NOC MARINE AUTONOMY & TECHNOLOGY SHOWCASE

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

noc.ac.uk/matshowcase

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Mr Aidan Thorn

Business Development Manager NOC

Session Chair Opportunities for Collaboration and Funding

Welcome to Day Three

AIDAN THORN – BUSINESS DEVELOPMENT MANAGER
NATIONAL OCEANOGRAPHY CENTRE

WEDNESDAY 16 NOVEMBER 2016

Programme for the Day

0900 - Enterprise Opportunities - Aidan Thorn NOC
0930 - Modelling / Marine Data Products and their interactions with Marine Autonomous Systems - Christine Sams NOC
1000 - South Coast Marine Cluster - Kevin Forshaw NOC
1030 - Year of Autonomy 2017 - Tessa Darley Knowledge Transfer Network
1100 - Refreshments
1130 - MAS Council Survey Review - Dan Hook ASV
1200 - European Union Funding for Research, Development and Innovation Louise Mothersole Innovate UK
1230 - Innovate UK Autonomy Roadmap and Funding - Andrew Tyrer Innovate UK
1300 - Networking Lunch

Programme for the Day

1400 - Use of Marine Autonomous Systems and Technologies in Defence Applications - Peter Pipkin - RN

1430 - Marine Autonomous Systems helping mix Water and Electricity - Simon Cheeseman - Offshore Renewable Energy Catapult

1500 - Use of Marine Autonomous Systems and Technologies for the Oil and Gas Industry Peter Collinson, Joe Little & Alistair Fox - BP

1530 - Refreshments

1600 - Group Discussions (sessions will operate on a 30 minute rotation)
- Engaging with NOC
- South Coast Marine Cluster
- Funding

Engaging with the NOC for Research & Development Support

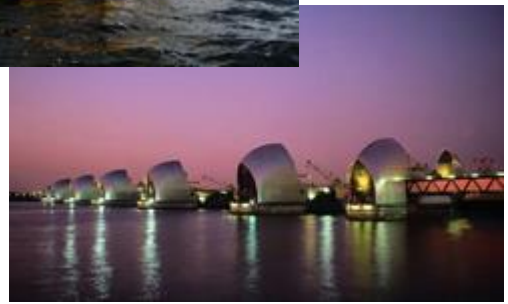
Creating Impact from our Research

We seek to actively engage with business to generate positive socio-economic impacts based upon our research outputs

What do we mean by impact?

Immediate impacts on your business may include:

- Development on new products or services
- That generate additional sales / exports
- And mean that you create new jobs



Secondary impacts may include:

- Lower carbon emissions from renewables
- Greater understanding of ocean processes flood defence, etc, etc,

It is key for us to report this back to UK Government and any new products created may reduce the cost of our ongoing research effort

How can we engage with you to create this impact?

1. Funded collaborative research, with NOC as a partner

2. Accessing NOC developed technology for development into commercial products

3. Access to NOC expertise and knowledge to improve your business operation
4. Providing added value information products

5. Access to specialist equipment and test facilities Or, any mixture of the above to meet your specific company need

Funded collaborative research, with NOC as a partner

- The NOC seeks to engage with both individual companies, and groups of companies for collaborative research
- Many sources of funding exist to support the costs of R&D to help bring new developments to market, which then stimulate economic development

Innovate UK
Technology Strategy Board

HORIZON 2020

Examples of Collaborative R&D Projects

£5m Innovate UK competition for Collaborative R&D, for which the NOC engaged with 3 consortia that successfully won 38% of the funding available

- **Launch & Recovery of Multiple AUVs from an USV**

  Planet Ocean as Lead, and ASV, University of Southampton and NOC

- **Pressure Tolerant Lithium Sulfur Battery for Marine Autonomous Systems**

  Steatite as Lead, and partners Oxis, Msubs and NOC

- **Autonomous Surface / Sub-surface Survey System**

  ASV as Lead and partners Sonardyne, Seebyte and NOC

Innovate UK Projects leading to additional work - Pipeline Tracking

South Coast

Centre of Excellence in Satellite Applications

Marine & Maritime

Renewables
Agri- tech
Manufacturing

Transport

Autonomous Systems

National Oceanography Centre
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marine south east

University of Southampton

University of Brighton

Hampshire County Council

CATAPULT Offshore Renewable Energy

University of Portsmouth

South Coast
Centre of Excellence in Satellite Applications

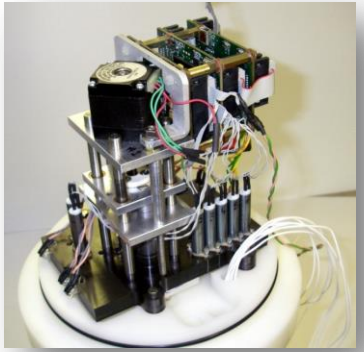
NOC's Aims from the Centre of Excellence

Develop Collaborative projects that:

- Better enable MAS to avoid hazardous conditions
- Can help direct MAS to areas of scientific interest
- Use the Marine Robotics Innovation Centre as a hub to introduce Space organisations to the broad and varied MAS industry

Accessing NOC developed technology for development into commercial products

- The NOC has a long history of developing new technology to enable our research in the ocean's most challenging environments
- This includes pioneering AUV platforms, and component systems, and world-leading sensor developments
- The NOC develops this technology for its own research purposes, but does not seek to develop commercial products
- Where companies can conceive a commercial angle, the NOC can License this technology on an exclusive or non-exclusive basis



Thank you for listening

Enjoy the remainder of MATS 2016

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Christine Sams

Business Development Manager NOC

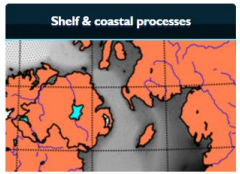
Modelling / Marine Data Products and their Interactions with Marine Autonomous Systems

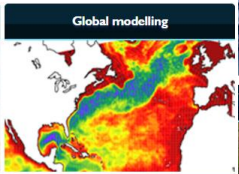
Marine Physics & Ocean Climate Group

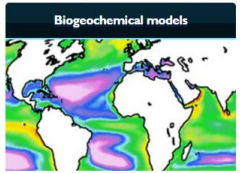
The Marine Physics and Ocean Climate (MPOC) research group studies fundamental physical processes in the marine environment and their connection with, and influence on, the rest of the Earth system. Our research spans microscopic to global scales, extends from the coast to the abyssal ocean, ed. Read more →

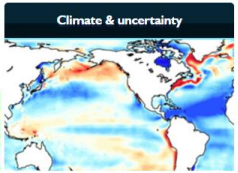
Marine Systems Modelling Group

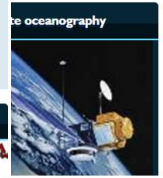
The Marine Systems Modelling (MSM) group are world-leaders in numerical modelling of the global oceans and shelf seas. This includes modelling the ocean circulation and heat transport, marine ecosystems, sea-ice, turbulence, surface waves, sediment transport, tides and storm surges.
Read more →

