



## **COST Action TU1208**

**“Civil Engineering Applications of Ground Penetrating Radar”**

**Lara Pajewski**

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COST is supported by the  
EU Framework Programme Horizon2020



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**Chair: Dr Lara Pajewski**

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- Introduction to the COST Programme
- COST Action TU1208  
“Civil Engineering Applications of  
Ground Penetrating Radar”



# What is COST?

*European **CO**operation  
in **Science** and **Technology***



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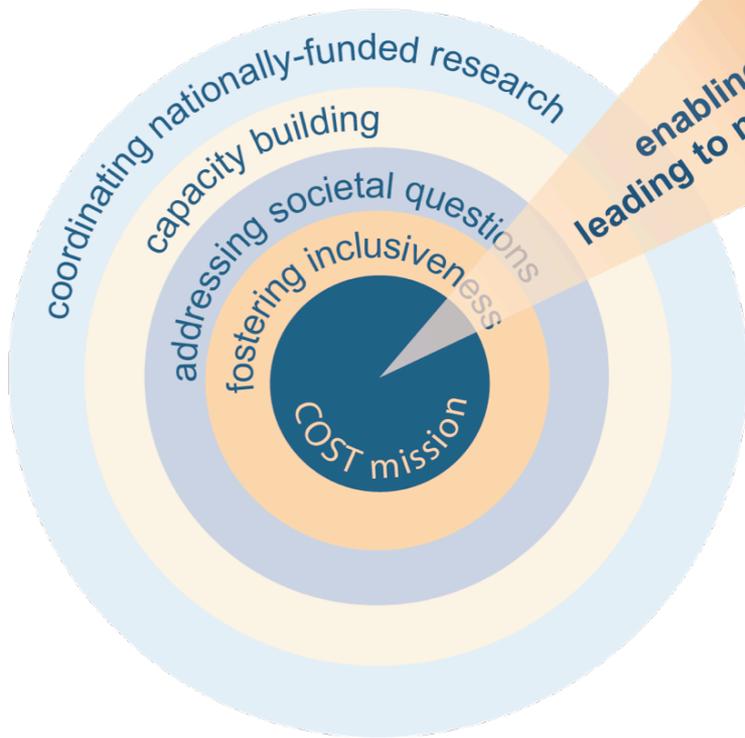
# What is COST?

COST is the oldest and widest European intergovernmental framework for translational Cooperation in Science and Technology.

COST has been supporting the networking of research activities across all 36 Member Countries and beyond for over 40 years (19 Countries in 1971).

