

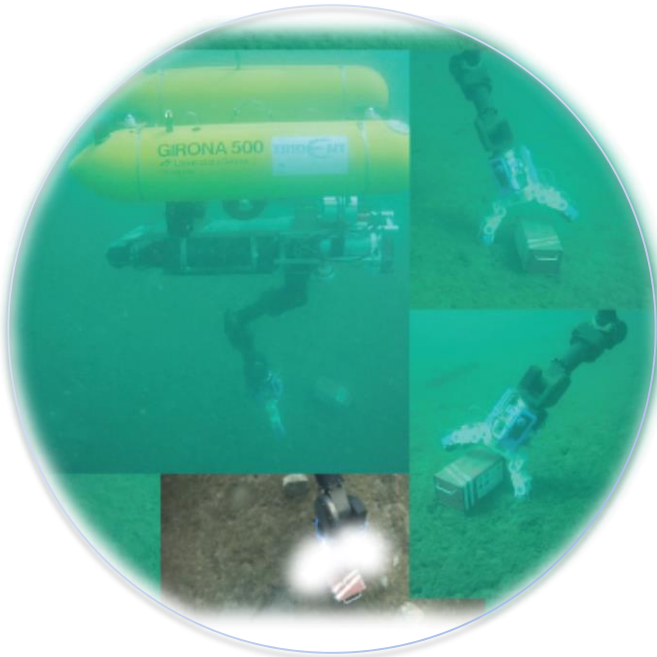


“Marine Robots and Dexterous Manipulation for Enabling Autonomous Underwater Multipurpose Intervention Missions”



By Pedro J Sanz

TRIDENT Coordinator



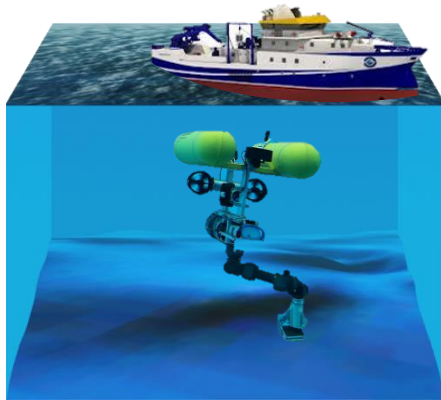
What is the unique contribution of TRIDENT?



Marine Robot and
Dexterous Manipulator for
Enabling Multipurpose
Intervention Missions