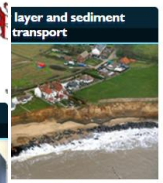


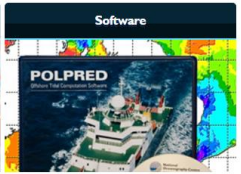












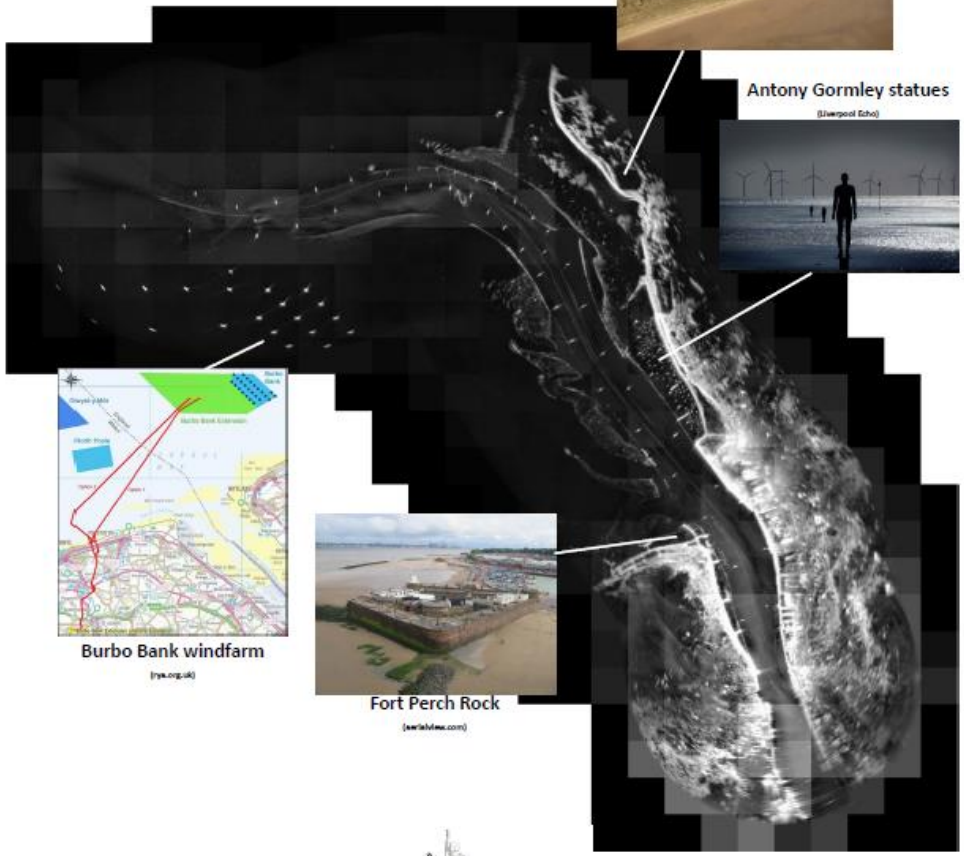
Offshore Technology and Engineering

This 'Synthetic Aperture' image is generated much in the same way as satellite-flown radar imagery, however here we use marine navigational radar data recorded from a moving vessel. Complex geo-referencing and image registration is performed utilising the Discovery's navigation data and state-of-the-art algorithms developed at NOC. The data were recorded as the Discovery sailed into Liverpool for the NERC 'Into the blue' event on the 4th October 2016.

Altcar military ranges

Antony Gormley statues

(Liverpool Echo)



Burbo Bank windfarm

(rya.org.uk)

Fort Perch Rock

(aerialview.com)

Premise: We are only just scratching the surface of the capabilities that can be unlocked through connecting marine modelling expertise with the marine autonomy and remote sensing sectors

Modelling expertise at NOC

Core Expertise

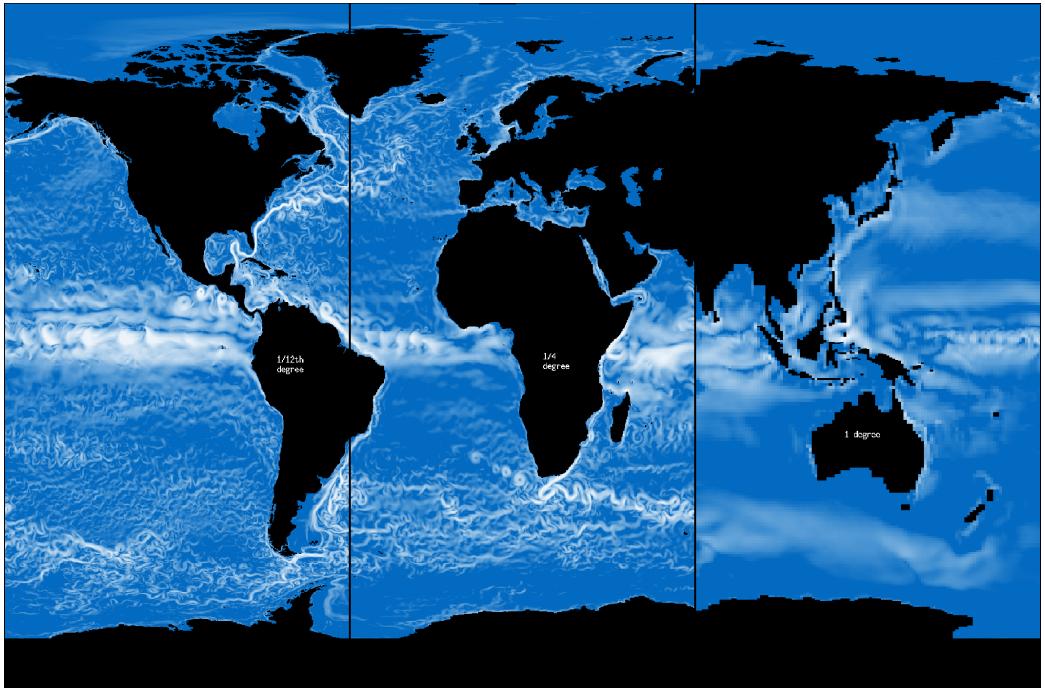
- Ocean modelling at a range of scales:
  - Global (NEMO)
  - Regional seas (NEMO)
  - Coastal (FVCOM)
- Model coupling
- Development
- Analysis/interpretation
- Application/dissemination

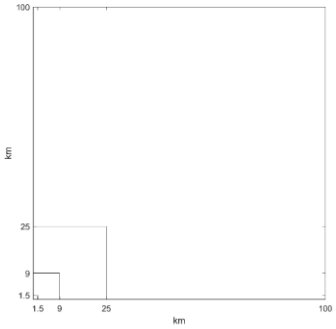
Key facilities

- Cluster computers: Southampton, Liverpool
- Access to MONSOON / ARCHER
- JASMIN Big Data Service

