. 753-759 DOI: 10.4236/jep.2013.47079

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- Castells, M.; Usabiaga, J.J.; Martinez, F. J. (2013) Manoeuvring and hotelling external costs: enough for alternative energy sources? Maritime Policy & Management p.1-19 DOI: 10.1080/03088839.2013.782441

Participation in relevant EU projects:

- **H2020-815083-COREWIND** (https://cordis.europa.eu/project/id/815083) Floating offshore wind is still a nascent technology and its LCOE is substantially higher than onshore and bottom-fixed offshore wind, and thus requires to be drastically reduced
- **IAMU-2019**. Calibrating ship emissions with AIS data and field measurements
- **IAMU-2016**. DAME: Data Alternative for Marine Efficiency monitoring: overcoming constraints in the development of an on-board fuel data collection scheme
- **2014-EU-STM-0206-S- STM Validation Project**. The main objective of the Action was to validate the target concept of Sea Traffic Management (STM), by establishing large-scale test beds for Sea Traffic Management in the Nordic region and in the Mediterranean Sea. In these test beds, Voyage Management, Flow Management and Port Collaborative Decision Making (CDM) were tested and validated in practice.
- **2007- ANTARES**: Analysis of environmental efficiency of the application of different types of high-speed vessels in short sea lines against the road alternative

Personnel Involved:

Dr. Anna Mujal-Colilles(female) is a Serra Húnter Lecturer at UPC. Civil Engineering (UPC, 2008), PhD in Civil Engineering (UPC, 2013). She has participated in several EU and national funded research projects. She is in charge of the AIS system at the CEN and has leaded the use of the data for several purposes including ship emissions, underwater noise contamination, ship collisions, ship traffic and port-queuing management.

Prof. Marcella Castells-Sanabra(female) is an Associated Professor at UPC. Nautical Science and Engineering (UPC, 2001), PhD in Nautical Engineering (UPC, 2009). She has participated in several EU Framework Programme and TEN-T projects and also in national research projects. she is the Coordinator of the Master's degree in Nautical Science and Maritime Transport Management. Her research is mainly focused on maritime transport, optimization of short sea transport chains from economic and environment point of view and Maritime Education and Training.

Dr. Jordi Fonollosa (male) is Lecturer at the UPC, under the Serra Húnter Programme. He holds a BS in Physics (Universitat de Barcelona, UB, 2003), a BS in Electronic Engineering (UB, 2007) and a PhD in Electronic Engineering and Advanced Technologies (UB, 2009). He has participated in different EU and national funded research projects in the fields of smart sensors, development of algorithmic solutions for multi-sensor systems and data integration. His publication record includes 25 papers published in international journals. He is member of the B2SLab.

Prof. Xavier Martínez de Osés (male) is an Associated Professor at UPC. Nautical Science and Engineering (UPC, 1998), PhD in Nautical Engineering (UPC, 2003). He has participated in several EU Framework Programme and TEN-T projects and also in national research projects. He is in charge of the TRANSMAR Research Group whose main research lines are short sea shipping operational viability and emissions analysis, ship collisions, ship traffic and port-queuing management.

Significant Infrastructure and Equipment:

CEN hosts an AIS receiver (SeaTraceR AIS Class B Transponder S.287) covering an area ranging from Barcelona to the Balearic Islands (approximately 120 nautical miles). AIS uses VHF channels to transmit dynamic (e.g. lat-lon position, velocity, heading) and static (e.g. vessel dimensions, the port of arrival) data and is mandatory for all international voyaging ships with a gross tonnage larger than 300 GT.

B2SLab research group at the UPC will support this project with the high performance computing platform existing in the center. This is composed by a hybrid Hewlett-Packard Blade System BL280/BL460c totaling 144 CPUs with R statistical software with distributed computing capabilities as well as a Hadoop Map Reduce interface. The platform is offered to the project to hold an integrated relational database hosting data corresponding to recordings, data encryption and computational resources for database mining, statistical analyses, feature selection and extraction and signal processing computations.

4.1.5 Serco Group plc (SERCO)

Organisation type:	Industry	**Web:**https://www.serco.com/

Profile of the organization (short description):

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Serco Group plc is a worldwide company specialised in the management and operation of outsourced services for the public and private sectors. Founded in 1929, with its headquarters located in Hook in the UK, Serco commands revenues of £3.5bn, employs over 70,000 staff and delivers services in 30 countries. Serco is a values-led company which places a strong service ethos at the heart of everything we do. We improve services by managing people, processes, technology and assets more effectively.

Serco has a unique breadth of experience in providing operational and engineering support for different entities:

- International organisations
- Government Agencies
- Defence
- Aerospace Industry
- End User Support Businesses
- Scientific Institutions

The scope of our activities has seen our staff operate worldwide in support of their customers and we have established a track record in a wide range of market sectors and geographies that allows us to share best practice, expertise and innovation in the business solutions we propose today.**Serco Italia is the legal entity in Italy specialised in the formation and provision of managed services to support the preparation, development, operation, quality control and maintenance of the European Earth Observation Satellite, Meteorology and Space Exploration Missions**.

In particular we are experienced in providing managed teams of engineers, technicians and operations specialists supporting a wide and deep range of EO activities concerning the Payload Data Ground Segment (PDGS), from data archiving and product processing, to ground systems development, operation and maintenance, to data production quality control, scientific support and data delivery to end-users.

SERCO is experienced in providing services to support the delivery and dissemination of Sentinels data products to the User community, including supporting and training of EO data users. Serco Italia is also the prime contractor of the ONDA-DIAS Service.

Main Tasks to be involved:

SERCO will serve as an end-user partner running PUC1: Extreme-scale analytics on ONDA DIAS platform. In addition, SERCO will lead **WP2**, namely User Requirements, Use Cases Design and Ethical Dimensions, and activities coping with the development of the validation scenario and evaluation methodology **(T8.1)**. Besides, they will lead the technical activities of extreme scale data storage and indexing of Earth Observation data **(T3.1)**. Finally, they will contribute to the impact creation activities of the project (WP9).

Main achievements relevant to the call:

For the present opportunity SERCO brings to the Consortium their specific relevant experience in the exploitation of Sentinels data, providing support and services to the growing community of Copernicus Users and the associated exploitation projects. Their relevant experience is exemplified by the following contracts where they are fully engaged in delivering excellent, pro-active services to ESA:

- ONDA- DIAS - Copernicus Data and Information Service: The European Commission (EC) has launched an initiative to develop Copernicus Data and Information Access Services (DIAS) that facilitate access to Copernicus data and information from the Copernicus services. By providing data and information access alongside processing resources, tools and other relevant data, this initiative is expected to boost user uptake, stimulate innovation and the creation of new business models based on Earth Observation data and information. Serco S.p.A. has been awarded to develop a DIAS Service for ESA. The four-year contract with the European Space Agency will involve Serco developing a cloud-based online platform offering a simple, user-friendly way for anyone to access Copernicus data and geospatial information via secure web services. The platform is set to launch in the first half of 2018, following a six month build and testing process.
- Sentinels Rolling Archive Products User Access, Operations, Maintenance and Evolutions – as prime contractor we are responsible for the development and operation of the Copernicus Sentinels Data Hub Services (DHuS) which provide free and open access to the latest Sentinel data products.

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Participation in relevant EU projects:

- **EOPEN: http://eopen-project.eu/**
- **MOSES: http://moses-project.eu/moses_website/**
- **Unity http://www.unity-project.eu**
- **AUGGMED http://www.auggmed-project.eu**

Personnel Involved:

Dr. Guido Vingione (male)graduated in Space Engineering and with a PhD in Space technologies. Senior programme manager with a wide-ranging background in system engineering; understanding the various Earth Observation Ground Segment systems architecture and interfaces: from data acquisition to its exploitation by end users. Responsible for the overall technical coordination of a large number of ESA projects in the Copernicus Programme, including management of sub-contractors and Integrated Teams coordination in an international environment. Bid Director of EC H2020 proposals. He has published many papers in specialized magazines, internal technical reports and has participated with his works at national and international conferences. At the present, Guido is acting as Commercial Director for Serco managing projects like ONDA and EOPEN. For the current project he will act as Contract Officer.

Maria Gabriella Scarpino(female)graduated in Atmospheric Physics (Univ. La Sapienza, Rome) and collaborated with the Atmospheric Physics Institute (CNR, Rome) on agro-meteorological modeling; she worked on soil moisture modeling, in the framework of the Italian-Israelis Research Council Exchange Program and on evapotranspiration estimation based on remote sensing data for the Italian Environmental Agency (Telespazio S.p.A.); she carried out the feasibility study of a Regional Agro-meteorological Service for the Italian Basilicata Region (Metapontum Agrobios, Project Coordinator); under ESA contracts she has been involved in training courses on environmental applications of EO data and on EO project monitoring; in the last years she has been working in the Instrument Data quality Evaluation and Analysis Service. She is actually the deputy coordinator of the project EOPEN considered a perfect reference for the present proposal.For the current project she will act as Coordinator of Serco tasks.

Mario D'Alessio(male): Civil and Environmental Engineer with technical and commercial experience in the Geospatial and Space industries. Business Developer with analytical mindset and strong communication skills, able to efficiently identify customer's challenges, and clearly demonstrate the unique benefits of solving them with company's products and services.For the current project he will act as Product Assurance.

Marco Cavicchioni(male). Experience Service manager in the EO ground segment domain. He has followed a large number of ESA operational projects being in charge of Service governance, operations coordination and service monitoring and evolution.

Arduino Pepe(male). Experienced ICT Architect with proven experience in design and delivery of Enterprise and High Availability Ground Segment projects based on Cloud technologies. Arduino is working as cloud architect on ONDA Service to migrate On-premise VMware infrastructure to private cloud OVH SDDC based on VMware and NSX software defined network. His tasks include: implementation of a centralized Logging Platform using Elasticsearch and Graylog, delivery of a managed containers infrastructure based on kubernetes and openstack cloud provider, network and security topology design implementation and monitoring. For the current project he will act as Cloud and Security Engineer.

Significant Infrastructure and Equipment:

ONDA- DIAS - Copernicus Data and Information Service: The European Commission (EC) has launched an initiative to develop Copernicus Data and Information Access Services (DIAS) that facilitate access to Copernicus data and information from the Copernicus services. By providing data and information access alongside processing resources, tools and other relevant data, this initiative is expected to boost user uptake, stimulate innovation and the creation of new business models based on Earth Observation data and information. Serco S.p.A. has been awarded to develop a DIAS Service for ESA. The four-year contract with the European Space Agency will involve Serco developing a cloud-based online platform offering a simple, user-friendly way for anyone to access Copernicus data and geospatial information via secure web services. The platform is set to launch in the first half of 2018, following a six month build and testing process.

4.1.6 National Observatory of Athens (NOA)

Organisation type:	Research	**Web:**http://www.noa.gr/

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Profile of the organization (short description):

The National Observatory of Athens (NOA) has been historically nominated by the Greek government as the sole institution in charge of natural disasters monitoring, with a clear mandate to conduct innovative research for the benefit of the Greek citizens. At global level it hosts, a) the UNESCO Chair for Natural Disasters, established within the framework of UNESCO-BRESCE, b) the Secretariat of the South Eastern European (SEE) Disasters Risk Assessment and Mitigation Network, and c) the Focal Point on the Global Earth Observing System of Systems (GEOSS), one of the four national GEO Offices in the World.The Institute for Astronomy Astrophysics Space Applications & Remote Sensing (IAASARS) of NOA, through its systematic participation to EC and ESA-funded projects, has achieved a considerable excellence in the area of EO-based environmental and natural disaster monitoring and management during the last decade. It has been providing support for Emergency Planning and Emergency Support, and Disaster Recovery to Environmental Monitoring, Civil Protection and Public Governmental Authorities in Greece, while it has consistent participation to EC, ESA and GMES/Copernicus projects.

IAASARS has been qualified (through SAFER FP7 project), the GMES Focal Point dealing with Emergency Response and Emergency Support, and has been partner in the sole GMES operational project (linkER), for the implementation of an operational concept in GMES, establishing links with the Institutional Focal Points in EU27 acting in the field of Emergency Response and Disaster Management.Within IAASARS, a Center of Excellence has been established, for EO-based Monitoring of Natural Disasters. In BEYOND innovative integrated observational solutions have been setup (i) allowing to a multitude of monitoring networks (space borne and ground-based) to operate in a complementary, unified and coordinated manner, (ii) creating archives and databases of long series of observations and derived higher level products, and (iii) making these observations and products available for exploitation with the involvement of stakeholders, scientists and/or institutional users, applicable for down-streaming to their specific needs.

Over the years, through the systematic participation to EC, ESA, GMES (Copernicus) and national projects, NOA has consolidated state-of-the-art scientific equipment including a satellite ground station for missions Meteosat, NOAA/AVHRR, MODIS, NPP, FYI, MetOP and future NPOESS. NOA hosts the first Collaborative Ground Segment of the management and dissemination of data flows from the Sentinel family of satellites.

Main Tasks to be involved:

NOA will lead the technological task dealing with the deep learning pipelines to drive efficient radiative transfer model inversion **(T4.3)**, while contributing to a number of technical tasks led by other consortium partners, particularly in WP3 and WP5-WP8, alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

- CharalamposKontoes, Ioannis Papoutsis, Themistocles Herekakis, EmmanuelaIeronymidi, Iphigenia Keramitsoglou, (2017), Remote Sensing Techniques for Forest Fire Disaster Management: The FireHub Operational Platform, Journal *Integrating Scale in Remote Sensing and GIS*
- Kazadzis, S., Founda, D., Psiloglou, B. E., Kambezidis, H., Mihalopoulos, N., Sanchez-Lorenzo, A., Meleti, C., Raptis, P. I., Pierros, F., and Nabat, P.: Long-term series and trends in surface solar radiation in Athens, Greece, Atmos. Chem. Phys., 18, 2395-2411, https://doi.org/10.5194/acp-18-2395-2018, 2018.
- Kosmopoulos, P. G., Kazadzis, S., Taylor, M., Raptis, P. I., Keramitsoglou, I., Kiranoudis, C., and Bais, A. F.: Assessment of surface solar irradiance derived from real-time modelling techniques and verification with ground-based measurements, Atmos. Meas. Tech., 11, 907-924, https://doi.org/10.5194/amt-11-907-2018, 2018.
- Kosmopoulos, P. G., Kazadzis, S., Taylor, M., Athanasopoulou, E., Speyer, O., Raptis, P. I., Marinou, E., Proestakis, E., Solomos, S., Gerasopoulos, E., Amiridis, V., Bais, A., and Kontoes, C.: Dust impact on surface solar irradiance assessed with model simulations, satellite observations and ground-based measurements, Atmos. Meas. Tech., 10, 2435-2453, https://doi.org/10.5194/amt-10-2435-2017, 2017.
- M. Taylor, P.G. Kosmopoulos, S. Kazadzis, I. Keramitsoglou, C.T. Kiranoudis, Neural network radiative transfer solvers for the generation of high resolution solar irradiance spectra parameterized by cloud and

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aerosol parameters, Journal of Quantitative Spectroscopy and Radiative Transfer Volume 168, Pages 176–192, January 2016

Services:

- Solar Energy Nowcasting System (SENSE): SENSE produces maps of spectrally-integrated irradiances of the order of 10,000 to 100,000 pixels within 1 minute and hence provides the capability needed to serve high precision solar power applications for energy planning. Surface spectra for Direct Normal Irradiance (DNI), which applies to Concentrated Solar Plants (CSP), as well as Global Horizontal Irradiance (GHI), which applies to PhotoVoltaic (PV) installations are produced at high resolution using input data from Copernicus Atmosphere Monitoring Service (CAMS) for aerosols impact and from Spinning Enhanced Visible and InfRared Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) for clouds impact.

Participation in relevant EU projects:

- **H2020, SC5-2018-2019-2020, EuroGEOSS Showcases: EuroGEOSS Showcases: Applications Powered by Europe** – Project GA number: 820852;
- **H2020, PCP-2016, Marine-EO: Bridging Innovative Downstream Earth Observation and Copernicus enabled Services for Integrated maritime environment, surveillance and security** – Project GA number: 730098;
- **H2020, SC5-2015, GEOCRADLE: Coordinating and integRating state-of-the-art Earth Observation** Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS – Project GA number: 690133;
- **FP7, REGPOT, BEYOND: Building a Centre of Excellence for Earth Observation based monitoring of Natural Disasters** in south-eastern Europe - Project GA number: 316210;
- **Service Contract with EC, JRC/IPR/2014/G.2/0012/OC: European Commission / JRC – Copernicus EMS** – Risk & Recovery - Multi-hazard and multi-parametric mapping for disaster preparedness and recovery activities at large scale;

Service Contract with EC, ENTR/08/028, DG ENTERPRISE, SAFER: Supporting the implementation of operational GMES service in Emergency Response (linkER), EC/DG Enterprise.

Personnel Involved:

Dr Ioannis Papoutsis (male): Ioannis is an Associate Researcher of IAASARS/NOA with more than 7 years of experience in international EO activities and initiatives. His research domain in on big EO data processing for cross-sectorial applications with emphasis on disaster risk reduction. Since January 2017, Ioannis is the Operational Manager of several Copernicus Hubs for the dissemination of Sentinel data, under the ESA's contract. He was the Copernicus Emergency Manager for the Copernicus Emergency Management Service, Risk & Recovery with 19 activations (2014-2019). Last but not least, Ioannis participated as technical manager to several projects. Specifically, JRC EFFIS, EOPEN, MARINE-EO, NextGEOSS, RECAP, GEO-CRADLE, linkER (Supporting the implementation of operational GMES services in Emergency Response), SAFER (Services and Applications For Emergency Response), TELEIOS (Virtual Observatory Infrastructure for Earth Observation Data) and BEYOND (Building a Center of Excellence for EO Based Monitoring of Natural Disasters). Awarded the 1st prize for FireHub, an EO-based fire management platform, at the 2014 Copernicus Best Service Challenge. Extensive experience in developing, testing and automating processing chains for the real-time fire monitoring based on EO data with diverse spatial, spectral and temporal resolutions. Responsible and/or part of the design and development team for the following systems:

1) FireHub (http://ocean.space.noa.gr/FireHub);
2) GeoHub: (http://beyond-eocenter.eu/index.php/geophysical/overview);
3) FloodHub (http://beyond-eocenter.eu/index.php/floods/floodhub);
4) System for the remote monitoring of CAP obligations (H2020 project RECAP (https://www.recap-h2020.eu/);
5) Atmospheric monitoring Service

Ioannis has expertise in EO data processing, data mining, and semantics with more than 40 publications in peer-reviewed journals and international conferences and workshops action.