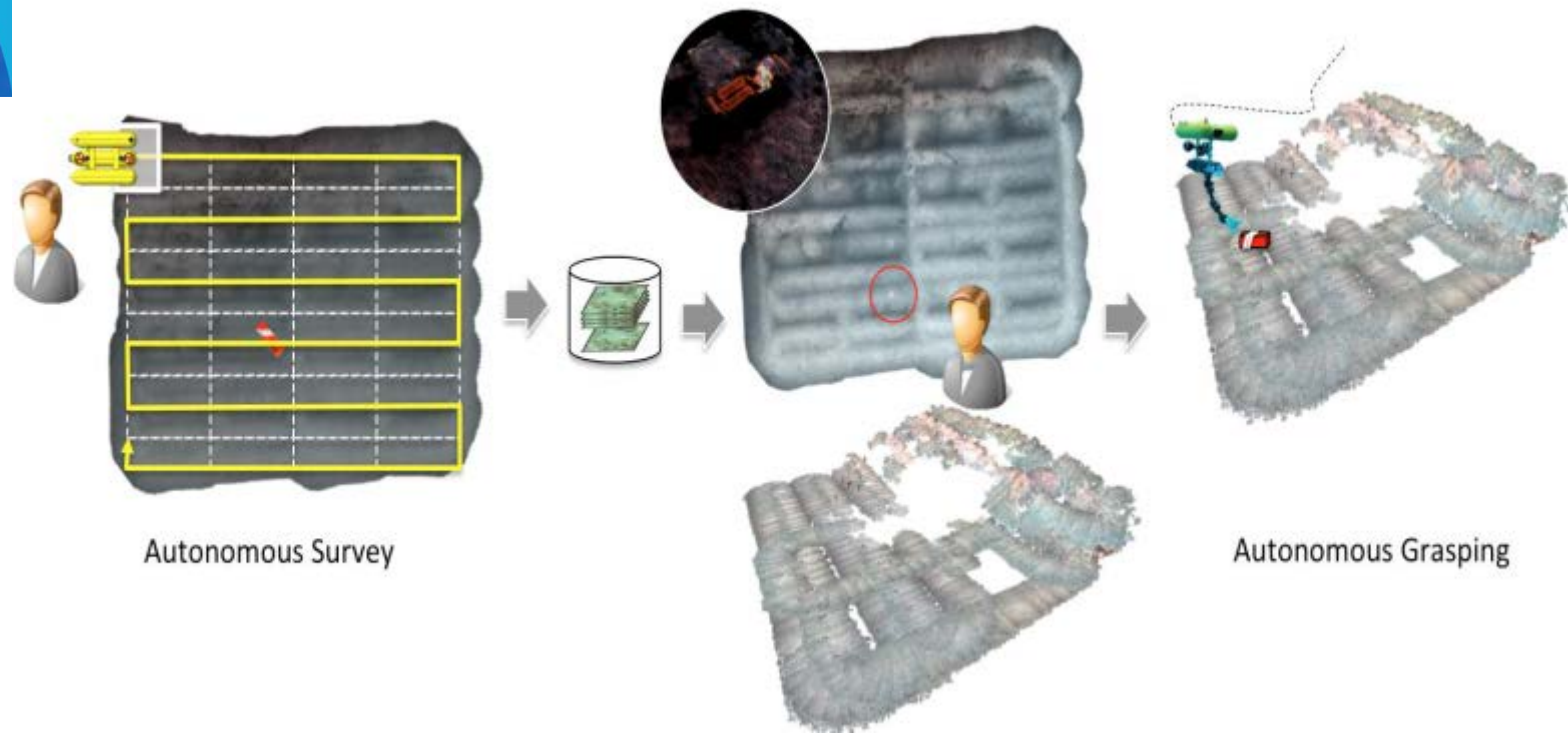


Represents a unique lightweight AUV for multipurpose intervention missions able to operate in shallow waters with a high autonomy degree



A new *benchmark* on
marine robotics

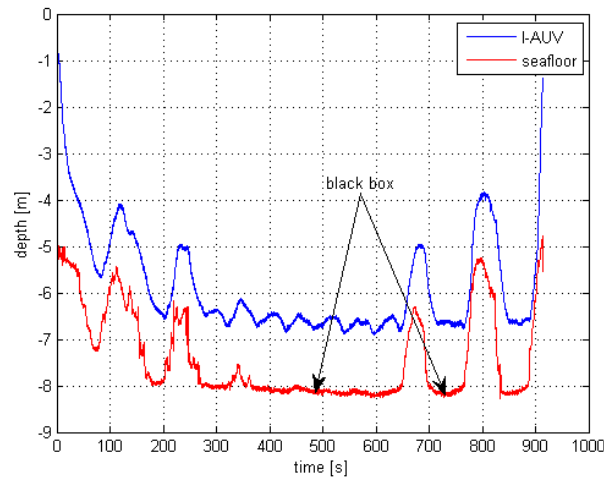
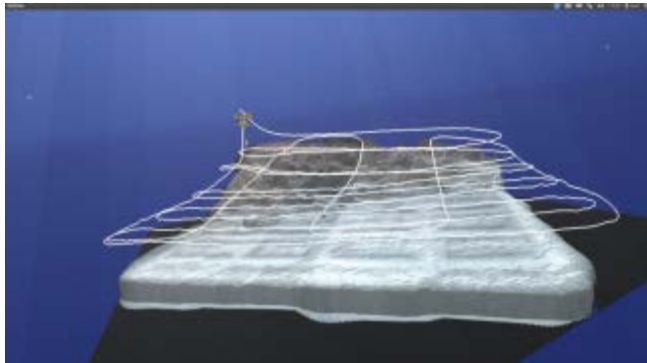
“The search and recovery
of a black-box mockup”



Final Experiments in a harbour (Sóller, Mallorca, Spain; Oct 2012)