Image courtesy of Stephen Kill, STFC

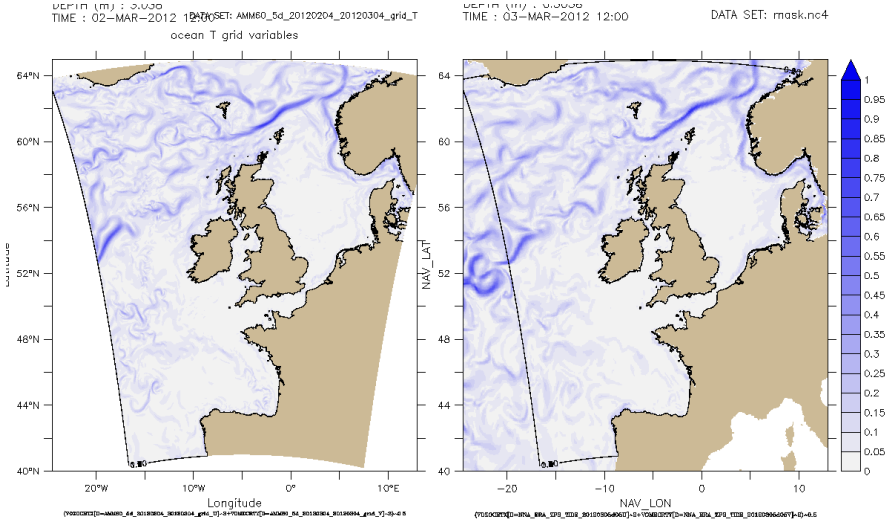
Ocean modelling at different scales… global..





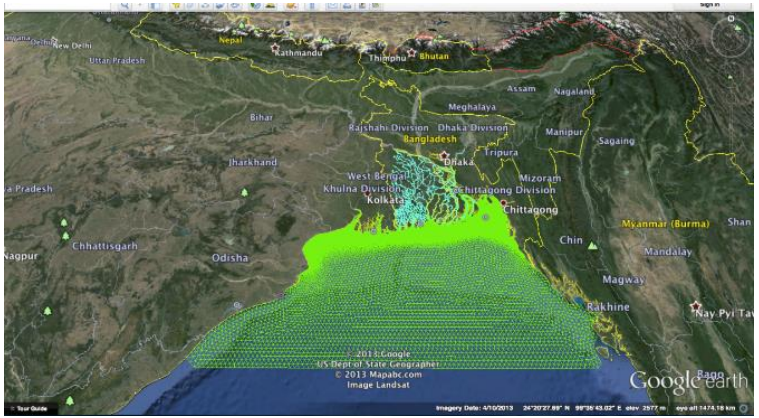
9km 25km 100km

…to regional and ‘local’



1.5km

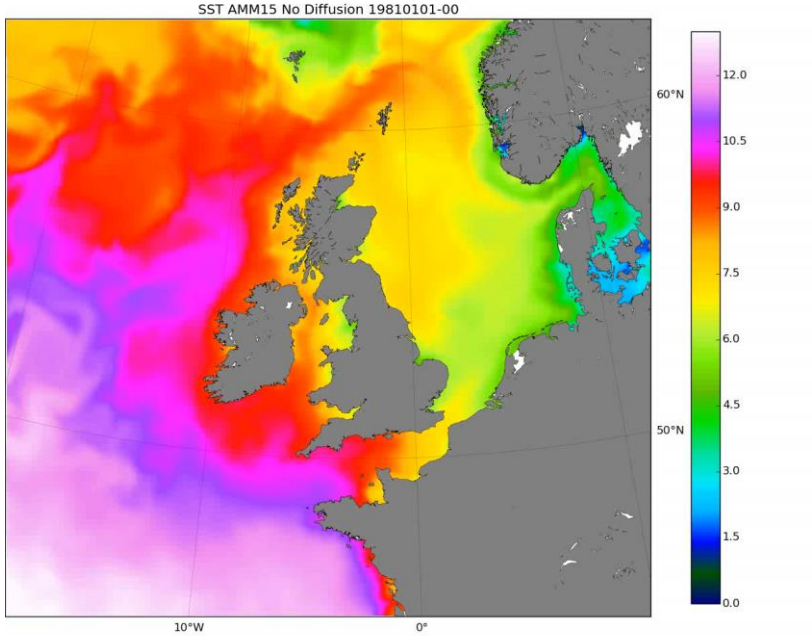
9km



1km -50m

Global NEMO circulation model in action..

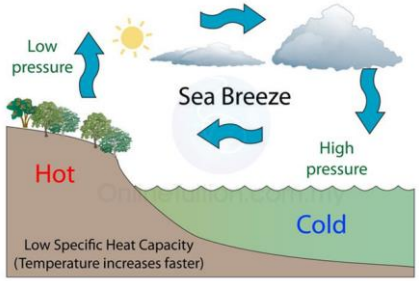
Next Generation Model for NW European Seas



1.5km

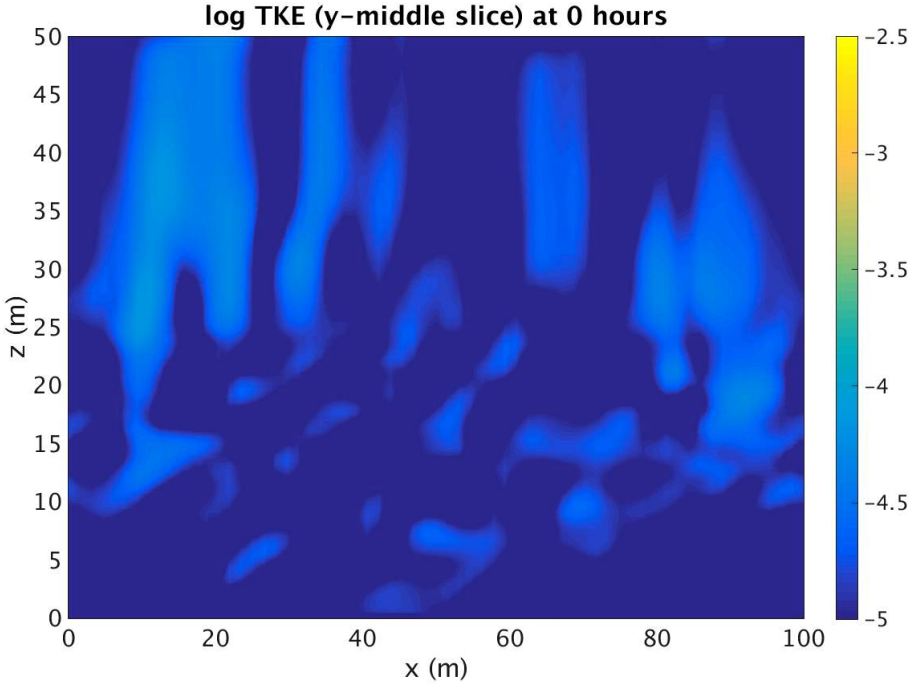
UK Environmental Prediction
Part of a fully coupled System