Dr Charalampos (Haris) Kontoes (male): Research Director of IAASARS/NOA with solid professional experience in the management and coordination of several EC, ESA and national funded projects in the domain of remote sensing of environment following the GMES standards. He is expert in the Remote Sensing of Environment

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experienced in the coordination of 30+ EC, ESA, and national/regional competitive projects funded in the context of framework initiatives e.g. FP6, and FP7, COPERNICUS, GEO, EOEP/ESA, DUE/ESA, Civil Protection Instrument/DG ECHO, GSE/ESA, CAP/DG AGR, etc. Haris is the National Point of Contact (NPC) of ESA'sCollGS initiative, coordinated the development and sustained operation of the first Copernicus data dissemination facility in the SE Europe and Balkans (the Hellenic Sentinel Data Hub) and chairs the organisation of several international research forums, scientific conferences, and dissemination event, including GEO and Copernicus. Haris is an author of more than 110 publications in reviewed journals and scientific conferences.

Dr. Panagiotis Kosmopoulos (male): Dr. Panagiotis Kosmopoulosis a postdoctoral researcher at the National Observatory of Athens (NOA) with a PhD in the field of solar energy forecasting and applications. He has a 12-year experience in environmental physics through national and regional competitive project. He has 90 publications and more than 1000 citations in international journals and conferences (h-index 17), and is reviewer of 15 highly ranked scientific journals. Finally, he is the developer of the Solar Energy Nowcasting System (SENSE) as part of his PhD thesis, with end-users from the public and private sector, while he deals with the exploitation of Earth Observation, Copernicus Atmosphere Monitoring Service and modeled data (mainly using radiative transfer modelling) for a variety of solar energy applications (SOLEA).

Mr Anastasios Tripitsidis (male): Research Associate | EU Project Manager. Anastasios is a GIS/RS project manager with an engineering background and master in Geoinformatics. He has strong experience in managing more than 15 projects at National and international level (EC, Maltese Government, GSRT –, JRC, DGENV etc.). He has experience in MS Office Project 2010, Redmine, GIS &WebGIS tools (ESRI ArcGIS Desktop 10.x, ArcGIS Server 10.x), RDBMS (MySQL, SQLyog, Postgre/PostGIS), INSPIRE editor s/w tools (INSPIRE metadata editor, GeoNetwork, Publisher), Programming (small experience in Visual Basic), and applies these to urban and regional planning using GIS, spatial data collection and tracking, spatial databases;

Mrs Alexia Tsouni (female): Research Specialist at NOA. Ms. Alexia Tsouni is a Flood expert, member of the service provision team as part of the European partnership "NOA - Geoapikonisis SA - Altamira SA - CIMA Foundation" in the framework contract of Risk & Recovery mapping to address needs of the Copernicus Emergency Management Service. Production of thousands of risk & recovery maps for a range of hazards, such as floods and flash floods, forest fires, earthquakes, volcanic eruptions and lava flow, landslides, soil and coastal erosion, tsunamis, as well as toxic gasses concentrations and cloud dispersion due to industrial accidents. Moreover, suggestion of risk-specific mitigation measures for all the above cases of risks, and critical first response spatial analysis to support decision making concerning planning and recovery activities. She is also the coordinator of the FloodHub service in the BEYOND Center of Excellence. Alexia is an author of 6 publications in peer-reviewed journals and international conferences and workshops. Alexia is also a PhD candidate in floods monitoring with remote sensing from the National Technical University of Athens in cooperation with the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens. She has an engineering background as MEng in Civil Engineering, M.Sc. in Water Resources Science and Technology.

Mrs Eleni Christia (female): Communication and Dissemination Manager at NOA. Mrs. Eleni Christia Communication and Dissemination Manager of European Projects. She is the Communication Manager of the e-shape project since 2039, GEO-CRADLE project since 2016, with the responsible for the Communication and Dissemination Strategy of the Project. Organising of regional Workshops in Middle East, North Africa and Balkans related to stakeholder's engagement and end users' needs. Eleni also organized conferences, workshops and communication activities in collaboration with the European Commission, the GEO Secretariat, the National Observatory of Athens and the Copernicus Academy. She is the dissemination and communication manager of BEYOND Center of Excellence for monitoring Natural Disasters since June 2013. Since 2007, she is the executive Secretary of Greek GEO Office, Eleni was also a member of the writing team of Implementation Plan Working Group of GEOSS and she worked in several EU projects related to GEOSS such as ERA-PLANET, GEOMON, and DARECLIMED. From 2015-june 2018 she was a senior Officer of the Press Office of NOA, responsible for the communication strategy and the communication activities of NOA and member of the Public Relationship and Outreach of NOA.

Mrs Katerina (Mirka) Rossi (female): Dissemination and Communication at NOA. Katerina (Mirka) Rossi graduated in 2000 from ST.GEORGE Independent Studies - Commercial College, she completed her studies in English-Greek Executive Secretarial and Administration Course for Personal Assistants. With her fluency in English (she was born in Cape Town - S. Africa and spent her junior years in Kenya) from an early age she started working in private owned businesses and large multinational companies such as Kraft Foods SA, as an administrative support and executive assistant to the Sales Director, Coca Cola Hellas as a Marketing executive assistant and for Alfa Laval as a Communication Specialist, introducing and promoting corporate concepts, ideas and culture, P.R., organizing Exhibitions & Events in Greece and abroad.

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Mrs Maria (Marietta) Papapakonstantinou (female): Administrative support of EU projects. Maria (Marietta) Papakonstantinou is currently a PhD candidate in Cultural Management at the University of Patra and graduated from the school of Philosophy at the University of Athens. She has worked in universities, in public and private sector as research associate and assistant project manager in European and national co-funded programmes and since July 2018, she has been working in the administrative support and as assistant project manager of EU funded programmes at IAASARS/NOA.

Other colleagues that will be part of NOA team are: Mr. Vasilis Sitokonstantinou, Dr. Kiki Makri, Mrs Dora Perou, Mrs ElisavetParselia, Mrs Katerina Karagianopoulou, Dr.EmmanouelaIeronymidi, Mr. Alexis Apostolakis, and Mr.Thanassis Drivas.

Significant Infrastructure and Equipment:

Solar Energy Forecasting: Technical and real time EO data support provided by the Collaborative Ground Segment – satellite sharing system that is currently running at NOA/IERSD (Sentinel data, OMI), the operational MSG-SEVIRI data were acquired by the EUMETCast station operated by NOA/IERSD, NOA servers for online now-casting and short term forecasting application, CAMS and AEROCOM aerosol forecasts/databases, radiative transfer look up tables for spectral solar irradiance outputs, neural networks and multilinear regression functions for fast solar irradiance related products calculations.

NOA/IAASARS overall Earth Observation infrastructure and equipment: Mobile lidar system EMORAL; since 2011, IAASARS has been operating the mobile lidar system EMORAL in collaboration with ESA, capable of providing aerosol extinction, backscatter and depolarization vertical distributions, as well as aerosol microphysical properties utilizing innovative inversion techniques. The system currently operates in campaign mode, participating in satellite validation activities and aerosol characterization experiments like HYFLEX (Verification of the Hyperspectral Plant Imaging Spectrometer), ACEMED (Evaluation of CALIPSO's aerosol classification scheme over Eastern Mediterranean), ChArMEx (The Chemistry-Aerosol Mediterranean Experiment), ARGON (Aerosol and TRace Gases Observational Campaign at NEO).

Figure 1: The 2.4m X-L band antenna

CIMEL sun-sky photometer; IAASARS operates since 2008 a CIMEL sunphotometer, member of NASA's-AERONET global sunphotometric network (http://aeronet.gsfc.nasa.gov/). The station has been recently installed in the remote area of Finokalia (Crete), which is an ACTRIS European Infrastructure super site (http://www.actris.net/). The Finokalia site is a unique area for ESA cal/val activities.

The new PollyXT lidar system; IAASARS operates since 2015 a multi-wavelength dual-depolarization lidar system, PollyXT. The new PollyXT station is already included in the Polly network (http://polly.rsd.tropos.de/). Moreover, IASSARS included also the Finokalia station in Crete, in the EARLINET European Lidar Network (http://earlinet.org/).

Figure 2: From left to right: The ESA-EMORAL lidar operating during HYFLEX campaign; The AERONET photometer and the PollyXT lidar system, operating in Finokalia during ESA-CHARADMExp campaign.

ESA-EUMETSATequipment installed at NOA: MSG SEVIRI acquisition stations; the MSG antenna provides real time acquisitions from the geostationary Meteosat satellites. ESA is a key partner in the development of the satellites required by EUMETSAT's mandatory programmes, as well as in the European Copernicus Initiative.

Big satellite archiving and management: Computer facilities of GS; the GS hosts and maintain the operations of high performance computer facilities/servers for physical image data handling and meta-data management and

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querying, as well as the image data processing and archiving. It hosts archiving facilities (disks, and tape libraries) for the physical storage of the collected satellite data.

Hardware infrastructure:

ServersCluster: Servers cluster comprised of a large number of scalable physical servers (Intel XEON E52620v3, 2.4GHz, 6C, 15M Cache) capable for the parallel processing of scientific applications over InfiniBand network.

Collaborationwith GRNET: IAASARS/NOA in close collaboration with Greek Research & Technology Network (https://grnet.gr/) can provide all the required services of a super-computing infrastructure. This means rapid execution of processing chains and forecasts that require high performances using big (Satellite or non-Satellite) data with very high resolution (through ARIS the national supercomputer).

4.1.7 AccelligenceLtD (ACCELI)

Organisation type:	Research	**Web:**https://www.accelligence.tech/

Profile of the organization (short description):

ACCELIGENCE Ltd (ACCELI) is a Cyprus-based company, established in 2019. ACCELIGENCE Ltd. is a unique ICT and business consulting firm, a highly skilled and trustful business partner that helps its customers excel in the era of globalization, technology acceleration and climate change.

It offers (among others) software development and business consulting services linked to IoT, BigData/ AI and Cyber-Security technologies, including business modelling, business planning and techno-economic analysis services. ACCELI is the partner of choice for projects that incorporate a high degree of technical challenge and therefore require high expertise and innovative approach. The company builds on the experience of world class experts, ICT and business consultants, who have a rich track record of providing services for very demanding projects worldwide. The company will thus offer the customer clear insights about leading edge and emerging ICT technologies (in the areas of Cloud Computing, Internet-of-Things, BigData, CyberSecurity). ACCELI really transforms innovation into increased competitiveness and concrete performance gains.

ACCELIGENCE

The company may successfully take up all the phases of a project's lifecycle (study-design-implementation-operation). The services of the company span consulting, project management and software development for different sectors. Since 2001, the key members of the ACCELI team have been actively and successfully involved in more than two hundred projects for different clients in Europe.

Main Tasks to be involved:

ACCELI will coordinate the activities related to semantic knowledge structures and the TADDIS ontology **(T6.1),** user training **(T8.2)** and dissemination and communication **(T9.1).** In addition, ACCELI will be contributing to rest technical tasks of WP6 (T6.2 and T6.3) while they will have an active role in the exploitation activities of the project in WP9 (T9.2 and T9.4).

Main achievements relevant to the call:

The core team of ACCELI has been involved in dozens of Research projects for more than 20 years in Research, Development and Innovation: Project & Scientific Coordination of Consortia for more than 15 years. ACCELI has developed wide experience in leading and managing EU projects covering their whole life cycle from the idea identification to submission and from project negotiation, grant agreement preparation to implementation, technical management, reporting and coordination.

Participation in relevant EU projects:

Dr PantelisVelanas, a founding partner of ACCELI was part of the coordinating team of the following projects:

- H2020-**SMILE**: Smart mobility at European land borders (H2020-SEC-2016-2017-1, 2017-2020 Grant No. 740931)
- H2020-**FORTIKA**: Cyber Security Accelarator for trusted SMEs IT Exosystems (H2020-DS-SC7, 2017-2020, Grant No. 740690).
- H2020-**SPHINX**: A Universal Cyber Security Toolkit for Health-Care Industry (H2020-TDS-02-2018, Grant No 826183)

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Furthermore, currently, ACCELI activities are mostly carried out in internal R&D activities, although always exploiting supporting technologies deriving from national or international R&D projects.
Personnel Involved:
Dr. PantelisVelanas (male) is the Head of R&D department and the founder of ACCELI. He received the B.S. degree in physics, the M.Sc. degree in telecommunications and the Ph.D. in photonics from the National and Kapodistrian University of Athens, in 2000, 2002 and 2009, respectively, and he has worked at the same university as a researcher in Optical Communication Laboratory, participating in several FP6 and FP7 EU projects (OCCULT, WAPITI, E-photon 1, BONE). From 2007 he has worked as a R&D project manager in numerous companies (e.g., Intracom Telecom SA - SARDANA, ACCORDANCE, KONNEKTABLE LTD – SPHINX, ENERGYSHIELD, PALAEMON, NAIADES, TRACK & KNOW) and research institutes (e.g. ICCS – INTETRANSIT, PPDR, RECONASS, ZONESEC, CERTH – FORTIKA, SMILE, NOTREMOR, COMPOSITION) in Greece. During 2015, Dr PantelisVelanas was the project manager of an ESA project (PO-4000113070), and acted as the main contact person between the Agency and the Greek Contractor. Pantelis has acted as a Quality and Information Security manager in several companies in the past. He has published more than 14 papers in Conference Proceedings and Journals. He is a founding partner of ACCELI. **Mrs Rea Levantinou (female)** received her BSc degree in Physical Education and Sport Science from the National and Kapodistrian University of Athens in 2009. Following that she received her MSc degree in Exercise and Health from the University of Thessaly, Department of Physical Education and Sport Science in 2014 where she worked as research fellow in the biomechanics lab of the university. From 2016 she has been working as a Senior Researcher and participated in the preparation of several R&D proposals of H2020, Eurostars, ENI CBC MED and other European and local funding schemes.
Significant Infrastructure and Equipment:
N/A

4.1.8 XLAB razvojprogramskeopreme in svetovanje doo (XLAB)

Organisation type:	SME	**Web:**https://www.xlab.gr

Profile of the organization (short description):
XLAB is a global IT solutions company focused on remote desktop technology (ISL Online), management and automation of hybrid infrastructure (XLAB Steampunk), security and privacy, IoT and data analytics, building on breakthroughs of its own research team. Since 2001, and in a team of 100+, XLAB has become recognized as a highly professional technology innovator, betting on the power of open source, open exchange of ideas, and teamwork.  Long track involvement in EU research and innovation programmes places XLAB among the Top 50 SMEs in terms of Horizon 2020 signed grants and at the 1st place among SMEs in Slovenia. XLAB Research was established in 2003 for the purpose of both basic and applied research, development of complex software, knowledge dissemination and technology transfer to other XLAB departments and products. It has become one of the strongest computer science research teams outside the academic sphere in Slovenia. Substantial contributions to 50 EU research projects have earned XLAB a prestigious responsibility of coordinating two of them - XLAB was the first Slovenian

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coordinator of a Horizon 2020 project. Working hand in hand with many research institutions, universities and research departments around the world, XLAB is renowned for leading projects throughout all development phases.

Continuous participation in EU projects

XLAB Research has been **highly active in EU projects**, either as a WP/task leader or as the project coordinator, focusing on cybersecurity, high performance computation, data analytics, cloud, and IoT.

According to the Horizon 2020 Dashboard, XLAB holds the top spot among SMEs in Slovenia in terms of H2020 funded projects and grants. Taking into account all Slovenian H2020 participants (academic, governmental and non-governmental institutions), XLAB holds 5th place. Looking through the lens of the all H2020 participants (EU and associated countries), XLAB holds 34th and 63rd spot among participating SMEs in terms of signed grants and funding, respectively. Looking at purely research projects among SMEs in EU and H2020 associated countries, XLAB holds 16th and 31st spot in terms of funded H2020 projects and received grants.Within**H2020**, XLAB coordinated MIKELANGELO and is currently coordinating SODALITE, which started in February 2019. Both projects deal with the merging of the HPC and Cloud paradigms. Software-as-a-Code and its automated deployment was/is being researched within the RADON and DICE projects, and IoT/edge concepts were/are being advanced in mF2C, TIMON, MANTIS, Inter-IoT, and PIXEL. On the security and privacy part, XLAB participated in SPECS, WITDOM, WISER, which focused on secure and privacy-friendly cloud services, and now participates in several cybersecurity related projects like FENTEC, FORTIKA, CYBERWISER, iPC, and KRAKEN, supporting research and innovation towards the protection of critical systems and highly sensitive data in untrusted environments.

Key products and services

XLAB is primarily a software development company with several **key products**: XLAB's prime product, **ISL Online**, allows users to instantly access and control any computer or mobile device to provide ad-hoc technical support or to manage systems remotely. **Gaea+** is a customizable 3D visualization solution, awarded by NASA. **MedicView** 3D dental and radiology imaging solutions are used by medical specialists worldwide.



XLAB has been gaining extensive data and open data management skills. XLAB provides technical expertise to the Slovenian Ministry of Public Administration for the development and maintenance of the **Slovenian Open Data PortalOPSI** and the **National Interoperability Framework PortalNIO**.

OPSI ODPRTI PODATKI SLOVENIJE

NIO Nacionalni interoperabilnostni okvir

This shows that XLAB is capable of providing state-of-the-art development expertise, is capable of applying the experience and knowledge gained in projects to products and services, and that it is able to support innovation management and exploitation efforts of the consortium with respect to joint commercial exploitation.