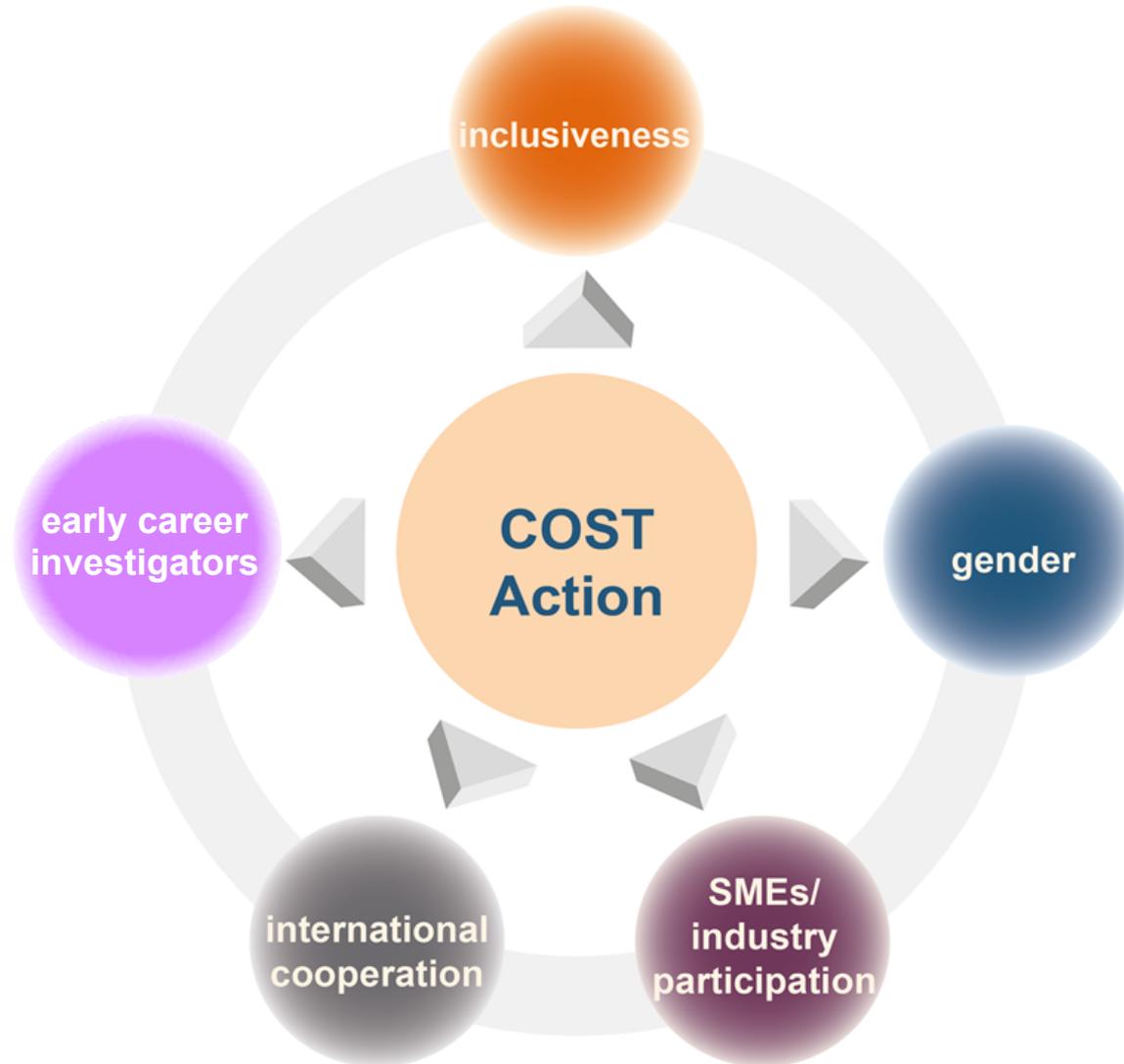
COST is open to all disciplines, all novel and groundbreaking science and technology ideas, and all categories of partners where mutual benefit is real.