Coastal-Ocean – Land- Atmosphere



Met Office | Centre for Ecology & Hydrology | National Oceanography Centre

Modelling turbulence

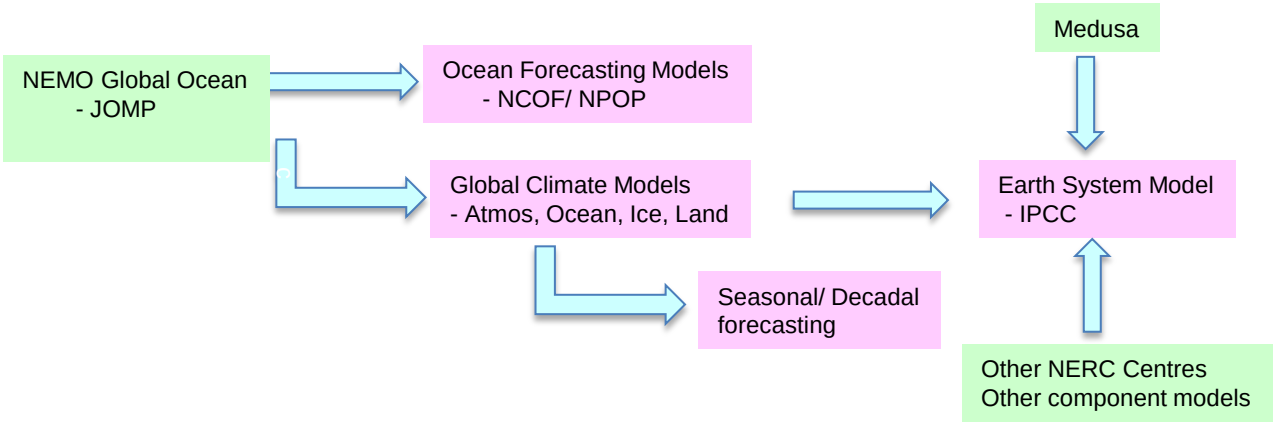


Turbulent kinetic energy generated from friction as a result of tide over the sea bed (1hr per second!)

Video from work by Ash Brereton, led by Mathew Palmer

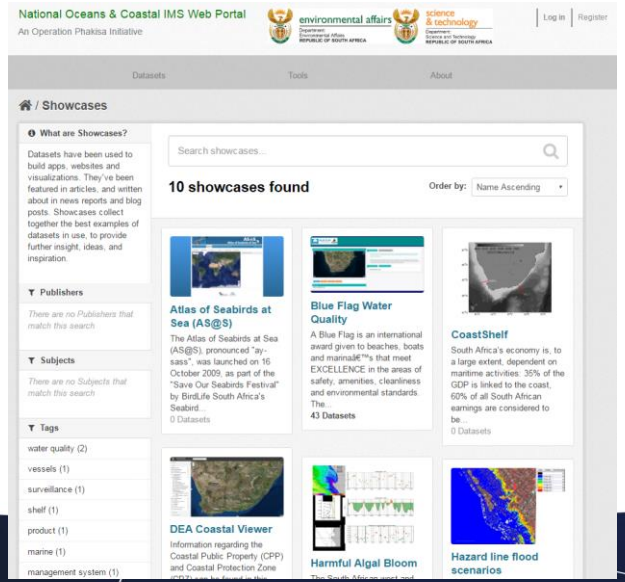
How do we use our models? How can MAS contribute?

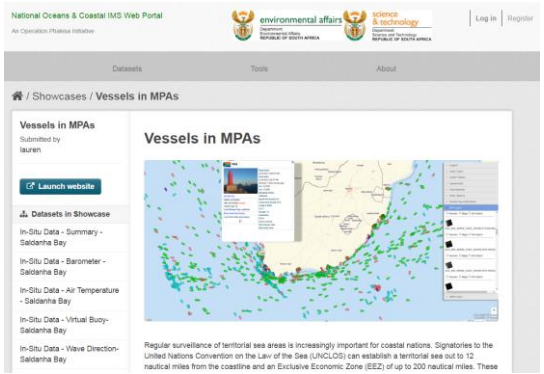
Scientific focus is mainly on environmental predictions, to deliver a better understanding of the changing environment and inform UK Govt policy



How do we use our remote sensing capabilities? How can MAS contribute?

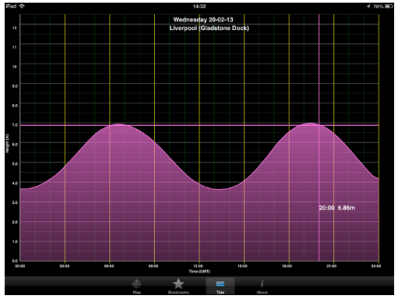
- C-RISe project - using satellite altimetry to understand sea level changes
- OCIMS platform is developing toolkits for monitoring pollution, fisheries, MPA's and coastal hazards..
- Potential for MAS / USV to complement these services by providing in-situ real time information





Suite of commercial software products and apps

Predictions based on Known Ports/Observation Points



POLTIPS·3 - coastal tidal software

Find out about POLTIPS·3 tidal prediction software. This software allows the user to do predictions up to 5 years ahead, especially useful for planning coastal activities.

Read more →

POLPRED - offshore tidal information system

Find out about POLPRED V·2 an offshore tidal information system. This software allows users to predict tidal currents and elevations. It has been used successfully during the Olympics by the British Yachting Team and in UK/Irish waters by Team Douglas.

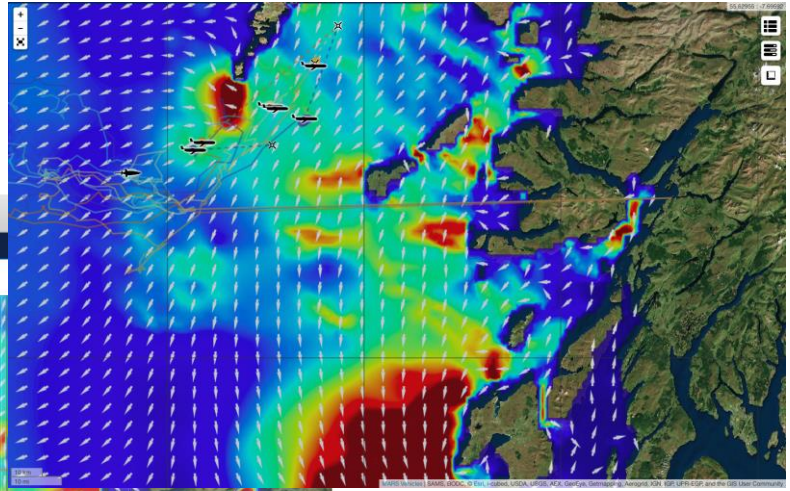
Read more →

Hydro-DLL - for software developers

If you are involved in developing software and have a requirement for the inclusion of tides or currents in your program, then the Applications Team has developed two Windows DLLs which could meet your needs.