Innovation track record

In continuous search for the next product, XLAB utilizes its R&D and industrial experience to foster creativity and innovation. Within our stable and supportive environment, a strong research and entrepreneurial team delivers tangible results and innovative services through our **start-ups**: **Koofr** (hybrid storage solution), **Olaii** (event discovery, ticketing, and cashless payment system), and **Sentinel Marine Solutions** (IoT-based vessel control module), to name a few.

KOOFR Olaii SENTINEL Marine solutions

Three innovations co-created by XLAB in the frame of EU research projects have been selected by the **Innovation radar EU service**: IoT Interoperability Middleware (INTER-IoT), a message bus to facilitate data exchange between existing grid market stakeholders and new entrants thus levelling the market (eBADGE), and a framework for

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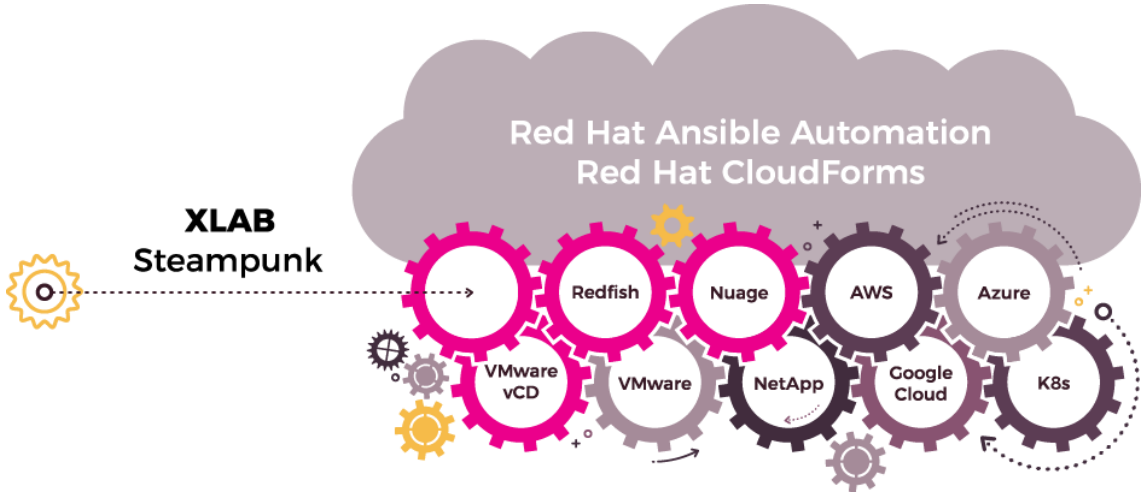
negotiating SLAs and comparing cloud services providers according to security levels and security reliability (SPECS). In 2018, XLAB has been selected as one of the Best Early Stage Finalists.

Commitment to open source

XLAB Research has contributed to well-established open source projects like OpenStack, ManageIQ, Unik, and SJCL. In 2019, XLAB Steampunk became a trusted Red Hat partner, enabling unified automation and management of hybrid infrastructure by integrating third-party technologies into Red Hat Ansible Automation and Red Hat CloudForms.



Security and privacy management

In 2017, XLAB acquired the **ISO/IEC 27001 Information Security Certificate**, which sets the highest standards for data and confidential data protection. XLAB has also dedicated an internal group to respond on all issues regarding data management (**CCSO** - Chief Cyber-Security Officer and **DPO** - Data Protection Officer). This team is up to date with all necessary legislation, bureaucracy steps and technical tools to lead the technical experts during the design and development of a secure and privacy-friendly data management.

Main Tasks to be involved:

XLABwill lead ethical and legal dimensions of the project **(T2.3)** and predictive analytics models **(T5.2).**In addition, XLABwill be contributing to a number of technical tasks led by other technical partners, particularly in WP4 and WP7, alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

- **D. Štepec**, Ž. Emeršič, V. Štruc, P. Peer, "*Constellation-Based Deep Ear Recognition*," in C.-T. Li, R. Jiang, W. Meng (Eds.), "*Deep biometrics*," 2019, Springer. To appear.
- **D. Štepec**, **T. Martinčič**, D. Skočaj, "*Automated system for ship detection from medium resolution satellite optical imagery*," in Proceedings of the OCEANS 2019 Seattle Conference & Exposition (MTS/IEEE OCEANS'19 Seattle). To appear.
- J. Lozej, **D. Štepec**, V. Štruc, P. Peer, "*Influence of segmentation on deep iris recognition performance*," in Proceedings of the 7th International Workshop on Biometrics and Forensics (IAPR/IEEE IWBF'19). https://ieeexplore.ieee.org/document/8739225
- M. Stopar, M. Bizjak, **J. Modic**, J. Hartman, A. Žitnik, T. Marc, "*Emmy – Trust-Enhancing Authentication Library*," in Proceedings of the 13th IFIP WG 11.11 International Conference on Trust Management (IFIPTM'19). http://ifiptm2019.compute.dtu.dk/IFIPTM19/IFIPTM.html
- T. Marc, M. Stopar, J. Hartman, M. Bizjak, **J. Modic**, "*Privacy-Enhanced Machine Learning with Functional Encryption*," in Proceedings of the 24thEuropean Symposium on Research in Computer Security (ESORICS'19). https://eprint.iacr.org/2019/1129

Participation in relevant EU projects:

- **PIXEL – Port IoT for environmental leverage (H2020, 2018-2021)**
- **mF2C – Towards an open, secure, decentralized and coordinated fog-to-cloud management ecosystem (H2020, 2017- 2019)**

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- **INTER-IoT – Interoperability of heterogeneous IoT platforms (H2020, 2016-2018)**
- **iPC – Individualized Paediatric Cure: Cloud-based virtual-patient models for precision paediatric oncology (H2020, 2019-2022)**

Personnel Involved:

Dr. Daniel Vladušič (male) received his PhD in computer science from the University of Ljubljana in 2005, with the thesis titled "*Use of qualitative models in quantitative prediction*". His main research interest was in the field of artificial intelligence but has since changed to cloud and high-performance computing, mostly working as a part of EU projects (e.g. Fortissimo, Fortissimo 2 and MIKELANGELO projects). He has vast expertise in project management and holds the PRINCE2 Practitioner certificate. He was the project coordinator of the H2020 MIKELANGELO project and also responsible for the exploitation of the project. Currently, he is the project coordinator for the H2020 SODALITE project and works as XLAB's Chief Research Officer.

Mr. Flavio Fuart (male) joined XLAB Research in October 2016 as Project manager of IoT R&D projects. He currently leads XLAB teams participating in research projects PIXEL (H2020 - Port IoT Solution for Environmental Leverage), TOPP (National research fund - AI-assisted design of underground connections in smart cities) and Industry 4.0 IoT Enablement for Messer Cutting Systems (commercial research project). He also led XLAB teams that participated in INTER-IoT (H2020 - Interoperability of IoT Platforms) and AALHP (National research fund - Ambient Assisted Living Health Platform) research projects. Between 2013 and 2016 he was Senior IT Expert at the Artificial Intelligence Laboratory of the Jozef Stefan Institute, Ljubljana. His work focused on productization, optimisation, integration and deployment of research modules, as well as research tasks related to text processing and on-line media monitoring. Previously, he worked as a Scientific/Technical Officer at the Global Security Unit of the Joint Research Centre of the European Commission. He managed IT projects that provided services to: European Centre for Disease Control and Prevention (ECDC), World Health Organisation and other international and national authorities. He contributed to the design, development and successful deployment of MedISys (Multilingual Media Monitoring Tool for Medical Intelligence and Early Warning), which is regularly used by ECDC for epidemic intelligence and monitoring of on-going health-related threats. For a brief period, he worked as IT consultant for the Communications and Information Services branch of the United Nations Office for the Coordination of Humanitarian Affairs. Before joining the civil service, from 1996 until 2005, he worked for a major Slovenian solution provider of health information systems where managed healthcare informatics projects and worked as a consultant for the Slovenian government during a major national healthcare reform in the early 2000s. He managed projects related to Integration of Hospital Information Systems (deployed in 10 hospitals), eOrdering Module for Pharmacies (deployed in 30 pharmacies) and Perinatal Information System (deployed in 10 hospitals).

Mr. DejanŠtepec (male) received his M.Sc. degree in 2017 at the Faculty of Computer and Information Science, University of Ljubljana in the field of computer vision. His professional career started in 2015 when he joined a start-up where he was responsible for the development of software solutions for processing 3D point clouds obtained from drone imagery. In 2016, he joined the XLAB Research department where his work and research interests are focused on different machine learning topics with special interest in deep learning. Image based biometrics is one of the scientific fields where he made significant advancements with publications at the top tier biometric conferences (i.e. ICB, IJCB) as well as by contributing a book chapter which will be published by Springer and will present the latest advancements in biometrics with the use of methods based on deep learning. In 2018, he visited University of Warwick and University of Salzburg as a visiting researcher, where he conducted research in different fields of machine learning. In 2019, he visited the Hong Kong Baptist University and South China University of Technology. He is also leading a predictive analytics task in a maritime research project, where they are utilizing vastly underutilized data from the ports, ships, as well as emerging space imaging technologies. He presented his work on fusing satellite imagery and Automatic Identification System (AIS) from ships at the OCEANS 2019 conference. Besides working on different EU Horizon 2020 research projects, he was also involved in different industrial research projects for various international companies.

Dr. Matija Cankar (male) has received his Ph.D. in 2014 at the Faculty of Computer and Information Science, University of Ljubljana for the work on the efficient resource allocation in grid and cloud computing systems. He shared his expertise in a few FP6 and FP7 projects, including XtreemOS and Contrail, on the activities regarding efficient resource allocation. He contributed also to FINESCE (FI-PPP) project with his expertise on FI-WARE technology, providing support on deployment of specific GEs. His main interest lies in applying cloud computing and IoT solutions and their automatic deploy and configuration. He has been involved in several EU research projects such as TIMON, mF2C, and, currently, RADON, and is part of the XLAB Steampunk team.

Dr. Jolanda Modic (female) received her Ph.D. degree in mathematics in 2014 from the Faculty of Mathematics and Physics, University of Ljubljana. She has been involved in research since 2010, working on different areas and

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intersections of mathematics and computer science. During her Ph.D., she tackled problems in graph theory, (numerical) linear algebra, geometry, and computer vision. After her Ph.D., she took a role as a researcher and a project manager at XLAB, where she participated in several EU research projects such as FP7 SPECS, H2020 WITDOM, and, currently, H2020 iPC, focusing on the design, implementation, and assessment of secure and trustworthy systems. She holds the PRINCE2 Practitioner certificate for project management and a certificate for the Data Protection Officer, and acts as the DPO for XLAB Research.

Significant Infrastructure and Equipment:

XLAB has all necessary infrastructure to perform its defined tasks. XLAB Research, as a research group and a software development company, does not aim to offer any significant infrastructure or technical equipment to the project.

4.1.9 Independent Power Transmission Operator (IPTO)

Organisation type:	Industry	**Web:**http://www.admie.gr/

Profile of the organization (short description):

The Independent Power Transmission Operator (IPTO or ADMIE) S.A. was established in compliance with Law 4001/2011 and European Union Directive 2009/72/EC regarding the adoption of common rules in the organization of EU electricity markets. According to Law 4001/2011 ADMIE undertakes the role of Transmission System Operator for the Hellenic Electricity Transmission System and as such performs the duties of System operation maintenance and development so as to ensure Greece's electricity supply in a safe, efficient and reliable manner. Although a wholly owned subsidiary of PPC S.A., ADMIE is entirely independent from its parent company in terms of its management and operation, retaining effective decision-making rights, in compliance with all relevant independence requirements of Law 4001/2011 and Directive 2009/72/EC.

The Operation Planning Section (OPS) of the Department of System Operation and Control is responsible for providing forecasting information to the market platform, which produces the optimal schedules. Among the forecast data provided by OPS is the system load forecast and the forecast of power produced by renewable sources. System load forecast and forecast of power produced by solar renewable sources (for brevity we shall refer to both as load forecast models) are produced by ADMIE utilizing proprietary software tools owned by ADMIE.

Once the market is cleared the system marginal prices are produced. Inaccurate forecasts may lead to sub-optimal schedules and it turns out that this has a significant impact in the economic cost of the operation schedules. More specifically, under-forecasts may lead to purchase of expensive services to deal with peaks and over-forecasts may lead to unnecessary capacity being committed.

In effect, load forecasting is fundamental in utility operation (Figure 3) and increasing penetration of renewable sources has caused a significant change in the resource mix making the use of accurate forecasts necessary. These changes have constituted load forecasting to be a dynamic process that should continuously be improved.

Weather conditions are among the predominant factors that affect electrical power consumption, and are therefore used as predictors in short-term load forecasting (the weather variables are used differently in long term load forecasting – many important weather variables are hard to be predicted beyond two weeks). Large penetration of solar generation at the distribution network has created new challenges for load forecasting, as the negative load from distributed energy sources has to be taken into account. This has created the need to incorporate weather factors such as light intensity or cloud coverage to accommodate for these effects and divert away from the traditional load forecasting models that used only temperatures or humidity.

The accuracy of the weather forecasts affects the load forecasts and it is therefore important for the load forecast to be provided with reliable weather forecasts, which are updated at regular intervals throughout the day.

The general constraints that the IPTO faces are mainly physical constraints. There are three factors that drive the upgrade and reengineering of the requirement according to a new weather forecast engine:

1. The large penetration of solar energy sources both at the system and the distribution. The light intensity measures that are currently available for four areas in Greece, used by the solar energy prediction model are not sufficient to capture the dispersed nature of solar production.
2. The need for a realistic, accurate and integrated consideration in the forecast of all renewable sources, so that, together with the production by the conventional units the actual load demand can be forecasted.

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3. Upcoming amendments in the Greek Grid and Exchange Code will require renewable sources to participate in the electricity market. This has significant effects in the load forecast as the power produced by these sources will no longer be treated as negative load.

As a result, the services and products required from the PUC3 feasibility pilot were the followings:

- Forecasting meteorological data concerning the mass penetration of Wind and PV energy into the Electrical System.
- Nowcasting solar energy potential for efficient energy planning.
- Realistic climatological estimations of surface solar irradiance.

Figure 3: The Independent Power Transmission Operator (IPTO or ADMIE) for Greece. It controls the energy demands and the effects of implementing demand-side management strategies on the daily demand curve.Here is the IPTO's area of operations.

Main Tasks to be involved:

IPTO will serve as co-designer end-user partner being actively involved in the design, development and evaluation of PUC3 dealing with solar energy short-term forecasting from satellite data. Therefore, IPTO will contribute to WP2 and WP8, while they will support impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

The Operation Planning Section (OPS) of the Department of System Operation and Control is responsible for providing forecasting information to the market platform, which produces the optimal schedules. Among the forecast data provided by OPS is the system load forecast and the forecast of power produced by renewable sources. System load forecast and forecast of power produced by solar renewable sources (for brevity we shall refer to both as load forecast models) are produced by IPTO utilizing proprietary software tools owned by IPTO.

Recent publication for the OPS development and evolution: Kosmopoulos, P.G., Kazadzis, S., Lagouvardos, K., Kotroni, V., and Bais A.: Solar Energy prediction and verification using operational model forecasts and ground-based solar measurements. Energy, 93, 1918-1930, 2015.

Participation in relevant EU projects:

- **Construction of the Overhead 400 kV Transmission Line Extra High Voltage Substation (EHV S/S) LAGADA - EHV S/S FILIPPI:** This project was an operational programme in the framework of Competitiveness, Entrepreneurship, and Innovation 2014-2020, funded by the European Regional Development Fund (ERDF) with a total budget of 31 million euro (public expenditure: 10.85 million euro). The project operator was the IPTO S.A. and the region of implementation covered the East Macedonia and Thrace Central Macedonia. The project concerns the construction of a 400 kV Overhead Transmission Line

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which connects the EHV S/S of LAGADA to the EHV S/S of PHILIPPI. The length of the Transmission Line is approximately 110 km. The project enhances the power transfer capacity and the reliability of the 400 kV System in East Macedonia and Thrace contributing to the development of Renewable Energy Sources, by allowing the absorption of significant wind power production in the region, the provision of access to the Transmission System for the new Thermal Power Stations in the Thrace area and the reinforcement of interconnections with neighboring countries.

- **The Interconnention of Cyclades Islands with the National Mainland Interconnected Transmission System**: This project was an operational programme in the framework of the Competitive, Entrepreneurship 2007-2013 and Competitive, Entrepreneurship, and Innovation 2014-2020, funded by ERDF WITH A TOTAL BUDGET OF 115.5 million euro for the period 2007-2013 and 273.6 million euro for the period 2014-2020 (public expenditure: 40.4 M € for 2007-2013 and 135.6 M € for 2014-2020). The project coordinator was the IPTO S.A. and covered the region of East Macedonia and Thrace, Central Macedonia, West Macedonia, Thessaly, Epirus, Ionian Islands, West Greece, Central Greece, Peloponnese, Attica and Southern Aegean Sea. The project of the Interconnection of Cyclades Islands is a technically complex project, completed in three phases, which ensures the reliable, economic and sufficient supply of electricity to the islands Syros, Paros, Tinos, Mykonos and Naxos islands for the next 30-40 years. The phase A is comprised of the connection of Syros Island with Lavrion (mainland) as well as with the islands of Paros, Mykonos and Tinos. The phase B is comprised of the connection of Paros island with Naxos island and the connection of Naxos island with Mykonos island. The phase C is comprised of the second interconnection between Lavrion (mainland) and Syros island. This project ensures reliable electricity supply of Cyclades Islands, which is hindered by the limited capability of installing new Autonomous Power Stations (APS), due to environmental reasons. The power supply production cost is reduced (substitution of oil with natural gas) and therefore the cost of the energy demand. Moreover there is an environmental improvement by allowing the reduction and the future removal of the existing power stations which operate on heavy fuel oil and light fuel oil (diesel), and the environmental disturbance is reduced by avoiding the construction of overhead transmission lines. Also this project creates the necessary infrastructure for the exploitation of the significant renewable power potential in the islands. This is a strategic project of national importance with great added value. To this end, the Ministerial Decision No. FA/E 3.2/57/3, dated 3.1.2011, specifically names the project of “Interconnection of Cyclades islands with the National Mainland Interconnected Transmission System" as a project of "general importance for the economy of the country".