# COST main objectives under H2020



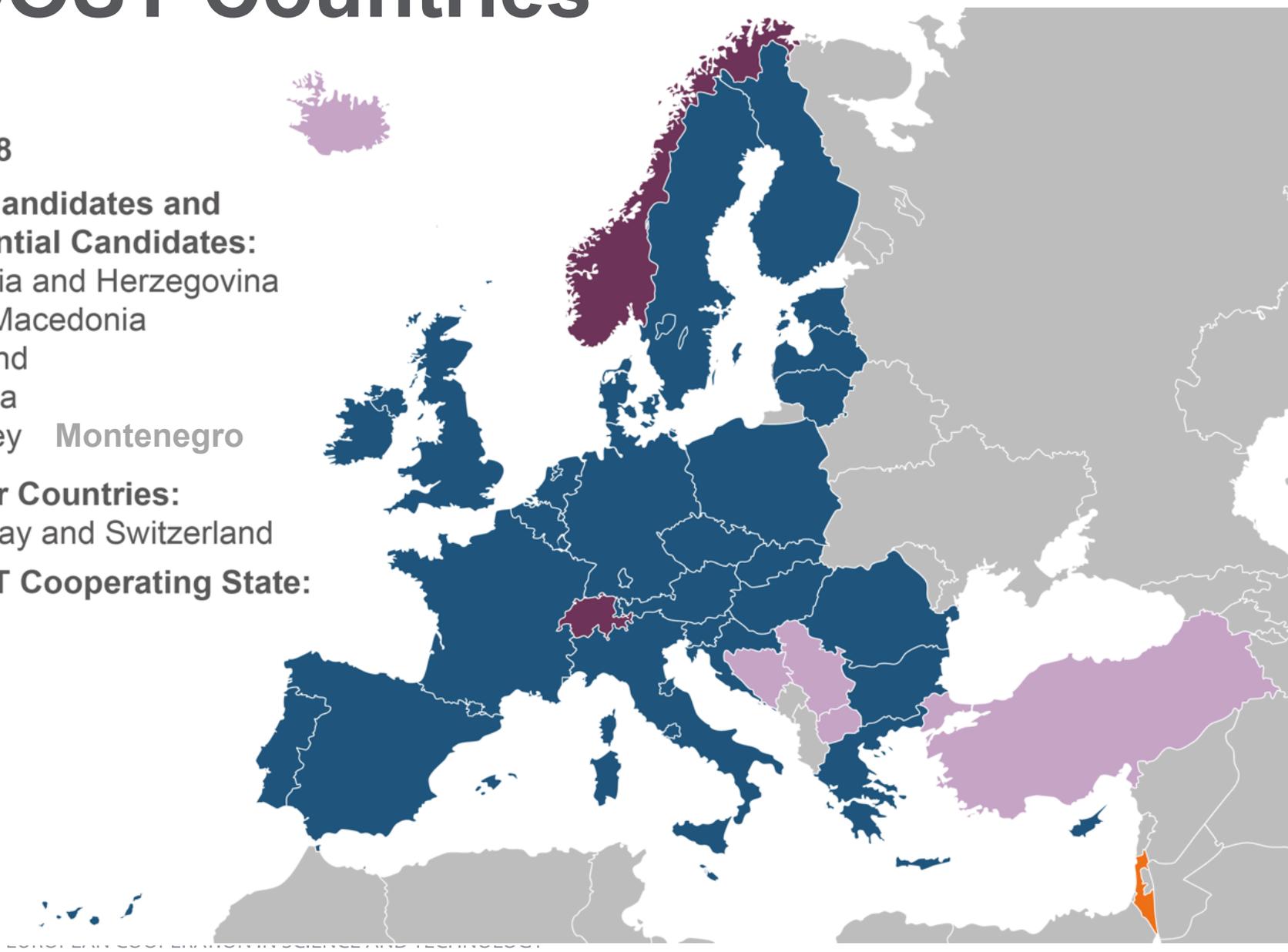
- Enabling breakthrough S&T developments leading to new concepts and products
- Strengthening Europe's research and innovation capacities, building a ERA