Sóller



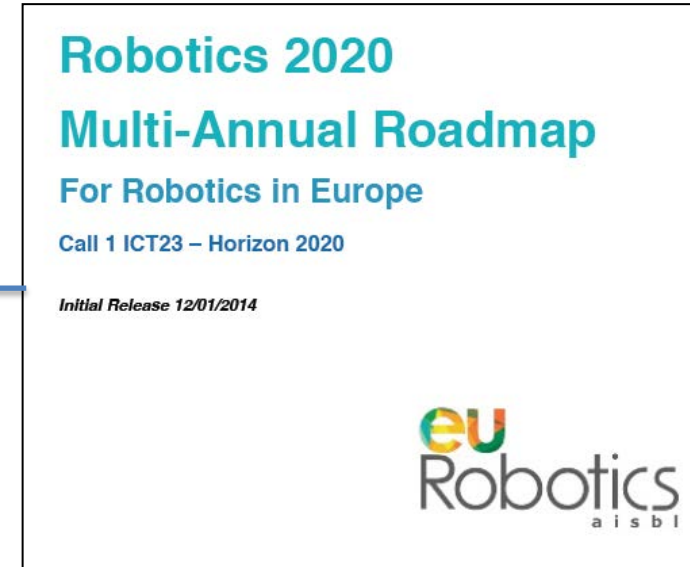
<http://youtu.be/iq5ePDKQB1g>

Sóller survey characterization

Surveyed area	25 x 20 m
Survey grid	5 rows x 11 columns
Survey altitude from the seafloor	1.5 m
Survey distance	357.67 m
Survey average velocity	0.37 m/s
Survey time	957 s
Max. Depth	8.18 m
Min Depth	4.88 m
BlackBox Depth	8.08 m
Water	Sea water
Visibility	2-3m approx.
Currents	Yes

Intervention characterization for Sóller benchmark

Target	Black box mockup size 13 x 15 x 40 cm and a space handle less than 3 cm
Intervention	Grasping
Approach	Visual free floating manipulation
Time of approach and intervention	143 s