Personnel Involved:

Mr. George Krestos (male) is a Software and Database Engineer with a Master of Science in Information Systems Engineering from the UMIST and the Victoria University of Manchester (UK). From 2005 until now is an IT scientific personnel of IPTO in the IT department.

Dr. Dimitris Zografos (male) is a Mechanical Engineer with a MSc in Advanced Manufacturing Systems from the Brunel University of London and a PhD in Smart Grids from the University of Bolton. Today is the IT Security and Infrastructure Manager of IPTO since 2012.

Significant Infrastructure and Equipment:

- IPTO owns 11,000 km transmission lines of high and ultra-high voltage connecting Greece's mainland with Aegean islands and Crete and Greece with 5 neighboring countries.
- IPTO manages the energy control centers in Greece providing reliable operation of the national electricity system.
- 290 high voltage substations and 21 ultra-high voltage centers across the country.

4.1.10 Physikalisch-MeteorologischesObservatorium Davos, World Radiation Center (PMODWRC)

Organisation type:	Research	**Web:**https://www.pmodwrc.ch/

Profile of the organization (short description):

pmod wrc

The “Physikalisch-MeteorologischesObservatorium Davos und Weltstrahlungszentrum” (PMODWRC), is a division of the SchweizerischesForschungsinstitutfürHochgebirgsklima und Medizin Davos (SFI DAVOS). The PMODWRC is a designated institute by the Swiss federal institute

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of metrology (METAS) for solar irradiance and is a participant of the International Committee of Weights and Measures.

PMODWRC has successfully managed a number of complex and time-critical projects, for example in the frame of space projects in cooperation with ESA, NASA, and CNES. Furthermore, it has been coordinator of a number of large-scale national projects and principal Investigator of several European framework projects (FP6 SCOUT, FP6 EUSAAR, FP7 SOTERIA, FP7 SOLID, H2020 Geo-Cradle). SFI DAVOS has successfully coordinated the EMRP projects (total budget 9 MEuro): SolarUV (2011 to 2014), ATMOZ (2014 to 2017) and MAPP (2019. PMODWRC also lead the task of solar energy now-casting of the H2020 project Geo-Cradle (2016-2019) and the solar forecasting pilot for the EU H2020 E-Shape (2019-2023). PMODWRC is the PI of the nowcasting and solar forecasting system SENSE and nextSense that have been developed and demonstrated in two EU projects (Geo-Cradle and E-Shape). nextSense is the system that the related solar energy for TSO and DSO pilot/show case will be based on.

The World Radiation Center (WRC) is composed of four sections which are responsible for maintaining and operating reference instruments in order to provide traceability and homogenization on a global scale: The Solar Radiometry Section, The Infrared Radiometry Section, The World Optical Depth Research and Calibration Center, and the World Calibration Center for UV. The WRC has the following terms of reference:

- Guarantee world-wide homogeneity of solar radiation measurements by maintaining the World Standard Group (WSG) which is used to establish the World Radiometric Reference and maintain a set of reference irradiance standards and ensure their traceability to the SI units through purchase and intercomparison of transfer standards traceable to primary irradiance standards held at National Metrological Institutes.
- Maintain the global infrared radiation reference and defining the longwave infrared scale to which all longwave infrared radiation measurements should be traced.
- Develop instruments and calibration procedures for absolute total and spectral solar and long-wave radiometry;
- Participate in solar energy related applications
- Maintain a Quality Management System following ISO 17025.

Main Tasks to be involved:

PMODWRC will lead in collaboration with NOA PUC3 dealing with solar energy short-term forecasting from satellite data.PMODWRC will be responsible for the pilot implementation, evaluation and training activities of the project **(WP8)**. Moreover, PMODWRC will lead **T5.3** dealing with the solar energy short-term forecasting from satellite data. PMODWRC will also be contributing to a number of technical tasks led by other consortium members, particularly in WP2, WP3, WP4, WP6 and WP7, alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

- Solar Atlas of Egypt: http://www.nrea.gov.eg/Content/files/SOLAR%20ATLAS%202018%20digital1.pdf
- Kosmopoulos, P.G.; Kazadzis, S.; El-Askary, H.; Taylor, M.; Gkikas, A.; Proestakis, E.; Kontoes, C.; El-Khayat, M.M. Earth-Observation-Based Estimation and Forecasting of Particulate Matter Impact on Solar Energy in Egypt. Remote Sens. 10, 1870, 2018.
- Kazadzis, S., Founda, D., Psiloglou, B. E., Kambezidis, H., Mihalopoulos, N., Sanchez-Lorenzo, A., Meleti, C., Raptis, P. I., Pierros, F., and Nabat, P.: Long-term series and trends in surface solar radiation in Athens, Greece, Atmos. Chem. Phys., 18, 2395-2411, https://doi.org/10.5194/acp-18-2395-2018, 2018. (highlight paper ACP)
- Kosmopoulos, P. G., Kazadzis, S., Taylor, M., Raptis, P. I., Keramitsoglou, I., Kiranoudis, C., and Bais, A. F.: Assessment of surface solar irradiance derived from real-time modelling techniques and verification with ground-based measurements, Atmos. Meas. Tech., 11, 907-924, https://doi.org/10.5194/amt-11-907-2018, 2018.
- Kosmopoulos, P. G., Kazadzis, S., Taylor, M., Athanasopoulou, E., Speyer, O., Raptis, P. I., Marinou, E., Proestakis, E., Solomos, S., Gerasopoulos, E., Amiridis, V., Bais, A., and Kontoes, C.: Dust impact on surface solar irradiance assessed with model simulations, satellite observations and ground-based measurements, Atmos. Meas. Tech., 10, 2435-2453, https://doi.org/10.5194/amt-10-2435-2017, 2017.
- M. Taylor, P.G. Kosmopoulos, S. Kazadzis, I. Keramitsoglou, C.T. Kiranoudis, Neural network radiative transfer solvers for the generation of high resolution solar irradiance spectra parameterized by cloud and

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aerosol parameters, Journal of Quantitative Spectroscopy and Radiative Transfer Volume 168, Pages 176–192, January 2016

Participation in relevant EU projects:

- **H2020 GEO-Cradle (http://geocradle.eu/en/about-geo-cradle/the-project/):**Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS
- **H2020 E-SHAPE(https://e-shape.eu/)**: EUROGEOSS Showcase: Applications powered by Europe.

Personnel Involved:

Stelios Kazadzis (male) has 21 years of experience in basic and applied research in Atmospheric Physics. In 2015 he took the position of Senior Researcher at the World Radiation Center (WRC) as Leader of the World Optical Depth Research and Calibration Center (WMO) at the WRC of the PhysicalischMeteorologischesObservatorium in Davos, Switzerland. He also became a member of the WMO Scientific Advisory Group for Aerosols (WMO). He is the PI of the Solar Energy Nowcasting System (SENSE), and provides consulting services for solar energy projects. From 2015, he has participated in 4 projects as a PI and 3 as a scientific partner in European and national (Switzerland) funded projects. He is a national representative (Switzerland) and is in charge of one of the four working groups in the European COST program "inDust" (2017-2021) related to dust aerosols. He has 109 publications in scientific journals that received 2800 references [h index = 32] (ISI Web of Knowledge, December 2019). He is a member of the Atmospheric Chemistry and Physics editorial board and is an active reviewer in more than 15 scientific journals.

Natalia Kouremeti (female) has a PhD in atmospheric physics. In her current position she is responsible for the AOD calibrations and the characterisation of the spectro- and filter-radiometers of the WRC-WORCC. She has participated to a number of international projects, including the ESA IDEAS+ ATLAS project (2015-2019) and the EMRP ATMOZ (2014-2017) projects. She has more than 15 years' experience in solar radiation measurements and remote sensing of the atmosphere using ground-based optical instruments and radiative transfer modeling.

Julian Gröbner (male) has a PhD in atmospheric physics and more than 25 years' experience in solar radiation measurements and remote sensing of the atmosphere using ground-based optical instruments. Since February 2005, he is senior scientist at the PMOD/WRC and co-leads the World Radiation Center since 2015. He has successfully coordinated several national and international projects, such as the EMRP SolarUV and EMRP ATMOZ projects. He is a member of the baseline Surface Radiation network Committee and has extensive experience in solar radiation and solar energy related measurements and modeling.

Significant Infrastructure and Equipment:

PMODWRC has developed and used solar radiative transfer codes in order to be used for atmospheric composition studies and solar energy ones.ThePMODWRC infrastructure provides calibration facilities for solar radiation sensors with traceability to established references by the World meteorological organization (WMO). The Optical Laboratory of PMODWRC provides spectral irradiance calibrations traceable to S.I., Angular and Spectral responsivity Measurements, as well as detector linearity determination. A Tuneable Laser Facility allows the characterisation of bandpass and slit function of spectroradiometers as well as the spectral transmission functions of radiometers in the range 250 to 2200 nm. A Climate Chamber is available for temperature characterisations.

PMODWRC maintains and operates a global network of 30 sun-photometric stations measuring Aerosol Optical Depth within the Global Atmosphere Watch Programme of the WMO since 1999.WRC hosts the World Radiometric Reference which is the measurement standard representing the SI unit of irradiance. It was introduced in order to ensure world-wide homogeneity of solar radiation measurements and is in use since 1980. The WRR was determined from the weighted mean of the measurements of a group of 15 absolute cavity radiometers which have been fully characterized. It has an estimated accuracy of 0.3%. The WMO introduced its mandatory use in its statutes in 1979. Solar radiation instrumentations of the Baseline Surface Radiation network/ national reference standards are mandatory/recommended by WMO to be calibrated at PMODWRC.

4.1.11 ANONIMI NAFTILIAKI ETERIA KRITIS [ANEK] Lines S.A. (ANEK)

Organisation type:	Industry	**Web:**https://www.anek.gr

Profile of the organization (short description):

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ANEK LINES was established in 1967 when a few visionaries from Crete, Greece decided to take a stance and come up with a solution to the problem of travelling from and to their island on modern and safe ships. A few hundred tradesmen, businessmen, pensioners and farmers, were motivated and joined their forces to materialize the bold idea of establishing the first multi-shareholder shipping company in the world.ANEK LINES is the only Greek coastal shipping company that has been operating continuously since 1967 keeping alive the vision of its founders for growth and ongoing improvement of services. The company that launched in 1967 with only one ship and just a few employees, is currently owning, managing and operating 9 vessels, serving various destinations in Aegean and Adriatic Seas by employing around 700 crew and staff members.

During 2018, ANEK Group in all routes where operated, transferred in aggregate 965 thousand passengers, 189 thousand vehicles and 132 thousand trucks.ANEK LINES is a pioneer in the Greek coastal shipping, introducing technological innovations, always aiming at ensuring the safety of its passengers and top quality services aboard.

Main Tasks to be involved:

ANEKwill serve as an end-user partner that will be actively involved in the design, development and evaluation of PUC2 (contributing to WP2 and WP8). They will also support technical activities related to AIS data collection, indexing and semantic representation, as well as user interfacing. Finally, they will contribute the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

ANEK LINES aims to offer high quality services to its customers by enlarging its commercial network, by creating new routes, by enhancing investment opportunities and challenges in the shipping field, by implementing well targeted marketing strategies which take into account all the specific peculiarities of each market, it efficiently and competitively activates its total potential in Greece and Europe. At the same time, ANEK LINES is a socially aware company and has responsibly contributed for years to the community through major environmental and cultural sponsorships. The company is on a constant effort to keep up with and adapt to the evolution in naval, marine and maritime technologies and techniques in order to sustain its competitive advantage and financial viability. Above all, ANEK LINES is committed to ensure the highest possible passenger comfort and safety levels

Participation in relevant EU projects:

- **BigDataOcean (H2020-ICT-2016-1**): "Exploiting Oceans of Data for Maritime Applications": enable maritime big data scenarios for EU-based companies, organisations and scientists, through a multi-segment platform that will combine data of different velocity, variety and volume under an interlinked, trusted, multilingual engine to produce a big-data repository of value and veracity back to the participants and local communities.
- **PALAEMON (H2020-MG-2-2-2018):** "A holistic passenger ship evacuation and rescue ecosystem": development and evaluation of a sophisticated mass centralised evacuation system, based on a radical re-thinking of Mass Evacuation Vessels (MEVs) combined with an intelligent ecosystem of critical components providing real-time access to and representation of data to establish appropriate evacuation strategies for optimizing the operational planning of the evacuation process on damaged or flooded vessels.
- **ASPIS (FP7-SST-2007-RTD-1/7.2.4**.): "Autonomous Surveillance in Public Transport Infrastructure Systems": development of a prototype surveillance system based on autonomous, smart monitoring devices that capture data only upon the occurrence of an incident, potentially dangerous for the passengers (like an explosion blast or the triggering of the fire detector).
- **REFRESH (FP7):** "Green Retrofitting of Existing Ships": Research on energy efficiency as an integral part of the life-cycle a ship. This was achieved with modelling and simulation of energy flows onboard for various operational conditions and for extended periods of time.
- **PICASSO (CEF Transport):** "Preventing Incident and Accident by Safer Ships on the Oceans": study with pilots' actions which aims at tackling the challenges and opportunities related to maritime safety and security of on board and on shore operations.
- **POSEIDON MED II (CEF Transport):** The project aims to facilitate the adoption of the regulatory framework for the LNG bunkering, design of LNG terminal, design and construct an LNG fuelled specific feeder vessel, technical designs and plan approvals for the retrofit/new building of LNG fuelled vessels,

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develop a sustainable LNG trading and pricing pattern, develop financial instruments to support the port and vessel installations and develop synergies with other economic sectors.

Personnel Involved:

Mr. MarinosNomikos (male) received his Diploma in Computer Science from the Polytechnic of Central London in 1988 and his Master in HCI & User Interface Design from London Guildhall University in 1995. He is the IT Manager responsible for the corporate ICT systems of ANEK LINES. He has a long research experience in UK and extensive working experience both in UK and Greece. Mr.Nomikos has been involved in the development and installation of BTS, ERP, CRM and RDBMS Systems.

Capt. Stavros Aggelidakis (male) received his Diploma as a Captain in 1985 from the Superior Public School of Merchant Navy. He has been employed in ANEK LINES since 2003 as Operation and Ship Monitoring Manager. He has a vast experience in the maritime sector and has also worked on tankers ships for more than 15 years.

Capt. Petros Chatzidakis (male) is a Commodore and the Safety Quality Manager at ANEK LINES. He is a graduate of the Highest Public School of Mercantile Marine (Captains). He has worked as a Chief Captain in VARNIMA being responsible for inspections, repairs and loading / uploading of Tankers equipped with system C.O.W. & INSERT GAS SYSTEM. He has been working at ANEK LINES since 1999 as a Chief Captain and since 2004 he is the Designated Person Ashore (DPA) and Company Security Officer (CSO) Chief Captain of the company. He is considered an expertise in ships' operational safety and security issues. His close to 50-year experience both at sea and on-shore covers all fields relative with super tankers, such as tanker inspection and rebuilding. He has written a book entitled "Ship's operational safety manual", which proves his wide knowledge of safety issues.

Mr. Georgios Railakis (male) holds a Bachelor degree in Economics from the University of Piraeus, Greece and a Master degree of Business Administration (MBA) from the University of Bradford, UK. He has been employed at ANEK LINES since 2010. His experience in maritime sector covers the fields of various vessels' efficiency issues, such as performance measurement, conditions based management, cost controlling, fuel consumption and maintenance cost.

The company is also supported by the European Affairs Directorate which has extensive experience and provides consultancy services related to proposal submission and management of National and EU co-funded project since 1990. The EAD is staffed with 4 employees (legal advisor, chemical engineer and 2 financial advisor) specialized in the field of management of research, demonstration, development and investment projects.

Significant Infrastructure and Equipment:

ANEK LINES is one of the leading companies in Passenger & Cargo Transport, by reliably serving international routes of the Adriatic sea and domestic routes of Greece.The company is owns, manages and operates 9 RO-PAX vessels, serving various destinations in Aegean and Adriatic Seas by employing around 700 crew and staff members.During 2018, ANEK Group in all routes where operated, transferred in aggregate 965 thousand passengers, 189 thousand vehicles and 132 thousand trucks.Those large assets, operational excellence, market knowledge and large client basis are the prerequisites, from an end user perspective, to ensure the success of the project.

4.1.12 Exus Software LtD (EXUS)

Organisation type:	SME	**Web:**https://www.exus.co.uk

Profile of the organization (short description):

EXUS INNOVATION

EXUS is an enterprise software company specializing in credit risk management, digital transformation services and innovation management. EXUS was founded with the vision to simplify enterprise software, make it simple, accessible and exciting. EXUS supports organizations worldwide to improve their results by introducing simplicity & intelligence in their business processes through state of the art technology.

EXUS designs, creates and markets software solutions and services in several business and application areas such as business, e-health, e-learning, business process management, collection, wireless applications. Currently, EXUS employs highly skilled professionals in areas such as software engineering & web development, project and product management, account management and research. The company aims at leveraging the successful track record of EXUS in view of delivering cutting edge innovation to its customers. Both products and bespoke solutions built by

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EXUS, serve demanding and critical business applications and domains, covering all types of diverse sectors. From consumer banking applications, smartphones-based payment and transaction systems, augmented-reality mobile applications, large-scale and complex portals, extranets, Electronic Data Interchanges to secure cloud services, serious games and gamification mechanisms, data management and analytics, EXUS covers a wide spread of activities by leveraging the expertise of its 130+ people strong technical divisions that are led by expert project managers and senior consultants. EXUS has been awarded with the EFQM "Recognized for Excellence" award. EXUS is certified with ISO: 9001 for quality assurance. The project managers are certified according to the Project Management Institute as Project Management Professionals. Finally, EXUS is a Gold Microsoft and Oracle Partner for development and Integration works.