Read more →

MASSMO 3



mars.noc.ac.uk/missions/massmo-3

MARS Portal Browse

MASSMO 3

- Inactive
- Part of MASSMO
- Began on 2016-09-15 (2 months ago)
- Last Updated 2016-11-01 12:14:04
- Finished on 2016-10-02 (a month ago)

MASSMO3 involves up to ten surface and submarine gliders collecting marine environmental data over a two-week period off northwest Scotland, in support of the Royal Navy's Unmanned Warrior. This is the largest simultaneous deployment of marine robotic vehicles attempted in UK waters, and includes seven submarine gliders operating southwest of Barra to the shelf edge, and three surface gliders operating north of Lewis.

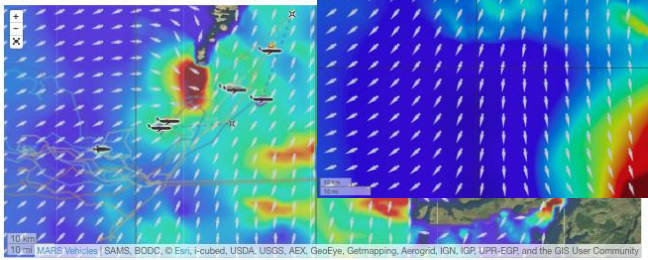
Vehicle Activity

Vehicle	Deployed	Recovered	Last Update	Distance (N. Mi.)	
Nelson	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 14:39:05 (a month ago)	179.22	No Public Data Available
Drake	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 14:21:15 (a month ago)	167.98	No Public Data Available
Talisker	2016-09-15 (2 months ago)	2016-09-30 (a month ago)	2016-09-30 14:22:28 (a month ago)	157.51	No Public Data Available
Blue Ocean unit_491	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 12:10:19 (a month ago)	233.27	No Public Data Available
Royal Navy unit_544	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 18:06:10 (a month ago)	200.40	No Public Data Available
Royal Navy unit_552	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 17:50:58 (a month ago)	269.87	No Public Data Available
Royal Navy unit_553	2016-09-15 (2 months ago)	2016-10-01 (a month ago) - End of Mission	2016-10-01 15:16:37 (a month ago)	266.59	No Public Data Available
Waimea	2016-09-19 (2 months ago)	2016-10-02 (a month ago) - End of Mission	2016-10-02 23:58:06 (a month ago)	406.83	No Public Data Available
Boeing SHARC 117	2016-09-19 (2 months ago)	2016-10-03 (a month ago)	2016-10-03 00:00:00 (a month ago)	458.31	No Public Data Available
Boeing SHARC 127	2016-09-19 (2 months ago)	None	2016-10-02 23:55:36 (a month ago)	472.53	No Public Data Available

Sensor Data

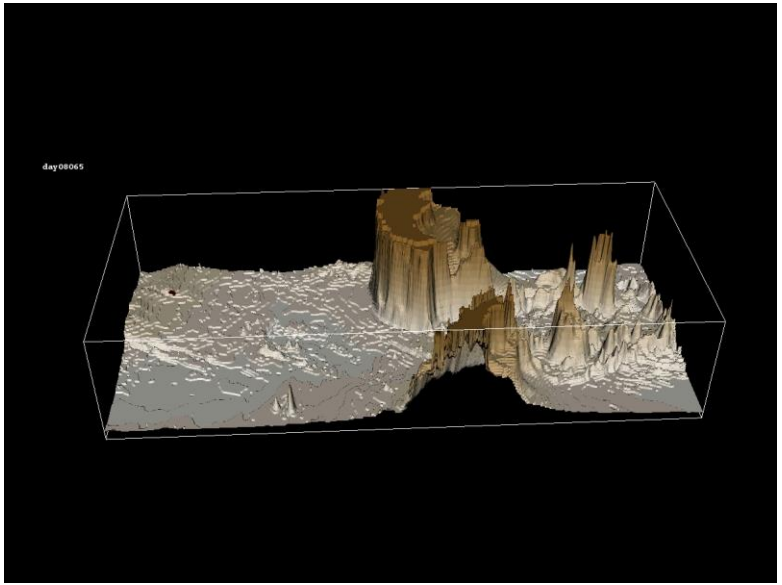
Nelson Drake Talisker Blue Ocean unit_491 Royal Navy unit_544 Royal Navy unit_552 Royal Navy unit_553 Waimea Boeing SHARC 117 Boeing SHARC 127