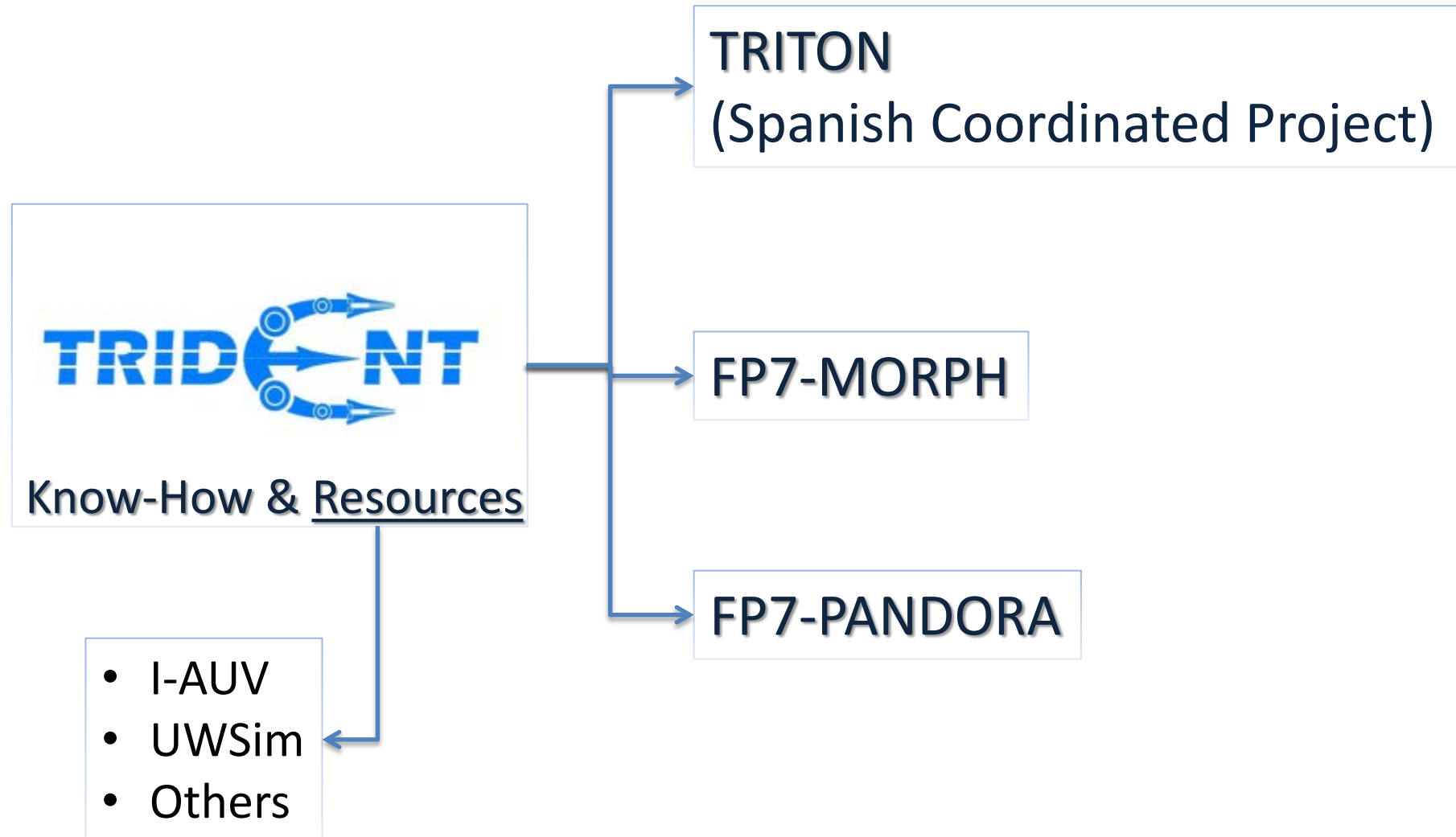
CIVIL ROBOTS

Marine ROBOTS

CIVIL ROBOTS

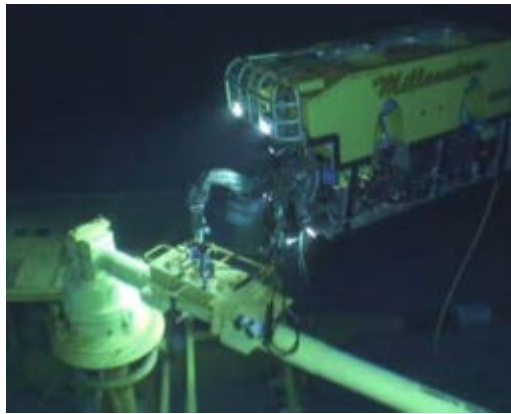
Current Key Projects

TG Marine Robotics

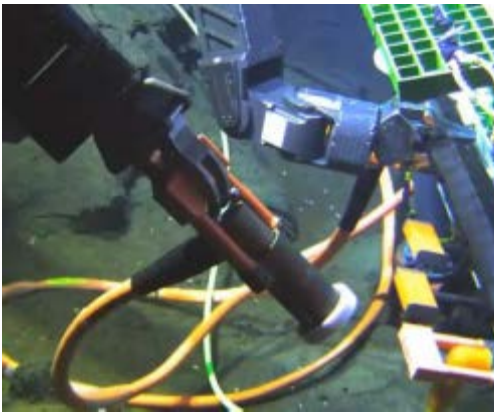


Concluding Remarks

- From **TRIDENT** *know-how* to end-users requiring *manipulation skills*



(1) Offshore Industry



(2) Ocean Observatories



(3) Marine Science



(4) Archaeology



(5) Geology



(6) Search and Rescue



TRIDENT - ERF

12th March 2014

Hugh Ferguson

Who are Subsea 7

40+
vessels



175+
ROVs



14,000+
people



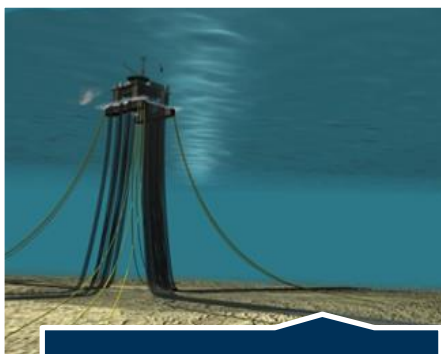
2,000+
engineers



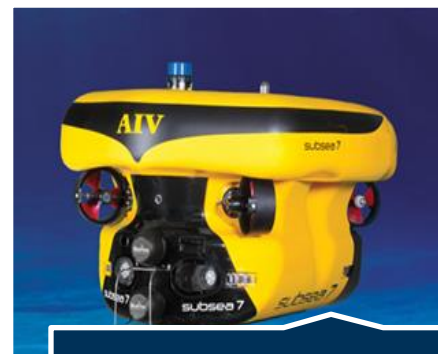
Core business segments

Engineering, construction, installation and procurement of Subsea Umbilical's, Risers and Flowlines.