Our vision is to transform research to successful market products. Products enhanced with intelligent services built upon novel data analytics algorithms, mechanisms and tools that are reusable and scalable across multiple application domains. EXUS actively contributes to the definition of new research and innovative opportunities harnessing the potential of Data.

Our approach includes the following important aspects:

- The successful transformation of primitive research ideas into large-scale innovation projects.
- Its strategic management, quality control and efficient coordination of multinational projects.
- Work closely with key industry and government stakeholders to provide real-world applications and drive impact.
- Privacy by design, federated access control in heterogeneous environments (e.g. finance, energy, security, health).
- Deal with different data quality: raw, processed, annotated, metadata.

Finally, the company operates its internal Innovation department which manages the strategic research and development portfolio of the company. EXUS Innovation manages a portfolio of initiatives that aim to pave the way for the introduction and take up of emerging technologies. Leveraging the results of strategic research activities allows us to harness untapped niches in our market sectors of interest. We excel in driving innovation in software engineering and data management to foster advances in key sectors such as: security, health, creativity and lifelong learning.EXUS employs a discovery-oriented approach and actively pursues innovation opportunities in the following sectors:

Artificial Intelligence

- Innovative AI-as-a-Service algorithms that provide real time predictive models on the cloud
- Sentiment analysis with Knowledge Graphs
- Real time Personalised Recommendation Engine
- Real Time Decision Support Systems
- Time Series Forecasting
- Semi-Empirical Expert Systems with Fuzzy Logic
- Gesture Recognition Algorithms
- Scalable Deep Learning Algorithms for Big Data

Civil Security

- The development of data fusion and enhanced situational awareness engines
- Exploiting diverse information exchanges to enhance openness of data
- Harnessing generic and key-enabling technologies (e.g. Big Data)
- Adopting security-by-design principle

Creativity & Learning

- The introduction of cutting-edge tools that empower non-technical people to express their creativity seamlessly with a focus on codeless platforms
- The discovery, collection, and extraction of creativity triggers from learning resources
- The visualization, diversity, personalization, novelty and other characteristics of creativity-supporting tools
- The application of machine learning methods for computational tools
- The extraction of wisdom of crowds' applications (e.g. prediction markets) & crowd-sourcing exploitation

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- The implementation of hybrid learning systems that harnessing all channels

Health

- EXUS' experience in software development drives the creation of health information systems and mission-critical decision support systems.
- Moreover, the definition of intuitive algorithms, targeting the discovery of predictive patterns and the extraction of comprehensive assessments further enhance the value of our software.
- At the same time, EXUS' m-Health applications, exploit recent advances in technology in order to define and support a new paradigm that allows constant and seamless access to health services.

Main Tasks to be involved:

Exploitingits huge experience in utilizing large amounts of data for research and commercial purposes, EXUS willcoordinate**WP5**, namely Extreme-scale Predictive Analytics. Furthermore, EXUS will be the task leader in **T3.4** Development of the Big Data Operations (DataOps) Fusion Engine (BIDOFE), **T4.1** AI workflows on structured data,**T5.4** Development of the TADDIS Intelligent Analytics Platform and **T6.4** Development of the TADISS Autonomous Decision-Making system in industrial and societal applications. All four tasks are connected and thus there will be a coherent manner in aggregating, fusing manipulating large amount of data in a scalable manner, while implementing AI predictive models. In addition, from technical point of view EXUS will contribute to "T5.1 Data stream clustering and similarity search in extreme-scale data collections" connecting it with BIDOFE platform (T3.4) and"T5.2 Predictive analytics models" that will be built upon the AI workflows platform (T4.1). EXUS will contribute to the design of pilot use cases (T2.2) and TADDIS architecture and integration plans (T7.1 & T7.2), while will participate with the developed technologies all pilots tasks and activities (WP8). At last based on its 30-year experience in the extensive sales network in more than 25 countries EXUS will contribute in the dissemination and market analysis tasks (T9.1 & T9.2 respectively).

Main achievements relevant to the call:

1. **Web and Mobile Apps.**EXUS designs and develops sophisticated Web-based and Mobile (native/cross-platform) Apps in various domains ranging from Banking and Telecom Markets (commercial products) to crowd safety and first responders, health and assisting living arenas (Research activities). These include running transaction-heavy intranets and extranets and e-learning, e-payment and iOS and Android phone apps. Indicative clients are Vodafone, WIND, Greek Public Power Supply Company, Historic Hotels of Europe, etc. By exploiting our rich experience in delivering complex and large scale Internet technology projects and our exposure to state-of-the-art research outcomes, we are currently introducing to the market an end-to-end solution covering the needs of fast and effective digital presence for all types of organisations. To that effect, our newly delivered platforms remove the complexity from the traditional approaches in building information-heavy portals and applications, to the benefit of the end-user/customer. It is a fully cloud-deployable solution going under the PaaS model. It empowers non-technical people to create, design, parameterize, launch, market and manage all types of native applications exploiting smart-phones' potential to the fullest. Its next release planned for Q4 2014, will entail a series of analytics functions in order to leverage the ability to monitor consumer/user behaviour for the delivery of increased value to EXUS' customers.
2. **EXUS Analytical Framework.** The EXUS Analytics Framework is the result of EXUS' long term product evolution that leverages in-house expertise and business activities in conjunction with a strong portfolio of research and innovation activities. The driving idea behind the design and development of EAF is the seamless facilitation of analytics functions for both batch and streaming data (including "Big Data") by different typed of business users, without imposing strong requirements on expertise and specialization. To achieve that, EAF employs a codeless approach in the sense that the end-to-end platform is integrated in such a way, so that the end users can interact with it, without requiring extra effort.

   EAF enables data scientists and application developers to design, implement and deploy novel applications that seamlessly process offline and online big data without having to cross disruptive boundaries between distinct processing systems or paradigms. Through a unified offline and online model, EAF increases the productivity of data scientists and enables new application use cases in a cost-efficient fashion. For this, EAF includes advanced predictive, interactive and visual analytics capabilities. Analytics applications on EAF execute on an underlying infrastructure that can exploit heterogeneous cluster compute resources for data-parallel processing of high volume and velocity data. EAF leverages existing and mature big data technologies, including Spark, Hadoop and Storm, where appropriate, and uses them to provide a comprehensive integration of offline and online processing models. EAF's focus on privacy-preserving

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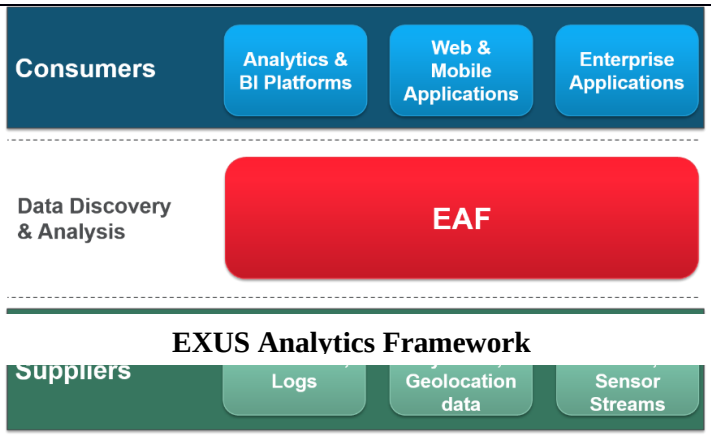
processing allows the platform to act as a building block for cross-border adoption by European stakeholders, such as public authorities, private organisations and research institutions that hold and work with sensitive data.

EAF focuses on overcoming key technical limitations of existing big data platforms in order to establish its new big data ecosystem. EAF is structured around four focused *technical innovation areas*.



3. **EXus Artificial Intelligence TEchnologies EXAITE Suite.** One of the key areas of focus within EXUS is predictive modelling and its application to a wide variety of fields. EXUS has developed an internal library of AI tools that can be re-used across various fields. More specifically the suite has the following tools: 1) Predictive model for patient readmission prediction which has shown excellent results in field tests. 2) Predictive Model for fraud detection that provides risk estimates for online transactions in real time. 3) Predictive models for boat engine fault prediction 4) crop failure prediction for insurance risk analysis. 5) EXUS has applied state-of-the-art methods to develop recommenders that allow collection processes, in financial institutions, to be tailored to the customer. This is achieved by analysing response patterns of customers to collection actions, combining with freely available social media data and developing targeted models for recommending actions best suited to the customer. 6) Another broad area of focus of analytics work undertaken by EXUS revolves around the use of natural language processing (NLP). EXUS is actively engaged in developing AI powered chatbots and sentiment analysis to support customer interactions for its clients. Works undertaken focus on applying these advanced techniques to utilize textual and voice data retained by its clients to feed into predictive models that deliver actionable insights. EXUS has also undertaken several projects delivering visual analytics solutions in the Healthcare and Financial verticals. Solutions developed range from customizable dashboards to drive business intelligence (BI) to advanced analytics visualizations tailored for the customer data. EXUS exploits and transfers this AI expertise in the security sector, developing predictive models, simulated scenarios and smart algorithms to facilitate the crisis operators and the first responders.

Participation in relevant EU projects:

- **H2020 IN-PREP (2017 - 2020):** "An INtegrated next generation PREParedness programme for improving effective inter-organisational response capacity in complex environments of disasters and causes of crises"
- **H2020 GHOST (2017 - 2020):** "Safe-Guarding Home IoT Environments with Personalised Real-time Risk Control"
- **H2020 WorkingAge (2019-2022):** "Smart Working and living environments supporting active and healthy ageing"
- **H2020 CURSOR (2019-2022):** "Coordinated Use of miniaturized Robotic equipment and advanced Sensors for search and rescue Operations"
- **H2020 RANGER (2016-2019):** "RAdars for loNG distance maritime surveillancE and SaR operations"

Personnel Involved:

Dr. Dimitris Kanakidis (male) is a Senior Research Consultant with the role to coordinate the Research Team of EXUS Innovation after joining the company on June 2013. He is highly experienced in R&D projects, currently supervising 5 FP7 and H2020 projects. Previously he led the research activities of Net Technologies from 2007 to 2013 and its participation in several EU funded projects under FP6 and FP7. During that period, he also managed major commercial projects related to the realization of TETRA and WiMAX networks in Saudi Arabia and Greece. Before 2007 he worked as a researcher in the National Kapodistrian University of Athens participating in its activities

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under the FP5 program. He holds a BSc Degree in Physics, an MSc Degree in Telecommunications and a Ph.D. Degree in the area of Optical Communications, all from National Kapodistrian University of Athens, Greece. His research interests are in the fields of Wireless Communications, Security and Secure Optical Communications being the author of several published papers.

Mrs. Hara Stefanou (female) has joined the company in January 2010 and until September 2013 she was a project manager and consultant for commercial IT projects including projects for Hellenic Public Power Corporation and Hellenic Electricity Distribution Network Operator. In September 2013, she joined EXUS Innovation and is now involved as a project manager and coordinator in EU funded projects regarding Creativity and Learning. She holds an M.Sc. Degree in Medical Informatics and Biomedical Engineering and in Multimedia from the University of Crete, Greece and a B.Sc. Degree in Informatics and Telecommunications from the National Kapodistrian University of Athens, Greece. Her current research interests focus on creativity enhancement solutions, gamification, serious games and she has obtained a gamification certificate from the University of Pennsylvania.

Mr. Anaxagoras Fotopoulos (male) is a Research Consultant at EXUS. He holds a B.Sc. in "Electronic Computing Systems Engineering" and received his M.Sc. in "Information Technologies in Medicine and Biology" with specialisation in Bioinformatics; with honours and scholarship (issued from the State Scholarships Foundation) finishing 2nd in Greece in the rankings of the category "Engineering & IT Sciences". A.F. has been awarded 11 times in national & international competitions, including a 2nd place in the IEEE Region 8 (Europe, Africa & M. East) Student Branches' website contest. In the past he has created multiple mobile applications with his team that have been downloaded in more than 1.6 million devices. Additionally, he possesses a strong research background with more than 30 scientific publications in conferences & peer reviewed journals and is well certified with 17 Technical certifications in IT (including: MSCE, MCSA, MCTS, MS, MSOMS, MSOE & MSOS). After army obligations, A.F. was integral member of the Ingred.io Start-up (founded from one of his MSc Professors) that won 4 Start-up prizes and has been part of "MIT Enterprize Forum" & "Egg" incubators. In February 2017 and until June 2019 worked in ERFC as a Project Manager handling the bidding of various EU Calls raising in 2 years more than 500.000€ (From 1 H2020 Innosup, 4 Erasmus+, 1 ENPI CBC MED, 1 Hellenic Green Fund and EIT Climate KIC). In the past he has managed 6 projects (Interreg YESS, Erasmus+ AUDID, Interreg TRAP, Interreg SYMBIOSIS, Interreg PASSAGE, Hellenic Green Fund e-CLIMA). Since July 2019 he joined EXUS as a Research Consultant - R&D Project Manager, where he is managing 3 H2020 Projects (IN-PREP, CURSOR & INGENIOUS) and coordinates the preparation and submission of various EU proposals. At last, for his voluntary offer in the creation of two Student NGOs (Erasmus Student Network & IEEE Student Branch) and various scientific & cultural events he has received 2 honorary plaques.

Mrs. Maria Plakia (female)has joined EXUS Innovation as data scientist in January 2019. She worked as a research engineer at ICS-FORTH for mobile computing group (2016-2017) and as a research assistant for TNL lab (2013-1016), her main activities were analysis and modelling of data for multimedia services and brain activity. She holds an M.Sc and a B.Sc. Degree in Computer Science from University of Crete. Her current research interests include machine learning, data modelling and statistical analysis.

Mrs. Theodora Galani (female)joined EXUS in June 2017 as a Software Engineer. She holds a Diploma in Electrical and Computer Engineering from the National Technical University of Athens (NTUA). Also, she is a PhD candidate in the School of Electrical and Computer Engineering of NTUA in the field of data management. In EXUS, she is currently involved in CRISS project.

Significant Infrastructure and Equipment:

EXUS can provide the following infrastructure for the development, technical testing and integration of the project:

1. Privately owned cloud infrastructure located at in-house data-room.
2. 4 dedicated Servers allowing for the quick and reliable testing of the prototypes developed in the context of the project. The server configuration is as follows:
   - DELL SERVER PE R420 E5-2407/8GB LV RDIMM/NO HDD /DVD-RW/PERC H310
   - Intel Xeon E5-2407 2,20GHz, 10M Cache, 6,4GT/s QPI, No Turbo, 4C, 80W,
   - 8GB Memory (2x4GB RDIMM, 1333 MHz, Low Volt, Dual Rank, x4), NO HDD's, PERC H310 Integrated RAID Controller, 16X DVD+/-RW Drive, iDRAC Enterprise, Dual Hot Plug Power Supplies 550W,
   - Additional info: 1U RACK Chassis, for Up to 4x 3,5" HDDs, Dual, Hot-plug, Redundant Power Supply (1+1), 550W
   - 16 GB Memory Module for PowerEdge ALL OTHERS- 2Rx4 RDIMM 1600MHz SV NEW

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- 1TB NL SAS 6Gbps 7,2k 3,5" HD Hot Plug Fully Assembled – Kit
- Intel Xeon E5-2407 2,20GHz,10M Cache,6,4GT/s QPI, No Turbo,4C,80W (Heatsink not included) - kit
- Heat Sink for Additional Processor - Kit R420
- PCIe Riser for 2CPUs R420 – Kit
- Fan 12V 40x40 – Kit

3. 3 more dedicated Servers with the following configuration:
   - DELL SERVER PE R210 II E3-1220/4GB LV UDIMM/2X1TB/DVD-RW/ PERC S100/
   - Intel Xeon E3-1220 Processor (3,1GHz, 4C/4T, 8M Cache, 80W, Turbo),
   - 4GB Memory (1x4GB Dual Rank LV UDIMM) 1333MHz,
   - 2x1TB SATA 7,2k 3,5" HD Cabled, PERC S100 RAID controller 0,1, Embedded Broadcom 5716 Dual port Gigabit Ethernet, iDRAC6 Express,
   - 4x8 GB Certified Replacement Memory Module for Select Dell Systems - 2Rx8 UDIMM 1600MHz LV
   - 16X DVD +/-RW, Power Supply (1 PSU) 305W,
   - Additional info: Rack Chassis 1U, for Up to 2x 3,5" CABLED HDDs, RAID 1 with PERC S100 Exactly 2 SAS/SATA/SSD Drives.

4.1.13 EVERIS Portugal SL (EVRPORT)

Organisation type:	Large enterprise	**Web:**https://www.everis.com/portugal/pt-pt/home-pt

Profile of the organization (short description):

Everis Portugal (based in Lisbon, Portugal) is part of the Everis Group, multinational large industry that offers its clients comprehensive business solutions covering all aspects of the value chain, from business strategy through to systems implementation. It is active in the sectors of Telecom, Banking, Healthcare, Industry, Insurance, Media, Public Sector and Utilities.

Everis was established in Spain in 1996 as DMR Consulting, its name until October 2006. It started operating in Spain with the opening of an office in Madrid and Barcelona soon followed by expansion in Europe and Latin America. At present, the company has two offices in Portugal, as well as in Spain, Argentina, Andorra, Belgium, Brazil, Chile, Colombia, Netherlands, Italy, Luxemburg, Mexico, Morocco, Peru, UK, and USA. Currently, Everis has over 24,500 employees in 18 countries and its annual turnover is 1,430 Million Euro. In January 2014, became part of NTT Data group, which enables everis to offer a wider range of solutions and services through increased capacity as well as technological, geographical, and financial resources, establishing the 5th worldwide ICT Company integrated by more than 110,000 employees and with presence in 50 countries.