# COST Key Principles in H2020



# COST Countries

- EU 28
- EU Candidates and Potential Candidates:  
Bosnia and Herzegovina  
fYR Macedonia  
Iceland  
Serbia  
Turkey Montenegro
- Other Countries:  
Norway and Switzerland
- COST Cooperating State:  
Israel



# COST Near Neighbour Countries

206 participations in running COST Actions across 16 countries

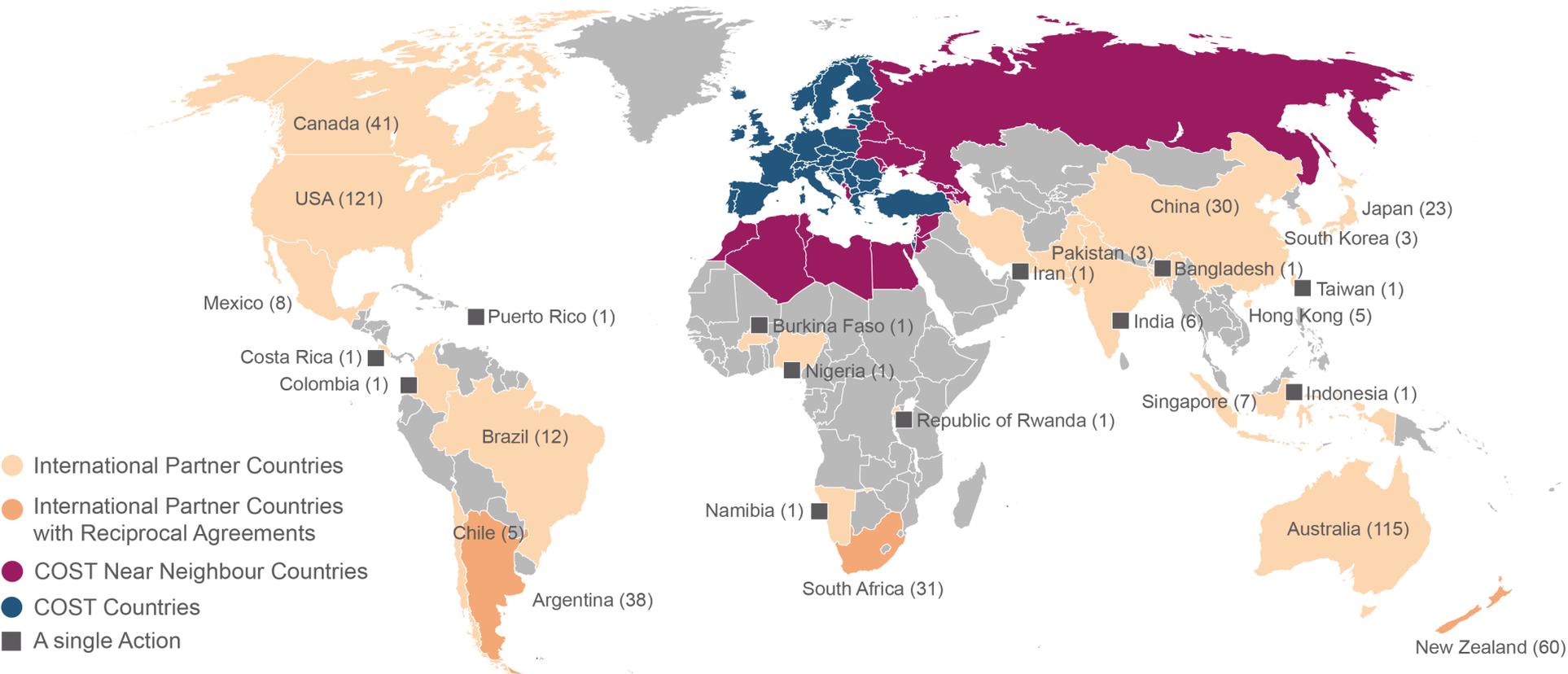
- Albania (15)
- Algeria (7)
- Armenia (8)
- Azerbaijan (5)
- Belarus (6)
- Egypt (7)
- Georgia (5)
- Jordan (2)
- Lebanon (5)
- Moldova (5)
- Morocco (13)
- Palestinian Authority (3)
- Syrian Arab Republic (2)
- Russia (51)
- Tunisia (14)
- Ukraine (46)