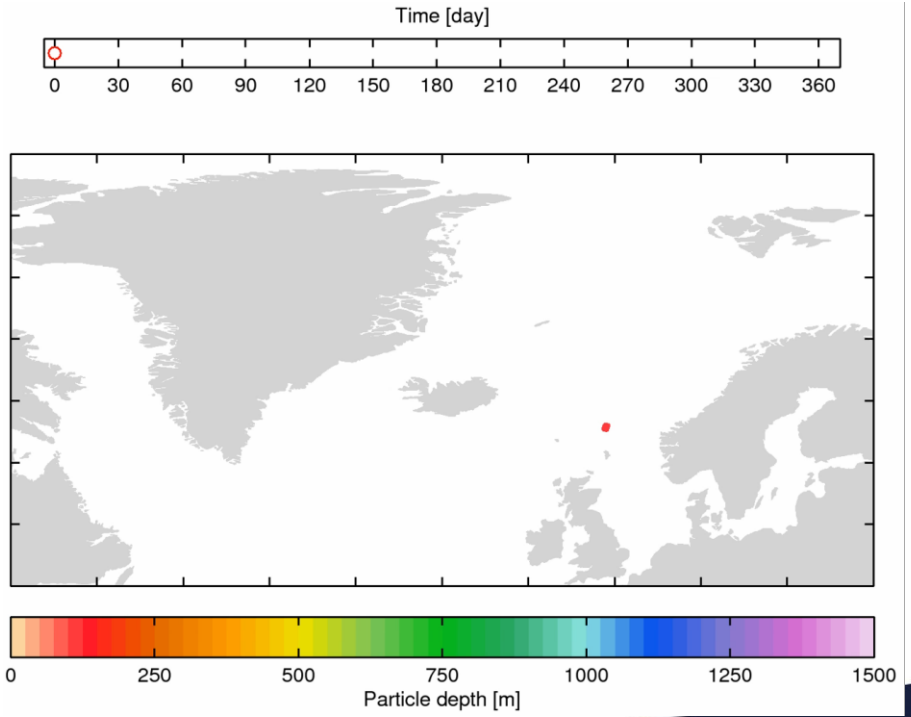
Map



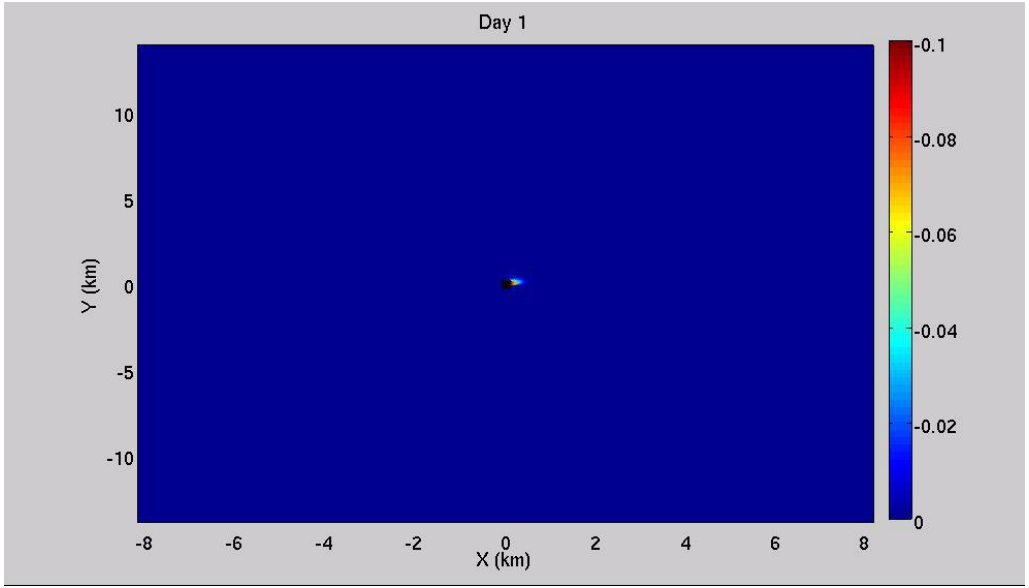
Partners

Mission planning e.g. particle tracking

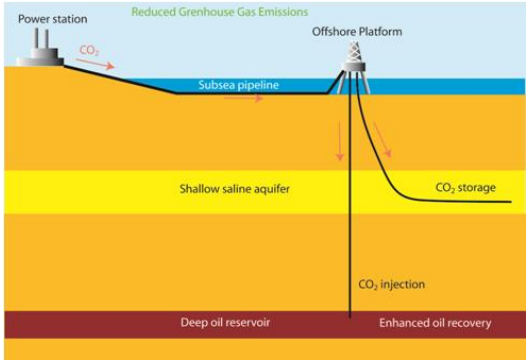




Dispersion from a CCS Sea-Floor Leak



Carbon Capture and Storage



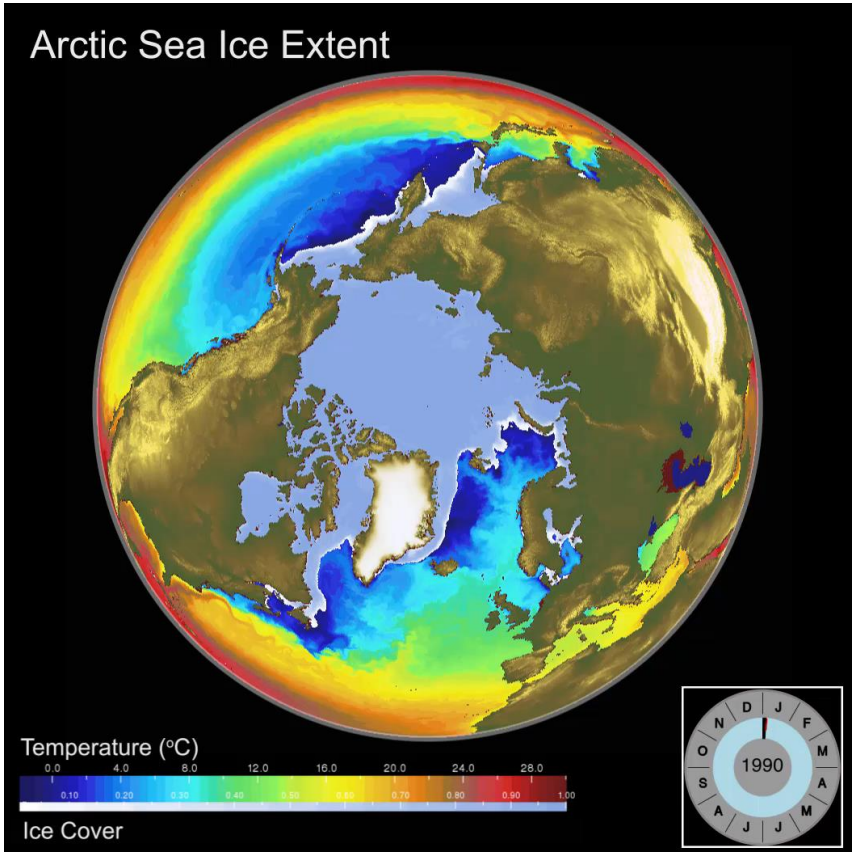
Where next ?

We have access to a powerful suite of models, we are keen to collaborate with others to do more with what we have.. and to create new tools using our skills and knowledge

- MAS has a role to play in complementing and enhancing model and remote sensing data
- MAS operators can benefit from using model and remote sensing data to guide operations

In Liverpool: Aiming to create a **marine data applications hub**, a physical space with IT infrastructure and resources to enable the co-creation and implementation of tools, products and services from marine data and models

Predictions out to 2100




Christine.Sams@noc.ac.uk

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Mr Kevin Forshaw

Associate Director Innovation and Enterprise NOC

South Coast Marine Cluster

UK
SOUTH COAST
MARINE CLUSTER

South Coast Marine Cluster

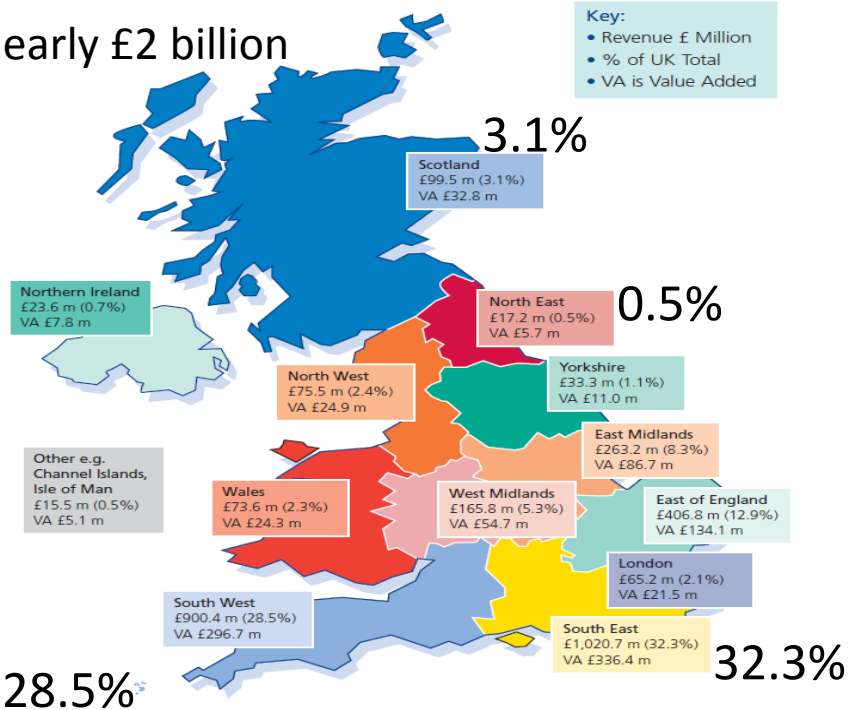
World Leading Innovation-led Marine
& Maritime Cluster