As ICT provider, everis is organised by sectors, from the business point of view, and we count on several technological key lines (Artificial Intelligence to be underlined). Thanks to our dual nature, both technological and business oriented, we can act as facilitators, providing a common place for technology solutions and their potential end users. The company gathers experts on projects management, preparation and implementation of business and exploitation plans, software development and dissemination, as well as a wide range of technological knowledge, put at the innovation activities disposal. In addition, everis has proven expertise in identifying business benefits and change processes, without forgetting business strategy development under co-creative spirit together with our partners and clients, as well as the management decisions required to achieve these objectives. This focus provides a methodological framework that guarantees that investments and projects are evaluated in line with business results. Our professionals are experts in applying this approach to the whole range of services we offer to our clients. This way, we ensure the investment in TADDIS will end on new product/services on the market.

From the technological perspective, everis counts on everis Technology, transversal unit to assist to the rest of area for defining and implementing complex technological architectures. It includes several key lines, subjects identified as core technologies which will transform the traditional IT business, implying our present and future value proposal to our clients. The most relevant key line to TADDIS execution is Everis Artificial Intelligence (everis IA) and Everis Cloud.

Everis Artificial Intelligence (everis AI) is the key line with the following services and assets:

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- Digital Intelligence & Advanced Analytics: Exploiting new sources of data for supporting strategic decision making. Using methods, models and advanced analytical technics to improve knowledge and business intelligence, predicting and measuring its impact on business.
- EverisBigData Technology: Our experience in large projects allows us to offer a Big Data´s Architecture Reference Model, functional and technological, as well as any kind of advice on its implementation, integration and governance
- AI Accelerators: Portfolio of innovative analytical solutions and components to address specific use cases. The continuous monitoring of trends and market solutions allow us to select the best alternatives according to criteria of functional envisioning and evolved technologies

Moreover, everis counts on other Key Lines, all of them working on developing solutions based on disruptive technologies to be put on the market, offered to our clients from public and private sector:

everis Cloud (https://everis.cloud/en/) is the expert offer of cloud solutions and services by everis Group, acting as Sherpa to help clients to transform into cloud, by using methodologies, tools, assets and experiences in hybrid cloud environments.Other key lines are:

- everis IoT (https://www.everis.com/portugal/pt-pt/whatwedo/technology) works together with clients in order to provide IoT services. Everest Group in the report "IoT services PEAK Matrix Assessment and Market Trends 2017: Have You Taken the Plunge in IoT Yet?" where it analyzes the latest trends in the market of IOT services in the race for digital transformation, places NTT DATA, thanks to the Key Line everis IoT, in a relevant position within the "Magic Quadrant" of IoT, which compares the power and relevance in terms of IoT of more than 18 IT service providers.
- everis Blockchain is the Technological Key Line devoted to the study, development and implementation of Blockchain based technologies, products and services. Everis experiments and prototypes practical use cases around blockchain. Everis has been forging a path for implementing blockchain, demonstrating both the viability of the technology while providing a mechanism to measure business impact.

Main Tasks to be involved:

Everis Portugal will be the leader of **WP6** dealing with the System Architecture, Integration and Interactive Visualization techniques. In addition, Everis Portugal will be contributing to WP2, and more specifically, the specification of the ethical and legal dimensions (T2.3).

Main achievements relevant to the call:

everis has already participated in several projects undertaking a wide range of activities such as technologicaldevelopment, industry reports and surveys, business plans, commercialisation programs, integration developments and Coordination management. The most relevant projects are explained below:

- **Blockchain platform for transactions within the distribution chain of a retail operator:** development of a DApp (decentralized application) of a public blockchain for validation as well as consultation of transactions between players in the fish product supply chain. This solution allowed the possibility to track the entire life cycle of the product chain.
- **Robotic Process Automation:** development of a technological software that allows to reproduce manual operations and processes through digital robots. This technology is the automation of processes where the software directs the execution of actions in one or more applications already existing in the organization, just as a user does. It is not considered an "integrated" automation because the tool or platform that operates and runs another application does it through the current user interface. With RPA, all the repetitive, monotonous, non-value-added tasks are transferred to digital robots, freeing up human resources to perform higher-value tasks, thereby improving productivity, customer experience, employee and service. This technology has been implemented in several clients from different sectors.
- **Predictive analytic model for customer consumption:** development of a statistical model obtained by advance and intelligent analytics to support the business decisions of an international retail company. With the development of this model, the client was able to increase the sales and improve the communication with the customer
- **everis Health Ophthalmology:** development of algorithms to detect pathologies based on ophthalmology images.
- **Virtual Reality and Augmented Reality application for on-site planning and intervention:** development of a prototype for a virtual reality / augment reality application to collect terrain information and support the

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planning of site interventions during the infrastructure installation and maintenance. This project will allow evaluating the efficiency gains and optimization in the construction processes, either by reducing the deviations between the designed project and the built work, or by the higher quality of data collection on the ground and consequent budgetary control.

On the other hand, client-driven projects give everis deeper expertise not only on the technological solutions to be developed but also on the particular needs from clients, so TADDIS results can be well market oriented

Participation in relevant EU projects:

N/A

Personnel Involved:

João Viana Ferreira (male): João is the partner in charge of the business sector at everis Portugal. Having graduated in Economics at ISEG (Lisbon School of Economics and Management), João also holds an MBA from INSEAD. During his more than 15 years in the consulting field, João has had the chance to gain experience in several sectors, being his specialty strategy and financial projects.

Hugo Balseiro Santos (male): Holding 15 years of experience in analytics consulting, Hugo is the current head of the Data & Analytics unit at everis Portugal. Hugo has worked in the Portugal, UK and Angola helping his clients developing IT projects and managing complex programmes with many teams involved. Hugo's main experience is related to BI, Analytics and Big Data projects. Hugo is a former graduate in Computer Science from IST (Lisbon's University) and he is currently one of the directors of the technology sector at everis Portugal.

André Nunes Machado (male): Holding 10 years of experience in technology consulting, André is one of the Data & Analytics specialist and architect of the Data & Analytics unit in everis Portugal. André is a former graduate in Computer Science from IST (Lisbon's University) as he also holds a Master Degree in Computer Science from IST.

Significant Infrastructure and Equipment:

everis is a company with extensive possibilities in deploying all the resources necessary for the optimal development of their projects. everis will make available for all the consortium the following resources:

- **Digital Pop Up Room,** a physical space dedicated to innovation and which intends to inspire and share technological use cases through the demonstration of the different functionalities of the present technologies. With a strong focus on the themes of digital transformation and Customer Experience, this hub was developed as an innovation engine among employees and customers, and there is a constant search for new concepts and technology and a collaborative culture to create new use cases and new features.
- **everis office in Lisbon,** where multiple meeting rooms are available if required during project meetings or trainings.

Furthermore, everis has offices in different countries along Europe. In case problems arise with the hosting partners by the time of a project meeting, everis could provide infrastructure support in those cities.

4.1.14 University of Athens (UoA)

Organisation type:	Research	**Web:** http://www.uoa.gr, http://ai.di.uoa.gr/

Profile of the organization (short description):

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

The National and Kapodistrian University of Athens was founded in 1837 and it is the oldest university in Greece.The Department of Informatics and Telecommunications1 has been active since 1986 and it is widely recognizedas the top Computer Science department in Greece. It has been ranked consistently among top departments inComputer Science by the Academic Ranking of World Universities founded and compiled by the ShanghaiJiaotong University. The department currently has 37 active faculty members covering all areas of Informaticsand Telecommunications. The department has a long standing tradition in research and teaching, and it isequipped with a number of contemporary research and teaching laboratories. It offers an excellent environmentfor undergraduate and postgraduate students (M.Sc. and Ph.D. levels). Many of the department faculty membersare world leaders in their individual research areas, and have been awarded distinguished professional societyfellowships (ACM, IEEE among them), prizes and awards. Four junior and one senior faculty members

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haverecently been awarded prestigious grants (3 Starting Grants, 1 Consolidator Grant, 1 Advanced Grant and 1 Proof of Concept Grant) by the European Research Council. Many of the department's alumni have gone on to distinguished careers in industry and academia, in Greece, Europe and elsewhere.

Main Tasks to be involved:

UoA will lead **WP6**, namely Extreme-scale Content Enrichment, and the relevant tasks of (i) ontology population, harmonisation, fusion and linking of data and (ii) semantic search and querying. UoA will also contribute to a number of technical tasks, particularly in WP3 and WP7, alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

The UoA team that participates in TADDIS is the Artificial Intelligence team (http://ai.di.uoa.gr/) led by Prof. ManolisKoubarakis. Over the last 10 years, the group has pioneered the use of ontologies and linked data in geospatial and Earth observation applications, and it is considered the best group internationally in the area of big linked geospatial data. In the context of FP7, ESA, Greek and H2020 projects TELEIOS, LEO, Optique, Melodies, Prod-Trees, SCARE, BigDataEurope and Copernicus App Lab, the group has developed highly scalable systems for data science pipelines for geospatial and Earth observation data (e.g., Copernicus data). Currently, it leads the ExtremeEarth project (http://earthanalytics.eu/) which develops deep learning and big linked geospatial data technologies for Earth observation data, and applies these technologies to two applications: one in food security and one in the Polar regions. The group is also a participant in the H2020 project on Artificial Intelligence AI4EU where it works on the use of Artificial Intelligence technologies in the agricultural domain.

Relevant publications:

- George Papadakis, Leonidas Tsekouras, Manos Thanos, Nikiforos Pittaras, Giovanni Simonini, Dimitrios Skoutas, Paul Isaris, George Giannakopoulos, Themis Palpanas and Manolis Koubarakis. *JedAI: beyond batch, blocking-based Entity Resolution*. The 23rd International Conference on Extending Database Technology (EDBT2020). Copenhagen, Denmark, 30th March-2nd April, 2020.
- Konstantina Bereta, Guohui Xiao and Manolis Koubarakis**.** *Ontop-spatial: Ontop of geospatial databases.* Journal of Web Semantics. Volume 58, October 2019.
- Dimitris Bilidas and Manolis Koubarakis. *Scalable Parallelization of RDF Joins on Multicore Architectures.* The 22nd International Conference on Extending Database Technology (EDBT 2019). Lisbon, Portugal, 26-29 March, 2019.
- Konstantina Bereta, Herve Caumont, Ulrike Daniels, Erwin Goor, Manolis Koubarakis, Despina-Athanasia Pantazi, George Stamoulis, Sam Ubels, Valentijn Venus, FirmanWahyudi and Dirk Daems. *The Copernicus App Lab project: Easy Access to Copernicus Data.* The 22nd International Conference on Extending Database Technology (EDBT 2019). Lisbon, Portugal, 26-29 March, 2019.
- Manolis Koubarakis, Konstantina Bereta, Dimitris Bilidas, Konstantinos Giannousis, Theofilos Ioannidis, Despina-Athanasia Pantazi, George Stamoulis, Jim Dowling, SeifHaridi, Vladimir Vlassov, Lorenzo Bruzzone, Claudia Paris, Torbjørn Eltoft, Thomas Krämer, Angelos Charalabidis, Vangelis Karkaletsis, Stasinos Konstantopoulos, Theofilos Kakantousis, Mihai Datcu, Corneliu Octavian Dumitru, Florian Appel, Heike Bach, Silke Migdall, Nick Hughes, David Arthurs and Andrew Fleming. *From Copernicus Big Data to Extreme Earth Analytics.* The 22nd International Conference on Extending Database Technology (EDBT 2019). Lisbon, Portugal, 26-29 March, 2019. Short visionary paper on the goals of the ExtremeEarth project.

Participation in relevant EU projects:

- **ExtremeEarth**(http://earthanalytics.eu/). ExtremeEarth is a H2020 big data analytics project which develops deep learning and big linked geospatial data technologies for Earth observation data, and applies these technologies to two applications: one in food security and one in the Polar regions. UoA co-ordinates ExtremeEarth and leads the work on big linked geospatial data. All the results of UoA from ExtremeEarth will be available to TADDIS.
- **AI4EU** (https://www.ai4eu.eu/). AI4EU is a H2020 project which develops a European AI on-demand platform and ecosystem, and carries out basic and applied AI research on areas of importance to European industry and society. All the results of UoA from AI4EU will be available to TADDIS.
- **Copernicus App Lab.** Copernicus App Lab was a H2020 project that started on November 2016. Its main objective is to make data from three Copernicus services (Land Monitoring, Marine for Environment Monitoring and Atmosphere Monitoring) available on the Web as linked open data to aid the development

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of applications by mobile developers who might otherwise find it difficult to access and use Copernicus data using the existing data access systems.

- **BigDataEurope**. The BigDataEurope project developed anopen source platform based on**Docker**, today's virtualisationtechnique of choice. It can work on alocal development machine, or onhundreds of nodes connected in anelastic cloud. It has been proven tomeet the different requirements of eachone of Big Data Europe's pilots thataddress the seven H2020 societalchallenges. The platform can be run inhouse, or can be hosted by vendors likeAmazon Web Services, MicrosoftAzure or T-Systems Telekom cloud.The base Docker platform is enrichedwith a layer of supporting services,helping setup and maintenance. AllBigDataEurope applications are"contained," making their installationand set-up a 10-minute job.

Personnel Involved:

Prof. ManolisKoubarakis (male). ManolisKoubarakisis a Professor in the Dept. of Informatics and Telecommunications, National and Kapodistrian University of Athens. He is also an Adjunct Researcher at the Institute of the Management of Information Systems (IMIS) of the "Athena" Research and Innovation Center. He holds a Ph.D. in Computer Science, from the National Technical University of Athens, an M.Sc. in Computer Science, from The University of Toronto, and a diploma (B.Sc.) in Mathematics, from the University of Crete. He is a Fellow of EurAI (European Association for Artificial Intelligence) since 2015 and vice-president of the Hellenic Association for Artificial Intelligence. He has published more than 200 papers that have been widely cited (6282 citations and h-index 41 in Google Scholar) in the areas of Artificial Intelligence (especially Knowledge Representation), Databases, Semantic Web and Linked Geospatial Data. His research has been financially supported with a total amount exceeding 7 million Euros by the European Commission (projects CHOROCHRONOS, DIET, BRIDGEMAP, Evergrow, OntoGrid, SemsorGrid4Env, TELEIOS, Optique, LEO, MELODIES, WDAqua, BigDataEurope, Copernicus App Lab, AI4EU and ExtremeEarth), the Greek General Secretariat for Research and Technology (recently through the project Choronomothesia and the Research Excellence Grant SCARE), the European Space Agency (project Prod-Trees) and industry sources (Microsoft Research and British Telecommunications). He co-chaired the European Data Forum 2014, the top European event aiming towards the development of a strong data economy in Europe. He has co-ordinated the well-known projects TELEIOS and LEO which developed tools for linked Earth Observation data and linked geospatial data, and applied them to the development of environmental and commercial applications. Manolis' team has also developed the linked data infrastructure of project MELODIES which studied how to exploit linked open data in a variety of environmental applications. Manolis is currently technical leader of the project Choronomothesia which aims to extract geospatial information from Greek legislation and make it available on the Web as linked data with the aim of utilizing it in the development of commercial services. He is also the coordinator of projectExtremeEarth (2019-2021) which develops deep learning and big data techniques for satellite data from the Copernicus program. Manolis also participates in the project AI4EU, which is the largest H2020 European project in the area of Artificial Intelligence.

Dr. George Papadakis (male). George Papadakis is a visitingPostdoctoral researcher in the Dept. of Informatics and Telecommunications, National and Kapodistrian University of Athens. Dr. Papadakis holds a Diploma in Computer Engineering from the National Technical University of Athens and a PhD from the Leibniz University of Hanover. His research focuses on Data Integration, Semantic Web and Web Data Mining and has received the best paper award from ACM Hypertext 2011. Dr. Papadakis has led Prof. Koubarakis' team in the project BigDataEurope, which developed a big data infrastructure used in tackling the societal challenges of the Horizon 2020 programme. Before that, he worked as researcher at the NCSR "Demokritos", the L3S Research Center, the National Technical University of Athens and the Athena RIC.

Dr. Eleni Tsalapati (female). Eleni Tsalapatiis a Research Associate in the Department of Informatics and Telecommunications of the National and Kapodistrian University of Athens. Eleni received her first degree in Applied Mathematics and Physical Sciences from NTUA (2005), her M.Sc. in Informatics from the University of Edinburgh (2007) and her Ph.D. in consistent and inconsistent query answering for description logic languages from NTUA (2016). She brings 10 years' experience in knowledge representation and reasoning. She has been actively involved in a number of European projects in ontology development, management and reasoning for the cultural and sports sector (AthenaPlus; LinkedHeritage; eContentPlus; BOEMIE). During the past two years she has been leading work-packages in UK-funded (EPSRC) projects vis-à-vis the application and development of ontologies for the automotive industry (RESILIENCE) and advanced manufacturing (AI2M; Embedded Integrated Intelligent Systems for Manufacturing).

Significant Infrastructure and Equipment:

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UoA has all the necessary infrastructure and equipment, including a modern computing cluster, for carrying out TADDIS successfully. UoA will contribute to TADDIS the distributed versions of GeoTriples, JedAIOntop-spatial and Strabon, which will be extended during the project.

4.1.15 UNIVERSITA DEGLI STUDI DI TRENTO (UNITN)

Organisation type:	Research	**Web:** https://rslab.disi.unitn.it/

Profile of the organization (short description):

The Department of Information Engineering and Computer Science (DISI) of the University of Trento represents an aggregation of top researchers and institutions. It has 53 faculty members, 129 research and technical staff members and 207 PhD students. DISI at UNITN has been involved in more than 100 projects in the last 6 years for a total funding of about 21 MEuros. The remote sensing and data processing expertise at DISI is related to the Remote Sensing Laboratory (RSLab) led by prof. Lorenzo Bruzzone. The RSLab has a long experience in the development of automatic and semi-automatic methods and algorithms for information extraction from remote sensing images acquired by both passive (multispectral, hyperspectral) and active (SAR for imaging, sounder, LiDAR) systems. With respect to the specific topics of this project, RSLab has a solid background and a huge experience in the definition, development, and implementation of classification techniques for the analysis of different kinds of remote sensing images acquired by passive and active remote sensing sensors. In this framework the members of the laboratory developed many advanced techniques that are the state-of-the-art for the automatic analysis of image time series, classification in multispectral, hyperspectral and SAR images. RSLab has a large experience in machine learning and big data in the framework of space data. RSLab developed more than 30 national/international projects related to the specific analysis of remote sensing data since its foundation. The RSLab visibility at national/international level is documented by the high number of international awards and honors received by its members in the field of remote sensing and signal processing, by the high number of publications in the most prestigious international journals, and by the high number of citations received (see https://rslab.disi.unitn.it/ for more details).