● COST Countries  
● Near Neighbour Countries

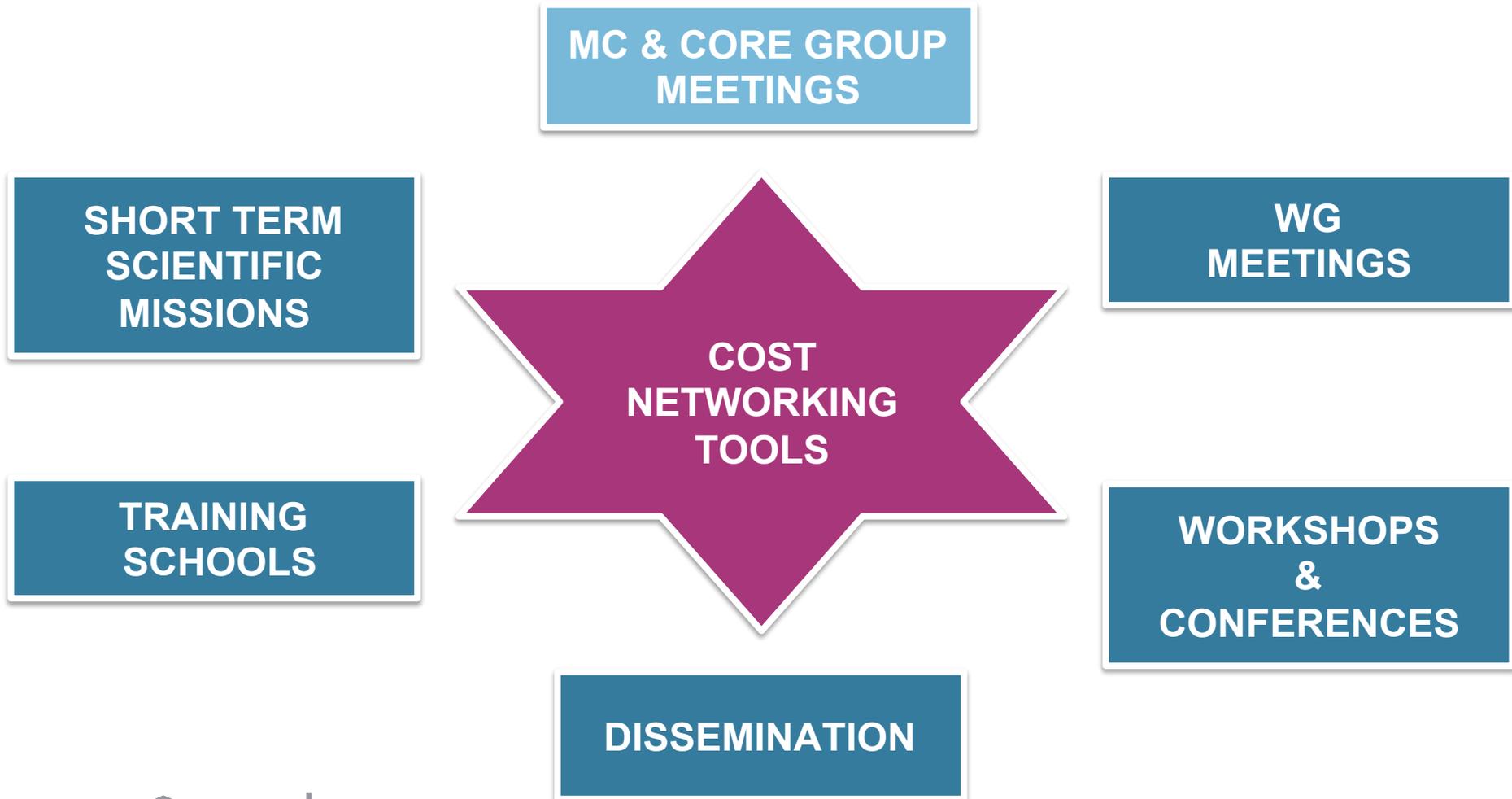


# International Partner Countries

519 participations in running Actions across 27 countries



# What can Actions do with COST budget?



# How can you participate?



- **Submit your COST Action proposal at any time throughout the year.**

**2016 Winter Collection Date:  
December 2016**



- **Become a COST Expert.**  
COST invites independent experts from all scientific areas to participate in the evaluation of proposals for COST Actions.



- **Join an existing COST Action.**  
The steps to follow mainly depend on the location of your institution.



# **COST Action TU1208**

## ***Civil Engineering Applications of Ground Penetrating Radar***



COST is supported by the  
EU Framework Programme Horizon2020

## “Civil Engineering Applications of Ground Penetrating Radar”

- **Chair of the Action & GH**

Dr Lara Pajewski

“Roma Tre” University (IT)

lara.pajewski@uniroma3.it

- **Vice-Chair of the Action**

Prof Andreas Loizos

National Technical University of Athens (EL)

- **Science & Administrative Officers**

Dr Mickael Pero & Ms Carmencita Malimban

COST Association (BE)

- **Start date – End date**

4<sup>th</sup> April 2013 – 3<sup>rd</sup> April 2017

- ***[www.GPRadar.eu](http://www.GPRadar.eu)***



# TU1208 Main Objective

- Exchange and increase scientific-technical knowledge and experience of GPR techniques in Civil Engineering, simultaneously promoting throughout Europe the effective use of this safe and non-destructive technique.

*The COST Action TU1208 has established and strengthened active links between universities, research institutes, companies and end users working in this field, fostering and accelerating its long-term development in Europe.*

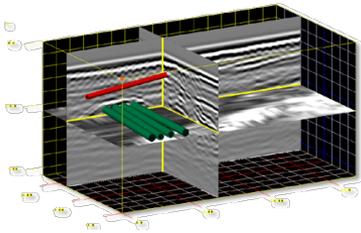


# TU1208 Background

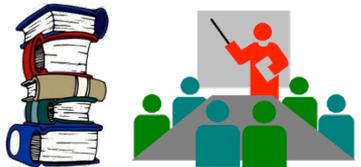
It is possible to identify three areas, in the GPR field, that have to be addressed in order to promote the use of this technology in the CE:



- Advancement of GPR system, increase of sensitivity to enable usability in a wider range of conditions (e.g. high-attenuation soils/materials);



- Improvement of data processing algorithms/EM analysis tools to ease the interpretation of the results by un-experienced operators as well (that is the ‘holy grail’ of GPR), thus enhancing the efficiency of the radar survey



- Contribute to the development of new standards/guidelines and to training of end users, that will also help to increase the awareness of operators.

# TU1208 Structure

**GRANT HOLDER**  
Roma Tre University\*

**MANAGEMENT  
COMMITTEE (MC):**  
76 MC M & Subs + 22 MC Obs

**MC CHAIR:**  
Dr Lara Pajewski

**COST ASSOCIATION**

**SCIENCE OFFICER:**  
Dr Mickael Pero

**ADMINISTRATIVE OFFICER:**  
Ms Carmencita Malimban

**256 WG Members**

**WG 1**

**Novel GPR  
Instrumentation**

**WG 2**

**GPR surveying of  
transport  
infrastructure,  
utilities and voids**

**WG 3**

**EM modelling,  
inversion, imaging,  
data processing  
techniques**

**WG 4**

**GPR applications  
outside from CE &  
GPR integration  
with other NDT**

**\*Scientific Representative & Grant Manager: Dr Lara Pajewski**  
**Legal and Financial Representative: Prof Paolo Atzeni**