Southern England: Centre for UK's Marine & Maritime industry

UK SOUTH COAST MARINE CLUSTER

Industry Revenue by Region

Nearly £2 billion



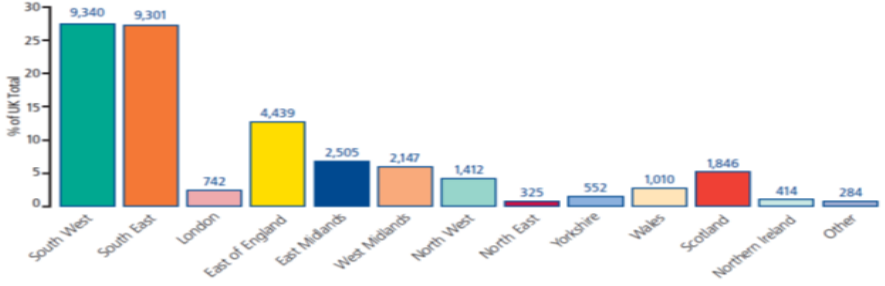
3.1%

0.5%

32.3%

28.5%

Employment (FTE) by Region



UK LEISURE, SUPERYACHT AND SMALL COMMERCIAL MARINE INDUSTRY

Southern England: centre for UK's Marine & Maritime industry

UK SOUTH COAST MARINE CLUSTER

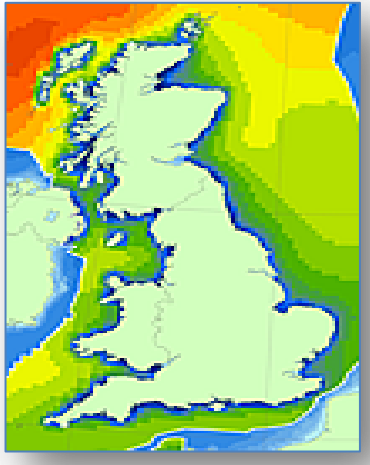
UK's largest concentration of natural harbours and associated ports

Southern England: Centre for UK's Marine & Maritime industry

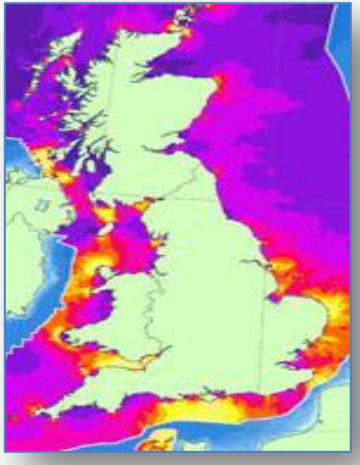
UK SOUTH COAST MARINE CLUSTER

Only region with all renewable energy resources close to major ports & infrastructure

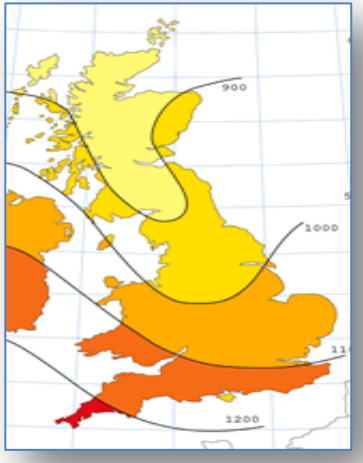
Wave



Wind



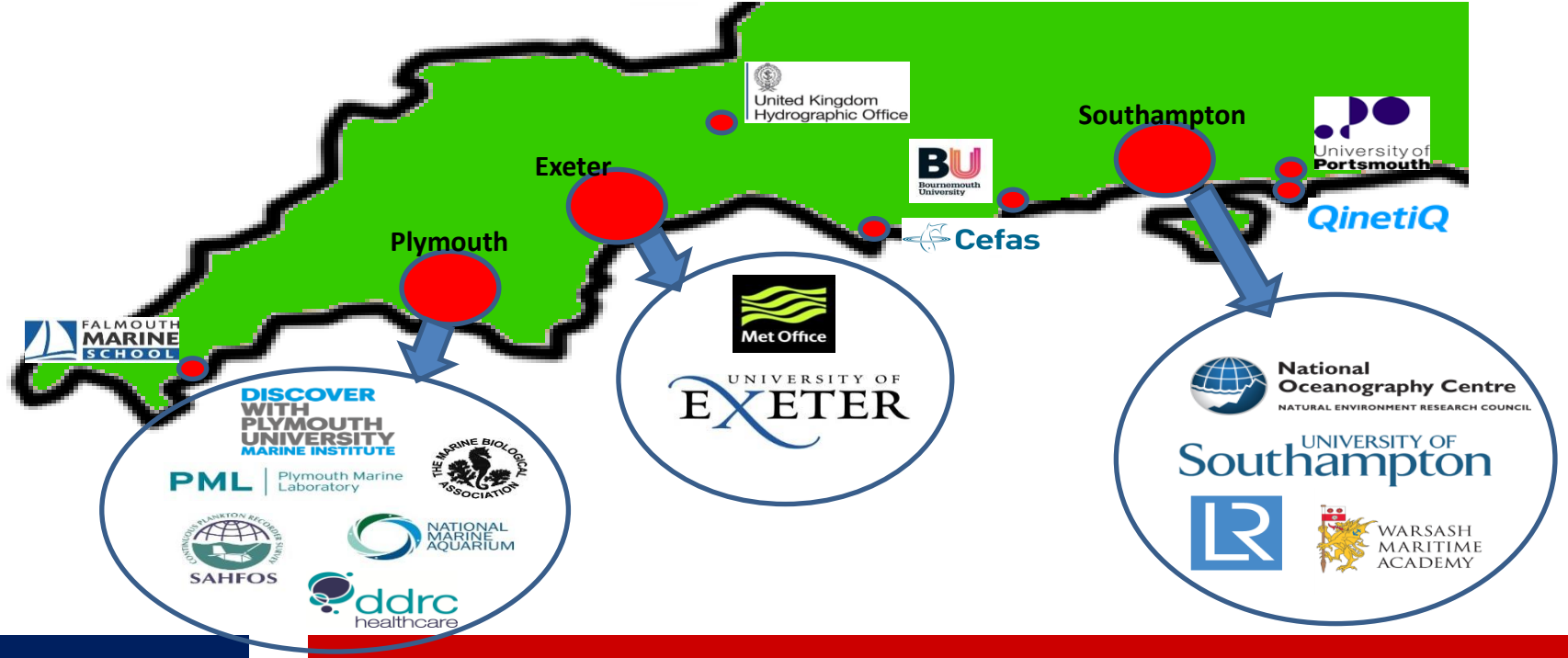
Tidal



Solar

South coast centres of expertise in marine research, innovation and training

UK SOUTH COAST MARINE CLUSTER



Research Capacity Highlights

South Coast includes…

UK SOUTH COAST MARINE CLUSTER

- Two of UK's leading Russell Group Universities
- World top 100 universities (QS/THE)
- UK top 10 (NatureIndex)
- The UK's two top post-92 universities
- World "top 100 under 50" ranking 2015 (THE)