Main Tasks to be involved:

UNITN will lead Task 4.6 on Deep learning in multisensor and multisource Earth Observation data in WP4, while contributing to a number of technical tasks led by other consortium partners, particularly in WP3and WP5-WP8, alongside with the impact creation, dissemination and exploitation activities (WP9).

Main achievements relevant to the call:

RSLab published more than 247 papers in referred international journals (183 in IEEE journals), more than 310 papers in conference proceedings, 21 book chapters, as well as 19 books/conference proceedings. These papers are highly cited, as proven form the total number of citations (more than 31500) (source: Google Scholar). Below we report a selected short list of 10 papers published on international journals that are relevant to the activity of the project. For a complete list refer to: https://rslab.disi.unitn.it/publications/

[1] L. Bruzzone, M. Marconcini, "Domain Adaptation Problems: a DASVM Classification Technique and a Circular Validation Strategy", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 32, No. 5, pp. 770-787, 2010.

[2] C. Persello, L. Bruzzone, "Active and Semi-supervised Learning for the Classification of Remote Sensing Images," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 52, 2014, pp. 6937-6956.

[3] P. Bose, N. Kasabov, L. Bruzzone, R. Hartono "Spiking Neural Networks for Crop-yield Estimation Based on Spatio-temporal Analysis of Image Time Series," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 54, No. 11, pp. 6563-6573, 2016. DOI: 10.1109/TGRS.2016.2586602

[4] S. De, L. Bruzzone, A. Bhattacharya, F. Bovolo, S. Chaudhuri, "A Novel Technique Based on Deep Learning and a Synthetic Database for Classification of Urban Areas in PolSAR Data," *IEEE Journal on Selected Topics in Applied Earth Observation and Remote Sensing, Vol. 11, pp. 154-170*, 2018. DOI: 10.1109/JSTARS.2017.2752282

[5] S. Hao, W. Wang, T. Nie, T. Ye, L. Bruzzone, "Two-stream Deep Architecture for Hyperspectral Image Classification," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 56, No. 4, pp. 2349-2361, 2018. DOI: 10.1109/TGRS.2017.2778343

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Participation in relevant EU projects:

RSLab at DISI developed more than 30 national/international projects related to the specific analysis of remote sensing data since its foundation. These projects have been funded by the European Space Agency, the European Commission, the Italian Space Agency, and several other public and private bodies. More details on current research projects at http://rslab.disi.unitn.it/projects/. A selection of the most recent and relevant projects is reported below:

- Climate Change Initiative Extension (CCI+) Phase 1, New Essential Climate Variables (NEW ECVS), High Resolution Land Cover ECV (HR LandCover CCI), *European Space Agency* (**Principal Investigator and Science Lead**) [2018-2021].
- From Copernicus Big Data to Extreme Earth Analytics (ExtremeEarth), European Commission (H2020-ICT-2018-2020, RIA) (**WP Leader**) [2019-2021].
- Scientific Exploitation of Operational Missions (SEOM) – S2-4Sci Land and Water – Multi-temporal Analysis, *European Space Agency* (**Principal Investigator**) *[2016-2019]*.
- Product Feature Extraction (PFA), *European Space Agency* (**Responsible of the Scientific Activity)** [2013-2015].

Mapping and the citizen sensor, ICT COST Action - European Union (**Member of the Management Committee**) [2012-2016].

Personnel Involved:

Lorenzo Bruzzone (male) received the Laurea (M.S.) degree in electronic engineering (summa cum laude) and the Ph.D. degree in telecommunications from the University of Genoa, Italy, in 1993 and 1998, respectively. He is currently a Full Professor of telecommunications at the University of Trento, Italy, where he teaches remote sensing, radar, and digital communications. Dr. Bruzzone is the founder and the director of the Remote Sensing Laboratory in the Department of Information Engineering and Computer Science, University of Trento. His current research interests are in the areas of remote sensing, radar and SAR, signal processing, machine learning and pattern recognition. He promotes and supervises research on these topics within the frameworks of many national and international projects. He is the author (or coauthor) of 247 scientific publications in referred international journals (183 in IEEE journals), more than 310 papers in conference proceedings, and 21 book chapters. He is editor/co-editor of 18 books/conference proceedings and 1 scientific book. His papers are highly cited, as proven from the total number of citations (more than 31500) and the value of the h-index (83) (source: Google Scholar). He was invited as keynote speaker in more than 32 international conferences and workshops. Since 2009 he has been a member of the Administrative Committee of the IEEE Geoscience and Remote Sensing Society (GRSS), where since 2019 he has been Vice-President for Professional Activities. Dr. Bruzzone was recipient of many international and national honors and awards, including the recent IEEE GRSS 2015 Outstanding Service Award, the 2017 and 2018 IEEE IGARSS Symposium Prize Paper Awards and the 2019 WHISPERS Oustanding Paper Award. Dr. Bruzzone is the co-founder of the IEEE International Workshop on the Analysis of Multi-Temporal Remote-Sensing Images (MultiTemp) series and is currently a member of the Permanent Steering Committee of this series of workshops. Since 2003 he has been the Chair of the SPIE Conference on Image and Signal Processing for Remote Sensing. He has been the founder of the IEEE GEOSCIENCE AND REMOTE SENSING MAGAZINE for which he has been the Editor-in-Chief between 2013 and 2017. Currently he is an Associate Editor for the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING. He has been Distinguished Speaker of the IEEE Geoscience and Remote Sensing Society between 2012 and 2016. He is a Fellow of IEEE and a member of the International Association for Pattern Recognition (IAPR) and of the Italian Association for Remote Sensing (AIT).

Claudia Paris(female)received the "Laurea" (B.S.), the "LaureaSpecialistica" (M.S.) degrees in Telecommunication Engineering and the Ph.D. in Information and Communication Technologies from the University of Trento, Italy, in 2010, 2012, 2016, respectively. She accomplished the Honors Master Program in Research within the Master Degree in Telecommunication Engineering in 2012. Since 2014 she is a teaching assistant at the Electronic and Telecommunication Engineering department of the University of Trento, Italy. In 2014 she was a visiting PhD student at the Rochester Institute of Technology (RIT), Rochester, USA, working on the fusion of airborne and terrestrial LiDAR data. She is currently Assistant Professor in the Department of Information Engineering and Computer Science, University of Trento, Italy. Her main research interests include remote sensing, signal and image processing, LiDAR data analysis and their fusion with hyperspectral images. She conducts research on these topics within projects on the estimation of forest dendrometric variables by using LiDAR and Hyperspectral data. She is working on the analysis of multitemporal images acquired by the ESA Sentinel 2 satellite constellation in the context of the Scientific Exploitation of Operational Missions Sentinel-2 for Science ESA program. She is a referee for the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING,

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IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING and IEEE GEOSCIENCE AND REMOTE SENSING LETTERS.

Daniele Marinelli (male)received the "Laurea" (B.Sc.) degree in Electronics and Telecommunications Engineering, the "LaureaMagistrale" (M.Sc.) degree in Telecommunications Engineering (cum laude) and the Ph.D. in Information and Communication Technologies (cum laude) from the University of Trento, Italy, in 2013, 2015, 2019, respectively. He is recipient of the prize for the 2015 Best Italian master Thesis in the area of remote sensing awarded by the the Italy Chapter of the IEEE Geoscience and Remote Sensing Society. He got the Second Place in the Student Paper Competition at the 2018 IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2018) hold in Valencia (Spain). In 2017 he was a visiting Ph.D. student at the Integrated Remote Sensing Studio, University of British Columbia, Vancouver, Canada working on Change Detection in LiDAR data. Since 2017 he is a teaching assistant at the Department of Information Engineering and Computer Science of the University of Trento. Currently he is a postdoctoral researcher at the Remote Sensing Laboratory of the University of Trento. His research interests include the analysis of multitemporal Light Detection And Ranging (LiDAR) data to study the dynamics of forests and multitemporal Hyperspectral data for change detection.

Significant Infrastructure and Equipment:

Many different research premises, including laboratories and office space, are available at DISI and RSLab. RSLab hardware equipment consists of: i) a cluster for remote sensing image parallel data processing (HP Proliant DL385 G7, 8 Blade HP Proliant BL465 G7) with 208 cores @ 2.1 GHz and 783 GB RAM; ii) a storage (HP StorageWorks P2000 G3, Modular Smart Array with 48 SAS 7400rpm Hard Drives) for a total net amount of 70 TB; iii) 15 desktop computers with high processing power and display devices with high quality. UNITN has also a large number of commercial software packages devoted to the analysis of remote sensing images and to a rich library of software developed by the group.

4.2 Third Parties Involved in the Project

No third parties involved

5 Ethics and Security

5.1 Ethics

The TADDIS project recognises that all research that uses human beings as research subjects must take account of established **ethical practices with human participants**. In addition, the very nature of the system being developed relies upon collecting, storing and analysing some anonymised data supplied by members of the public as well assynthethic data. In some cases, there might also be use of personal data from research volunteers, potential users and stakeholders interested in the project – in such cases, the partners involved will act according to the GDPR requirements, as specified bellow.

Ethics Self-assessment	**Applicable Work Packages**	**Measures to address considerations**
TADDIS involves research with human participants, including volunteers for research that are able to provide consent. *TADDIS does not involve research with vulnerable persons and/or children/minors.*	• WP2 • WP8 • WP9	• Information sheet (to be kept on file) • Informed consent (to be kept on file) • Secure data management (to be described in the Data Management Plan) • GDPR compliance when handling personal data (to be managed within T2.3 and described in D2.2 and D2.4) • Approvals from ethics committees, if relevant (to be kept on file)

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The collection and processing of personal data *(not including secondary use)*	• WP2 • WP8 • WP9	• Information sheet (to be kept on file) • Informed consent (to be kept on file) • Secure data management (to be described in the Data Management Plan) • GDPR compliance when handling personal data (to be managed within T2.3 and described in D2.2 and D2.4) • Host organisations to appoint a DPO or, alternatively, provide project-specific data protection policies (to be kept on file) • In case of imports/exports, if relevant, authorisations will be obtained (and kept on file)
Secondary use of personal data *The consortium may use previously collected data for the project developments.*	• WP9	• Prior confirmation that datasets have been lawfully obtained(to be described in the Data Management Plan) • GDPR compliance when handling personal data • Secure data management(to be described in the Data Management Plan) • In case of imports/exports, if relevant, authorisations will be obtained (and kept on file)

Note, any additional requirements stemming from the Ethical Summary Report (provided by the Commission after the proposal evaluation) will be fulfilled in tasks T1.4 and T2.3.

The **data management plan in Task 1.4** will be an integral part of ensuring that the project uses data ethically and provides adequate protection to research participants.

In WP8, the project will include the following pilot use cases to test the TADDIS solution:

- UC1: Extreme-scale analytics on ONDA DIAS platform - SERCO
- UC2: Modelling and monitoring ship traffic atmospheric emissions in the city of Barcelona – UPC, BSC
- UC3: Solar energy monitoring for energy exchange platforms in Greece– NOA, PMODWRC, IPTO

The pilot participants will be adults and will be asked to use and evaluate part of the TADDIS functionalities. Some of these use cases will include the collection of users' personal data (e.g., names, contact details, affiliation) or data that could be used to identify individuals, such as images from crowdsourcing data (UC2). The ethical protocol developed in WP2 (i.e., Task 2.3: Ethical and legal dimensions) will include specific information and guidance about how to contribute data to the TADDIS project and how to treat research volunteers. Specifically, the ethical protocol will ensure the following:

5.1.1 Processing of personal data

The TADDIS consortium is committed to perform the project in compliance with the General Data Protection Regulation 2016/679 ("GDPR") and any implementing local legislation (collectively referred to as the "EU Data Protection Legislation"). To this end, the partners will ensure that no Personal Data (as such term is defined in the GDPR) will be shared between the partners unless (i) it has been properly protected (including anonymization) prior to the data sharing, or (2) the specific partners who have elected to exchange or otherwise process Personal Data, have entered into separate data processing agreement and have determined what operational measures should be taken prior to such Personal Data exchange or processing, all in accordance with the EU Data Protection Legislation.

Accordingly, in order to ensure compliance with the GDPR provisions, the consortium partners have agreed to include the following clause in the Consortium Agreement:

> a) The Parties may share Personal Data of individuals involved in the Project for the purpose of administering the CA or the GA for example, name, business telephone, address, email ("Business Contact Information"). The Parties agree that the Business Contact Information will only be processed to the limited extent required to manage the business relationship between the Parties. Each Party, its Affiliated Entities, and its contractors may, wherever they do business, store and otherwise process such Business Contact Information. Where notice to or

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consent by the individuals is required for such processing, the Party who shares its employees', representatives' or contractors' BCI, as applicable, will notify and/or obtain such consent.

b) Each Party confirms that any Background, Results, Confidential Information and/or any and all data and/or information that is provided, disclosed or otherwise made available between the Parties during the implementation of the Action and/or for any Exploitation activities ("Shared Information"), shall not include Personal Data as defined by the General Data Protection Regulation 2016/679 except Business Contact Information, unless necessary for the project implementation (in this case, personal data will be processed in accordance with the GDPR).

c) Accordingly, each Party who first provides or otherwise makes Shared Information available to any other Party, ("Data Provider ") represents to all the Parties that, as per all data protection laws and regulations applicable in the EEA : (i) it will ensure that, all data and information contained in Shared Information, excluding Business Contact Information, is anonymized such that it is no longer Personal Data, prior to providing the Shared Information to such other Party; (ii) where legally required and relevant, it has a legal ground, and all authorizations, licenses and/or consents, to make the Shared Information available; and (iii) there is no restriction in place that would prevent any such other Party from using the Shared Information for the purpose of this Action and the exploitation thereof. The Parties acknowledge that they have no obligation to review the Shared Information provided by the Data Provider first, and thereafter by any other Party to determine if the Shared Information contains any additional Personal Data beyond the Business Contact Information. However, if either Party becomes aware of any additional Personal Data provided by the other Party, it will delete it or return the Personal Data.

(d) Additionally, each Party shall communicate to the other Parties, without undue delay any anticipated change affecting compliance with sections (b) or (c) above. In addition, if a Data Provider is expected to provide or otherwise make available Shared Information containing Personal Data as a Controller to any other Party (the Processor) in order to comply with the requirements of the Data Protection Legislation, this Data Provider and the applicable other Party (the Processor) shall then agree and enter into a data processing agreement, as is reasonably required (1) to reflect each Parties obligations and risks under the Data Protection Legislation and (2) to enable each Party to comply with their respective obligations under the Data Protection Legislation.

In the cases when personal data will be processed (see conditions above), partners commit to abide to the following principles:

Minimisation of personal data processing and purpose limitation: TADDIS will adopt the principle of data minimisation and purpose limitation, whereby the processing of personal data will be strictly limited in its collection, analysis and retention to the extent that such processing is strictly necessary and proportionated to its use.

5.1.2 Processing of public data (that might reveal individuals' identity)

In the research and development of the TADDIS platform, it is anticipated that data will be gathered through EO sensors, IoT sensors, weather stations/sensors and AIS sensors and through cameras (CCTV) mounted on vessels, while crowdsourcing data (images) from passengers on vessels will also be gathered that can be used to support the monitoring and modeling of air quality estimation. Data gathered from cameras mounted on vessels, used in UC2, aim to detect emissions so as to assist in the monitoring and modeling of air quality. Therefore, video footages depicting environmental conditions will be gathered. In case video footages of interest depict individuals, data anonymisation techniques will be first applied to remove of non-relevant data. Similarly, crowdsourcing data that will be used in UC2 will aim to support the estimation of air quality. (Anonymisation techniques used will be described in the Data Management Plan and/or in the deliverables of the ethics task T2.3).

In the research and development of the TADDIS platform, it is anticipated that several operations (especially in the gathering of data through cameras and social media) could be governed by Directive 95/46/EC and/or regulation 679/2016/EU as they imply processing of data that can relate to identified or identifiable persons. TADDIS partners will have no access to the real identity of users appearing in acquired video footage from CCTV cameras and the probability of identification would be minimal. In particular, video footage only from human individuals (actors) based on their written explicit consent will be employed, while the only data that will be collected and processed will be relevant and limited to the purposes of the research project, i.e., no additional personal data will be collected.

All collected data will be anonymised before being shared with the Consortium to build the platform tools. The Consortium is aware of the fact that anonymization of data is never absolute and that re-identification is a real risk. Therefore, all sharing, also of anonymous data within the Consortium, will be governed by the data management plans developed and supervised by the project management under the legal and technical guidance of WP1. Sharing outside the Consortium will only be allowed in accordance with a data access plan in accordance with legally binding data access agreements that will strictly forbid further sharing and distribution of data to unknown recipients. Data

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anonymisation techniques include (but are not limited to): suppresion (i.e., removal) of non-relevant data, character masking, generalisation (i.e., reduction in the precision of data), data perturbation and swapping, data aggregation, and the blurring of faces.