# TU1208 Key Objectives

- I. Highlight problems, merits and limits of current GPR systems in CE applications.
  - II. Design and realise **innovative GPR systems**.
  - III. Develop innovative **protocols and guidelines** for an effective GPR use in CE tasks → published in a handbook and constitute a **basis for EU Standards**.
  - IV. Improve EM modelling/inversion/data-processing methods → **freeware tools**
  - V. **Comparison** with GPR technology and methodology used in different applications, and **integration** with other NDT techniques for CE applications.
  - VI. **Promotion** of a more widespread, advanced and effective use of GPR in CE.
  - VII. Organization of a high-level modular **training program**.
- Interaction with other COST Actions; establishment of cooperation with



**IEEE**

**EAGE**



EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

# TU1208 Participants

**77 MC Members & Substitute Members from 29 COST Countries & CS**

AT, BE, CH, CZ, DE, DK, EE, EL, ES, FI, FR, HR, IE, IL, IT, LV, M, MK, NL, NO, PL, PT, RO, RS, SE, SI, SK, TR, UK

**13 MC Observers from 6 Near Neighbour Countries**

AL, ARM, ET, RUS, UKR, JOR

**11 MC Observers from 6 International Partner Countries**

AUS, CO, HK, PI, RWA, USA

- Researchers from different scientific disciplines (civil and electronic engineers, architects, geophysics experts, archaeologists, ...)
- NDT equipment designers and producers
- End users from private companies
- Some public agencies

**>300 Working Group Members**

**>150 Institutions**

**Economic Dimension:**

**60 millions of EUR**

# TU1208 Working Group 1

**WG1**

Novel GPR  
Instrumentation

- Chair: **Guido Manacorda (IT)**  
IDS Ingegneria dei Sistemi

**Project 1.1** Design, realization and optimization of innovative GPR equipment for the monitoring of transport infrastructures *Leader: Raffaele Persico (IT)*

**Project 1.2** Design, modelling and optimisation of GPR antennas  
*Leader: Craig Warren (UK)*

**Main activities:** (i) State of the art and open issues; (ii) New pulsed GPR capable of estimating mechanical properties of roads from em data; (iii) Detailed instructions to build a cheap FMCW GPR prototype for training purposes; (iv) New stepped-frequency air-coupled GPR for road & bridge inspection; (v) recommendations for the safety of people and equipment during GPR prospecting; (vi) Education Pack

# TU1208 Working Group 2

- Chair: **Christina Plati (EL)**  
National Technical University Athens
- Vice-Chair: **Xavier Derobert (FR)**, IFSTTAR

**WG2** GPR Surveying of Pavements, Bridges, Tunnels, Buildings – Utility and Void Sensing

Guidelines for effective GPR surveying of ...

**Project 2.1** ...critical transport infrastructures (pavements, bridges and tunnels)

*Leader: Josef Stryk (CZ)*

**Project 2.2** ...buildings *Leader: Gracia Vega-Perez (ES)*

**Project 2.3** ...underground utilities and voids, with a focus to urban areas

*Leader: X. Derobert (FR)*

**Project 2.4** ...construction materials *Leader: L. Kryszynski (PL)*

**Project 2.5** Determination, by using GPR, of the volumetric water content in structures, sub-structures, foundations and soil

*Leader: Fabio Tosti (UK)*

**Main activities:** (i) State of the art and open issues; (ii) Guidelines; (iii) Database of radargrams; (iv) Wide series of case studies; (v) Education Pack

# TU1208 Working Group 3

## WG3

EM Methods for Near  
Field Scattering Problems  
– Data Processing

- Chair: **Antonis Giannopoulos (UK)**  
University of Edinburgh
- Vice-Chairs: **Matteo Pastorino (IT)**,  
University of Genoa, **Jan Van der Kruk (DE)**,  
Forschungszentrum Jülich

- Project 3.1** Electromagnetic modelling for GPR *Leader: Silvestar Sesnic (HR)*
- Project 3.2** Imaging and inversion techniques for GPR *Leader: Andrea Randazzo (IT)*
- Project 3.3** Development of intrinsic models for describing near-field antenna effects, including antenna-medium coupling, for improved radar data processing using full-wave inversion *Leader: S. Lambot (BE)*
- Project 3.4** Development of advanced data processing techniques for GPR  
*Leaders: Francesco Benedetto (IT) & Nikos Economou (EL)*