Subsea 7 targets this segment globally.



SURF



Life-of-Field

Services over the life of a field's production, including inspection, repair and maintenance.

Subsea 7 performs this work in Europe; Africa; Gulf of Mexico and Australia and will target specific countries.

Fabrication and installation of fixed platforms and their associated pipelines in non-harsh environments.

Subsea 7 targets this segment in Africa. Entry into Mexico considered for positioning for deep water.



Conventional



Hook Up

Addition of modules on new platforms and refurbishment of topsides of an existing platform or FPSO.

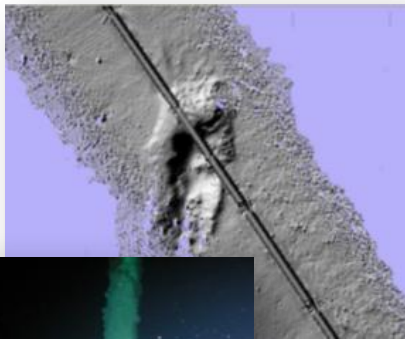
Subsea 7 has traditionally only targeted this segment in Africa.

Where we operate

We believe in strong local, integrated teams, leveraging our global know-how and resources.

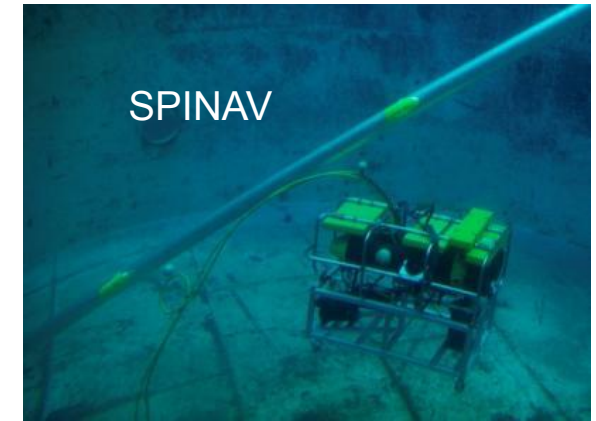
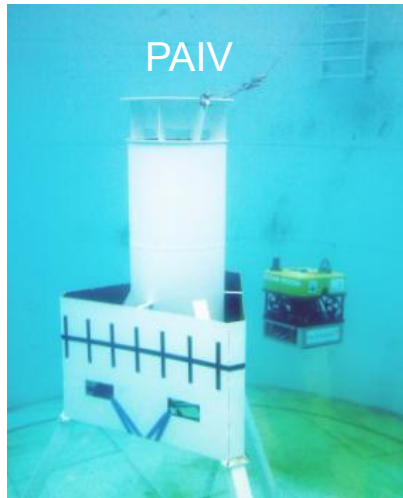


Autonomous Inspection Vehicle



- **Depth Rating** 3,000m
- **Dimensions** 1.7m (L) 1.3m (w) 0.8m (h)
- **Max Excursion** 40Km, 24 hour
- **Speed** 2kts (nominal)
- **Inspection sensors** 3D forward looking sonar & colour video camera.
Profiling sonar & downward look colour camera.
- **Communications** Acoustic, Wi-Fi, Satellite.
- **Navigation** Dead reckoning, feature identification using 3D World model.

Technical Pedigree



25 years of Autonomous Underwater Vehicle R&D for Military, Marine Science and Offshore Tasks,

30 years of ROV design build and operational experience
10 years AUV development

Technology Roadmap

MODEL	MARK I	MARK II	MARK III	MARK IV
	Visual Inspection GVI (single camera)	Mark I + MMS Level II Inspection Additional Non-Contact Sensors	Mark II + Contact Sensors	Mark III + V Light Intervention
Operations Scenario	SEE	SENSE	TOUCH	DO
Inspection GVI				
SIMOPS				
FPSO Deployment				
Post Hurricane Infrastructure Inspection (GVI)				
Ad-hoc Anomaly Investigation		3		
Inspection CVI		2		
Hull Inspection		4		
Post Hurricane		3		
Contact Inspection incl NDT			3	
Full Field (tooling ops)				4
Under Ice				5



Proven Technology



Method identified technology to be proven



Product development required



Technology gap to be closed

Severity rating relative to category 1-5 (five is hardest)