5.1.3 Involvement of human participants

Data Subjects Rights

Copies of information and consent forms, information notices and any mandatory notifications to public authorities will be kept by the controllers and will be provided to the EC upon request. These will be in language and terms understandable to the participants, prepared and gathered in writing. The participants will be able to ask any questions about the pilots at any time throughout their realisation phase. The corresponding pilot site responsible partner will be available to answer any questions, interests or concerns about the trial executions. During the executions, individuals participating in the pilots will have the right to withdraw at any time, without having to give any explanation and without being affected in any way. Participants will be provided with information, inter alia, of their right:

- To know the purposes and the expected duration of their participation;
- To know who will be responsible for the collection and processing of the personal data and who will have access to these data
- To know that participation is voluntary;
- To ask questions and receive clear and understandable answers before making a decision;
- To know the degree of potential risks and burden involved in participation;
- To know who will benefit from participation;
- To know how their data will be collected, protected during the project and either destroyed or reused at the end of the research; respectively, if minors are involved, they will be re-asked for their consent as soon as they reach legal majority;
- To access, rectify, erase, restrict or delete their personal data;
- To withdraw themselves and to have their data removed from the project at any time;
- To know of any potential commercial exploitation of the research;
- To know to which other countries personal data might be transferred.

Informed consent

All stakeholder engagement activities (pilots, trials, workshops, etc.) will be conducted using fully rational adults, which means that they will be in a position to understand their role in the project. Participants will be given information on who will benefit from their participation in the research and what risk or burden they are undertaking by participating.

The consortium has preliminary assessed that the possibility of privacy or data protection issues being raised during the user requirements and pilot activities (in WP2 and 9) to be performed within the scope of the project is limited but will remain vigilant of any other activities that may raise any concerns from a **research** ethics perspective. Activities involving research with voluntary human participants will be conducted in a manner that is compliant with European and national legislations and directives, including:

- The Universal Declaration of Human Rights and the Convention 108 for the Protection of Individuals with regard to Automatic Processing of Personal Data.
- General Data Protection Regulation (Regulation 2016/679) on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).
- Directive 2009/136/EC amending Directive 2002/22/EC (E-Privacy Directive) on universal service and users' rights relating to electronic communications networks and services.
- Compliance with the above will be reviewed by those involved in Quality Assurance, Risk Management and Research Ethics (WP1), with the adequate help of the Project Board (PB) and of the legal departments of the project partners.

5.1.4 Relevant Documentation

In the event of the TADDIS project being funded, the consortium will take measures to begin the process of complying with the ethical considerations outlined above, including the development of information sheets, informed consent sheets and data management practices that are in full compliance with The Charter of Human Rights, the

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European Convention for the Protection of Human Rights and Fundamental Freedoms, the General Data Protection Regulation (Regulation 2016/67 EC) and any other relevant legislation. Where required, they will also begin the process of gaining approvals from ethics committees or Data Protection Officers. Task 1.4 in WP1 (project management) has been incorporated into the planning of the project for the ongoing management of ethical and legal matters relating to the conduct of the project.

All partners agree to comply with all obligations and requirements of its corresponding national data protection legislation and to obtain all legal documents and certifications required for compliance with such legislation. The Parties agree that any Background, Results, Confidential Information and/or any and all data and/or information that is provided, disclosed or otherwise made available between the Parties during the implementation of the Action and/or for any Exploitation activities ("Shared Information"), may include personal data as defined by the GDPR, and applicable local implementing legislation (hereinafter referred to as "Personal Data"). Each Party who provides or otherwise make available to any other Party Shared Information containing Personal Data ("Contributor") represents that: (i) it has the authority and/or the authorisation to disclose the Shared Information, if any, which it provides to the Parties under this CA; (ii) where legally required and relevant, it has obtained appropriate informed consents from all the data subjects involved, or from any applicable institution, all in compliance with applicable regulations; and (iii) there is no restriction in place that would prevent any such other Party from using the Shared Information in accordance with and for the purpose of the Agreement.

In addition to ensuring that attention is paid to research ethics and the protection of personal data, the TADDIS consortium has also taken note of the importance of ensuring that the technical solutions developed across the project are respectful of legal and ethical regulations. As such, WP3 dedicated to ethical, legal and security consists of a range of activities designed to ensure Responsible Research and Innovation is at the centre of the project including the ethical and secure management of data across the project that is managed in accordance with the GDPR.

5.1.5 Internal Oversight Bodies

During the project, legal and ethics requirements in TADDIS will be the subject of the dedicated Task, which will be led by Jolanda Modic (XLAB), who has been appointed as the project Ethics Officer. This section contains the basic guidelines for ethics, particularly with regards to human participation and protection of personal data, whereas the detailed relevant processes and information will be clearly documented and made available in the planned deliverables.

Data security

Data storage will be secured so as for the data not to become accessible to unwanted third parties and protected against disaster and risk. In fact, Everis' data storage system provides a data-protected/secure legal and technical environment in compliance with the ISO/IEC 27001:2005 standards

5.2 Security

Activities or results raising security issues: **NO**

'EU-classified information' as background or results: **NO**

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Annex A: Letters of Support from the Advisory Board

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Ports IB

Anna Mujal i Colilles
Serra Húnter Lecturer
Barcelona School of Nautical Studies
Department of Nautical Sciences and Engineering
UPC-Barcelona Tech
Pla de Palau, 18
08003, Barcelona, Spain

Expression of interest

Dear Ms. Mujal,

I am writing on behalf of PORTS DE LES ILLES BALEARS in support to the TADDIS (AI technologies and semantic data fusion for enhanced analytics and decision-making on Tremendous Amounts of Diverse Data streams in Industry and Society) project presented in the framework of the H202 call (ICT-51-2020), and submitted by a consortium that includes the Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) and the Polytechnic University of Catalonia (UPC-Barcelona Tech).

Through this letter, we strongly support this grant application and the use case included that focus on combining data derived from sensors with machine learning techniques for modeling and monitoring atmospheric emissions from maritime traffic in the city of Barcelona through AIS data. If TADDIS is awarded, we will be very interested in following the results obtained.

Yours sincerely,
Palma, 10th January 2020

Managing Director

Pedro Puigdengoles Briones

Ports IB

C/ Vicente Tofiño, 36
07007 Palma
Tel. 971 628 089
info@portsib.es
www.portsib.es

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Barcelona Clúster Nàutic

Anna Mujal i Colilles
Serra Húnter Lecturer
Barcelona School of Nautical Studies
Department of Nautical Sciences and Engineering
UPC-Barcelona Tech
Pla de Palau, 18
08003, Barcelona, Spain

10th January 2020

Expression of interest

Dear Ms. Mujal,

I write on behalf of Associació Barcelona Clúster Nàutic in support to the TADDIS (AI technologies and semantic data fusion for enhanced analytics and decision-making on Tremendous Amounts of Diverse Data streams in Industry and Society) project presented in the framework of the H202 call (ICT-51-2020), and submitted by a consortium that includes the Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) and the Polytechnic University of Catalonia (UPC-Barcelona Tech).

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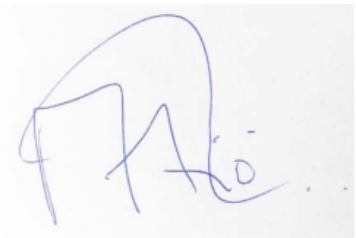
Yours sincerely,



Antoni Tió Sauleda
Executive President
Associació Barcelona Clúster Nàutic

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Camins.cat
Col·legi d'Enginyers de Camins, Canals i Ports de Catalunya

Anna Mujal i Colilles
Serra Húnter Lecturer
Barcelona School of Nautical Studies
Department of Nautical Sciences and Engineering
UPC-Barcelona Tech
Pla de Palau, 18
08003, Barcelona, Spain

10th January 2020

Expression of interest

Dear Ms. Mujal,

I write on behalf of Col·legi d'Enginyers de Camins Canals i Ports de Catalunya in support to the TADDIS (AI technologies and semantic data fusion for enhanced analytics and decision-making on Tremendous Amounts of Diverse Data streams in Industry and Society) project presented in the framework of the H202 call (ICT-51-2020), and submitted by a consortium that includes the Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) and the Polytechnic University of Catalonia (UPC- Barcelona Tech).

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Yours sincerely,

COL·LEGI D'ENGINYERS DE CAMINS, CANALS I PORTS CATALUNYA

Oriol Altisench i Barbeito
Dean of Col·legi de Camins Canals i Ports de Catalunya

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TO:
Ana González Segura
Support Smart Innovation (SuSI)
Avda. Cortes Valencianas 39, 9C
46015 Valencia
Tel.: + 34 96 347 73 73
Ext.: 114245
everis.com

Letter of Support

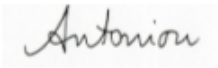
As the Director of the Planning, Autonomy and Representation of Knowledge Research Centre of the University of Huddersfield, I would like to confirm our willingness to support and join the Advisory Board (AB) of the **TADDIS project** led by EVERIS, which has been submitted under the Horizon 2020 framework, Big Data technologies and extreme-scale analytics (ICT-51), Sub-topic a): Research and Innovation Actions (RIA). The main objective of TADDIS is to exploit existing **cloud** and **HPC infrastructures** and **distributed processing** capacity to **collect** and **manage large streams** of **highly heterogeneous raw data**, **process** them to **extract knowledge** at the edge and on the cloud, and finally **deliver value-added data** through **novel** predictions, estimations, visualisations, semantic reasoning and extreme scale analytics for the **maritime**, **space** and **energy** sector.

Should the proposal be successful I will

- Participate and contribute, if requested, to meetings with the TADDIS consortium;
- Provide feedback (assess, comment, prioritise and supplement) on interim findings and final results of the project;
- Participate in the Advisory Board and to related workshops with all expenses covered by the TADDIS consortium budget, supporting the validation and exploitation of the project's outcomes;
- Provide expertise on specific questions relevant to the project;
- Help raising awareness and disseminating the project outcomes through our organisation's network.

We are interested in the project outcomes and we will support the TADDIS project.

Huddersfield, 14/01/2020



Grigoris Antoniou
Professor of Semantic and Knowledge Technologies
University of Huddersfield, UK

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Ana González Segura
Support Smart Innovation (SuSI)
Avda. Cortes Valencianas 39, 9C
46015 Valencia
Tel.: + 34 96 347 73 73
Ext.: 114245
everis.com

Letter of Support

As the Honorary Research Fellow at the University of Glasgow, I would like to confirm my willingness to support and join the Advisory Board (AB) of the **TADDIS project** led by EVERIS, which has been submitted under the Horizon 2020 framework, Big Data technologies and extreme-scale analytics (ICT-51), Sub-topic a): Research and Innovation Actions (RIA). The main objective of TADDIS is to exploit existing **cloud** and **HPC infrastructures** and **distributed processing** capacity to **collect** and **manage large streams** of **highly heterogeneous raw data**, **process** them to **extract knowledge** at the edge and on the cloud, and finally **deliver value-added data** through **novel** predictions, estimations, visualisations, semantic reasoning and extreme scale analytics for the **maritime**, **space** and **energy** sector.

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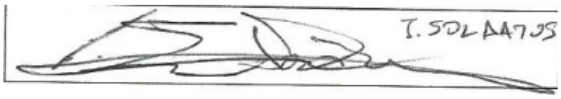
I am interested in the project outcomes and will support the TADDIS project.

January 14th, 2020

Prof. John Soldatos

Signature



Honorary Research Fellow

University of Glasgow

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CCS BARCELONA / MRCC BARCELONA

Anna Mujal i Colilles
Serra Húnter Lecturer
Barcelona School of Nautical Studies
Department of Nautical Sciences and Engineering
UPC-Barcelona Tech
Pla de Palau, 18
08003, Barcelona, Spain

10th January 2020

Expression of interest

Dear Ms. Mujal,

I write on behalf of CCS BARCELONA / MRCC BARCELONA in support to the TADDIS (AI technologies and semantic data fusion for enhanced analytics and decision-making on Tremendous Amounts of Diverse Data streams in Industry and Society) project presented in the framework of the H202 call (ICT-51-2020), and submitted by a consortium that includes the Barcelona Supercomputing Center – Centro Nacional de Supercomputación (BSC-CNS) and the Polytechnic University of Catalonia (UPC- Barcelona Tech).

Through this letter, we strongly support this grant application and the use case included that focus on combining data derived from sensors with machine learning techniques for modeling and monitoring atmospheric emissions from maritime traffic in the city of Barcelona through AIS data. If TADDIS is awarded, we will be very interested in following the results obtained.

Yours sincerely,

Gerardo Gantes Rodríguez
Head of MRCC Barcelona

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Ana González Segura
Support Smart Innovation (SuSI)
Avda. Cortes Valencianas 39, 9C
46015 Valencia
Tel.: + 34 96 347 73 73
Ext.: 114245
everis.com

Letter of Support

As the CEO of Sundosoft Ltd., I would like to confirm our willingness to support and join the Advisory Board (AB) of the **TADDIS project** led by EVERIS, which has been submitted under the Horizon 2020 framework, Big Data technologies and extreme-scale analytics (ICT-51), Sub-topic a): Research and Innovation Actions (RIA). The main objective of TADDIS is to exploit existing **cloud** and **HPC infrastructures** and **distributed processing** capacity to **collect** and **manage large streams** of **highly heterogeneous raw data**, **process** them to **extract knowledge** at the edge and on the cloud, and finally **deliver value-added data** through **novel** predictions, estimations, visualisations, semantic reasoning and extreme scale analytics for the **maritime**, **space** and **energy** sector.

Should the proposal be successful I will

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- Provide expertise on specific questions relevant to the project;
- Help raising awareness and disseminating the project outcomes through our organisation's network.

We are interested in the project outcomes and we will support the TADDIS project.

City, Date

Seoul, 16-Jan-2020

Signature

Hoon Joo Yoon

CEO

Sundosoft Ltd.

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Ana González Segura
Support Smart Innovation (SuSI)
Avda. Cortes Valencianas 39, 9C
46015 Valencia
Tel.: + 34 96 347 73 73
Ext.: 114245
everis.com

Letter of Support

As the Professor of University of Piraeus, Department of Digital Systems, I would like to confirm our willingness to support and join the Advisory Board (AB) of the **TADDIS project** led by EVERIS, which has been submitted under the Horizon 2020 framework, Big Data technologies and extreme-scale analytics (ICT-51), Sub-topic a): Research and Innovation Actions (RIA). The main objective of TADDIS is to exploit existing **cloud** and **HPC infrastructures** and **distributed processing** capacity to **collect** and **manage large streams** of **highly heterogeneous raw data**, **process** them to **extract knowledge** at the edge and on the cloud, and finally **deliver value-added data** through **novel** predictions, estimations, visualisations, semantic reasoning and extreme scale analytics for the **maritime**, **space** and **energy** sector.

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- Provide expertise on specific questions relevant to the project;
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We are interested in the project outcomes and we will support the TADDIS project.

Piraeus, 16.01.2020

Signature

George Vouros
Professor
Department of Digital Systems,
University of Piraeus

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Ana González Segura
Support Smart Innovation (SuSI)
Avda. Cortes Valencianas 39, 9C
46015 Valencia
Tel.: + 34 96 347 73 73
Ext.: 114245
everis.com

Letter of Support

As Key Account Manager France of Airbus Defence and Space FR, I would like to confirm our willingness to support and join the Advisory Board (AB) of the **TADDIS project** led by EVERIS, which has been submitted under the Horizon 2020 framework, Big Data technologies and extreme-scale analytics (ICT-51), Sub-topic a): Research and Innovation Actions (RIA). The main objective of TADDIS is to exploit existing **cloud** and **HPC infrastructures** and **distributed processing** capacity to **collect** and **manage large streams** of **highly heterogeneous raw data**, **process** them to **extract knowledge** at the edge and on the cloud, and finally **deliver value-added data** through **novel** predictions, estimations, visualisations, semantic reasoning and extreme scale analytics for the **maritime**, **space** and **energy** sector.

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- Help raising awareness and disseminating the project outcomes through our organisation's network.

We are interested in the project outcomes and we will support the TADDIS project.

Elancourt,16/01/2020

Philippe Chrobocinski
KAM R&T France
TERR-TL3
Airbus Defence and Space FR

Hervé Mokrani
Team leader TERR-TL3
TERR-TL3
Airbus Defence and Space FR

AIRBUS
Airbus Defence and Space SAS
1 boulevard Jean Moulin - ZAC de la Clef Saint Pierre
78990 Elancourt - France
Société par actions simplifiée (393 341 516 00119 RCS Versailles)
au capital de 29 821 072 €
TVA FR 69 393 341 516 - APE/NAF 3030Z

Hervé MOKRANI
Head of R&T Public Funding & Associations

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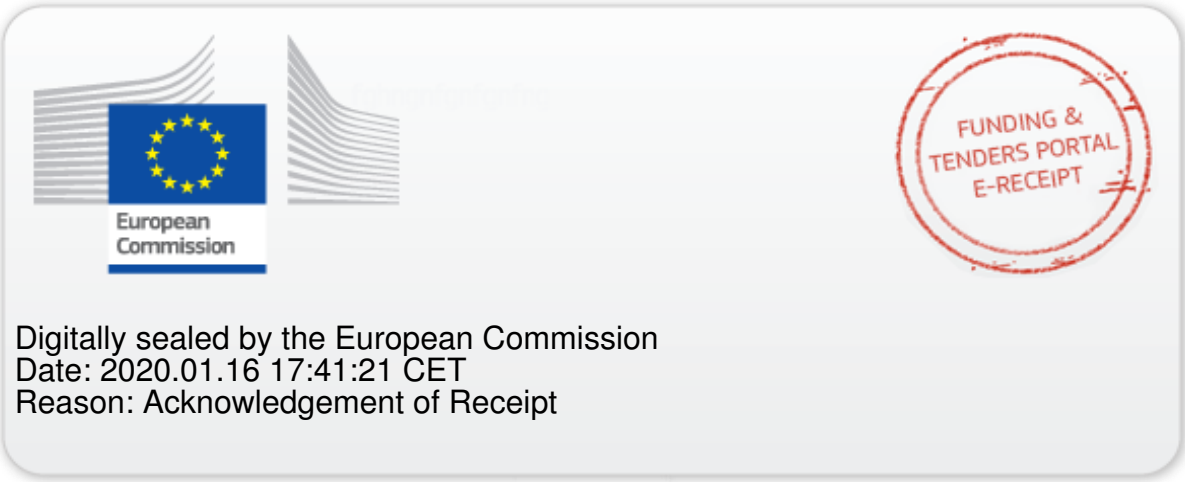

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