**Main activities:** (i) State of the art and open issues; (ii) Database of radargrams; (iii) Freeware tools: gprMax & E<sup>2</sup>GPR; (iv) Education Pack

# TU1208 Working Group 4

- Chair: Immo Trinks (AT),  
Ludwig Boltzmann Institute for Archaeological  
Prospection and Virtual Archaeology
- Vice-Chair: Mercedes Solla (ES),  
University of Vigo

## WG4

Different applications of GPR  
and other NDT technologies  
in Civil Engineering

**Project 4.1** Advanced use of GPR for archaeological prospecting and  
cultural heritage diagnostics *Leader: W. Neubauer (AT)*

**Project 4.2** Advanced use of GPR for the localisation and vital signs  
detection of buried and trapped people *Leader: V. Ferrara (IT)*

**Project 4.3** Advanced use of GPR for the management and protection of  
water resources *Leader: A. De Coster (BE)*

**Project 4.4** Advanced use of GPR in association with other NDT methods  
*Leaders: S. Fontul (PT), K. Dimitriadis (EL)*

**Main activities:** (i) State of the art and open issues; (ii) Case studies; (iii) Education Pack

# TU1208 Training Schools

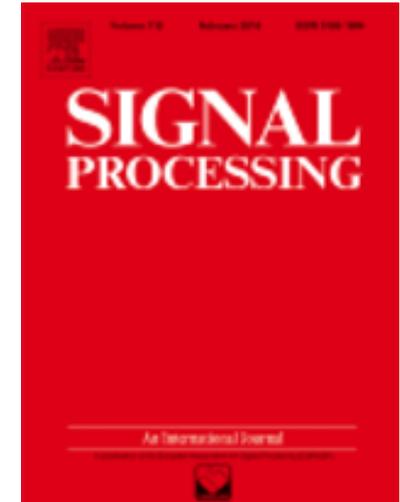
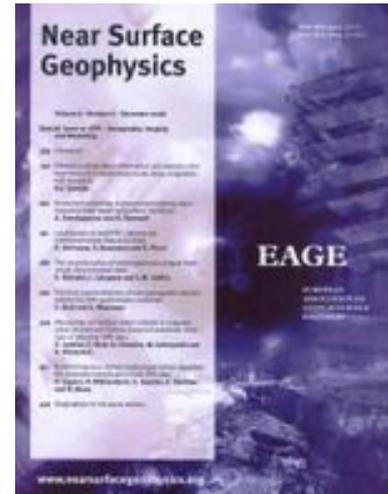
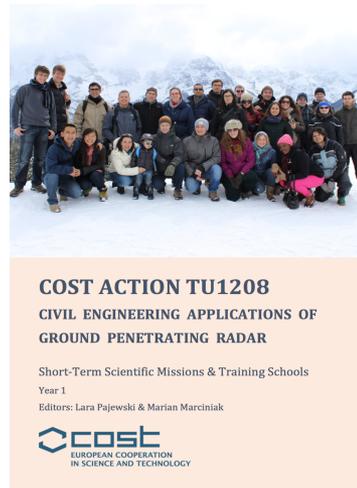
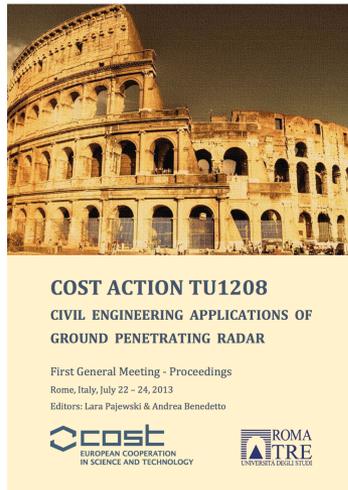
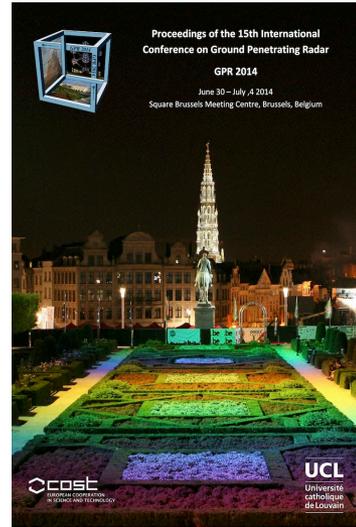
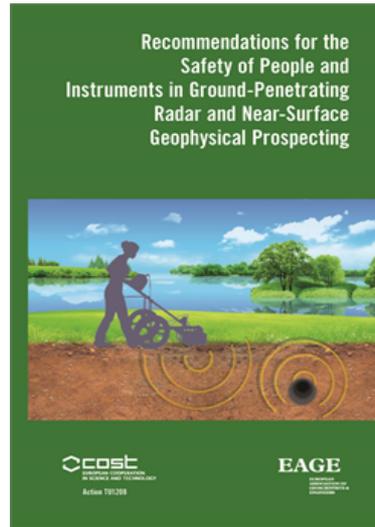
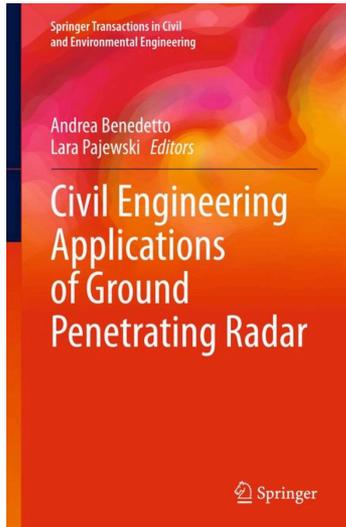
- 1) COST-ESoA TS on Microwave Imaging and Diagnostics  
Madonna di Campiglio, Italy, March 24-28, 2014 (39 Trainees)
- 2) COST-ESoA TS on Future Radar Systems: Radar2020  
Karlsruhe, Germany, May 5-9, 2014 (16 Trainees)
- 3) COST - Université catholique de Louvain Tutorials on GPR  
Brussels, Belgium, July 5, 2014 (34 Trainees)
- 4) COST TS on Civil Engineering Applications of GPR  
Pisa, Italy, September 22-25, 2014 (33 Trainees)
- 5) COST Half-Day Training on GPR  
London, United Kingdom, March 4, 2015 (46 Trainees)
- 6) COST-ESoA TS on Ultra Wide-Band Antennas, Technologies and Applications, Karlsruhe,  
Germany, April 20-24, 2015 (18 Trainees)



# TU1208 Training Schools

- 7) COST TS on Applications of GPR in Urban Areas: the Sensitive Case of Historical Cities, Cracow, Poland, May 5-7, 2015 (25 Trainees)
- 8) COST TS on GPR for road pavement assessment and detection of buried utilities, London, United Kingdom, October 12-14 2015 (33 Trainees)
- 9) COST - Aristotle University of Thessaloniki TS on Numerical modelling of GPR using gprMax, Thessaloniki, Greece, November 9-11, 2015 (40 Trainees)
- 10) COST Training School on Applications of GPR to civil engineering and archaeology Msida, Malta, January 25-29, 2015 (28 Trainees)
- 11) COST Training School on NDT techniques for civil engineering Barcelona, Spain, March 14-18, 2016 (30 Trainees)
- 12) COST-ESoA-EuMA Training School on Future Radar Systems: Radar2020 - II edition Karlsruhe, Germany, May 2-6, 2016 (14 Trainees)

# TU1208 Editorial Activities





# “The Cities of Tomorrow: the Challenges of Horizon 2020”

*Torino, Italy, 17-19 September 2014*

## **TU1208 praised among running Actions as COST Success Story**

*TU1208 "Civil engineering applications of Ground Penetrating Radar" (Chair: Lara Pajewski, Roma Tre University) is an interdisciplinary Action and represents a milestone in GPR research, being the first European network ever existed in this field, in line with the spirit and goals of the ERA. In June 2014, it co-organised the 15th International Conference on Ground Penetrating Radar, the premier forum on GPR.*

# TU1208 Next Events

- 2-6 May 2016: ESoA-COST **Training School** on Future Radar Systems: Radar2020 (Karlsruhe, Germany)
- Summer 2016: A series of **Technical Workshops** on GPR for Stakeholders and end-users, to be held in Poland (Warsaw, Cracow, Torun, Kielce), Greece (Athens) and Romania (Bucharest)
- 10-14 October 2016: ESoA-COST **Training School** on microwave imaging and diagnostics (Taormina, IT) (**GRANTS**)
- 7-9 November 2016: **General Meeting** (Split, HR)
- 10-12 November 2016: **Training School** on electromagnetic modelling for GPR (Split, HR) (**GRANTS**)
- 25-27 January 2017: **Training School** on GPR surveying of transport infrastructure (Lisbon, PT) (**GRANTS**)
- 29-31 March 2017: **Final Conference** (Warsaw, Poland)



**Thank you!**  
**Join COST Action TU1208!**

[www.GPRadar.eu](http://www.GPRadar.eu)

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