University of Southampton

University of Exeter

Discover with Plymouth University

University of Portsmouth

"Education and research solutions for the global marine sector"

Research Capacity Highlights

South Coast includes…

UK SOUTH COAST MARINE CLUSTER

UK's two largest University Marine Institutes

DISCOVER WITH PLYMOUTH UNIVERSITY MARINE INSTITUTE

500+ marine staff/researchers
2600 marine-themed students

UNIVERSITY OF Southampton

Southampton Marine and Maritime Institute

500+ marine staff/researchers
1000 marine themed students

Research Capacity Highlights

South Coast includes…

UK SOUTH COAST MARINE CLUSTER

UK's four largest and most renowned non-university institutions undertaking marine research

Met Office

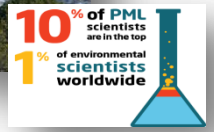
65+ marine scientists

Cefas

150+ staff

PML Plymouth Marine Laboratory

160+ staff



National Oceanography Centre

NATURAL ENVIRONMENT RESEARCH COUNCIL

- 350+ staff at Southampton
- UK's largest institution for integrated marine science

Research Assets

UK SOUTH COAST MARINE CLUSTER

Unparalleled suite of world-class facilities

FaB Test
Falmouth Bay Test Site
Marine Renewables Commissioning Site

Innovation & Knowledge Exchange

UK SOUTH COAST MARINE CLUSTER

South Coast can offer…

Marine Robotics Innovation Centre at the NOC

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

ASV unmanned marine systems
seebyte
Planet Ocean Ltd

Associate Members

Sonardyne SOUND IN DEPTH
QinetiQ
TELEDYNE MARINE Everywhereyoulook
bp
HYDROID A KONGSBERG COMPANY
ATLAS ELEKTRONIK UK A company of the ATLAS ELEKTRONIK Group

Innovation & Knowledge Exchange

UK SOUTH COAST MARINE CLUSTER

South Coast can offer…

Marine Innovation Centre (MARIC)

MARINE INNOVATION CENTRE WITH PLYMOUTH UNIVERSITY

- Since 2012 MARIC has engaged with hundreds of businesses on a global scale
- Work closely with core group of companies to maintain a reciprocal relationship through focused knowledge exchange
- Blue Environmental Hub, Brixham (inward investment)

BRIXHAM LABORATORY WITH PLYMOUTH UNIVERSITY

Innovation & Knowledge Exchange

South Coast can offer…

UK SOUTH COAST MARINE CLUSTER

Southampton Marine and Maritime Institute

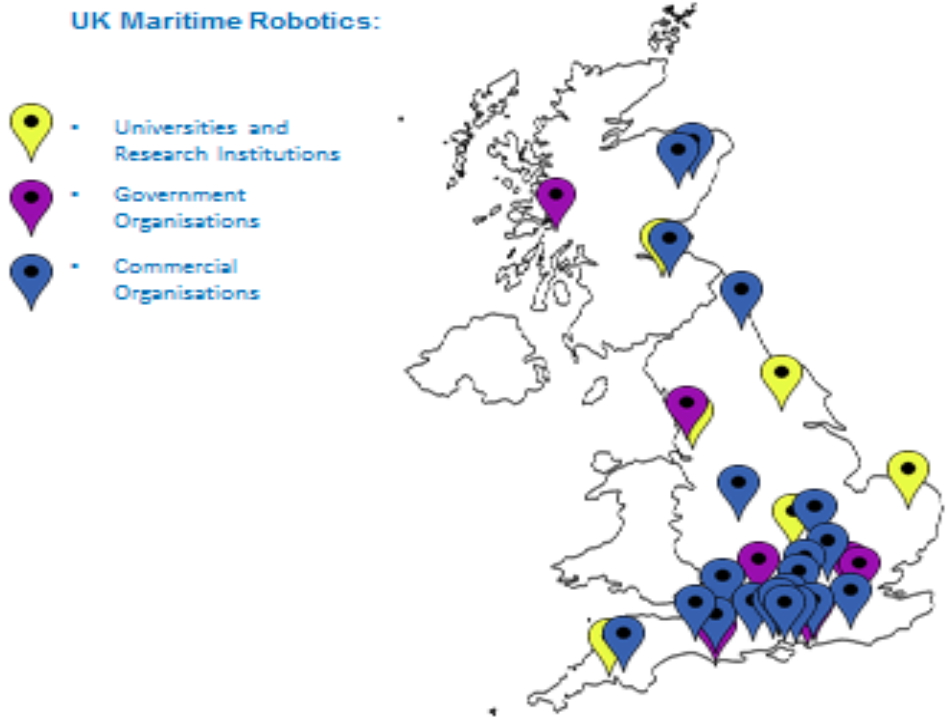
UNIVERSITY OF Southampton

LR

- Lloyd's Register - Global Technology Centre (Marine)
- Aim: A world-leading centre for innovation, business and education
- A focal point for industries, enterprises and universities to conduct leading edge research and technology application

World-leading marine autonomous and robotic system expertise on the South Coast

UK SOUTH COAST MARINE CLUSTER



For illustration purposes only

Marine & Maritime Training

South Coast can offer…

UK SOUTH COAST MARINE CLUSTER

Next generation of maritime professionals

DISCOVER WITH PLYMOUTH UNIVERSITY

MLA COLLEGE

Southampton SOLENT University

WARSASH MARITIME ACADEMY

Maritime Strengths

UK SOUTH COAST MARINE CLUSTER

Shipping

The Port of Southampton is:

- The UK's number one vehicle handling port
- Europe's leading turnaround cruise, welcoming 1.7m passengers every year
- Contributes over £1bn to UK economy every year
- Home to the new 500m deepwater quay SCT5, which was purpose built to handle the biggest ships in the world

Maritime Strengths

UK SOUTH COAST MARINE CLUSTER

Defence - Plymouth

The Naval Base & Dockyard directly support 8.4% of Plymouth's total Full-Time Equivalent (FTE) employment and 11.8% of its Gross Value Added (GVA).

It is the primary UK location for deep maintenance of surface and submarine vessels, including up-graded facilities for nuclear submarine work .

Devonport is the largest Naval Base in Western Europe (650 acres).

South Coast…In Summary

UK SOUTH COAST MARINE CLUSTER

- The South Coast of England is clearly and incontrovertibly the centre for marine science and technology in the UK
- Capacity available is of global significance
- Well developed mechanisms of Knowledge Exchange and innovation support
- Significant maritime sector

Thanks to…

DISCOVER WITH PLYMOUTH UNIVERSITY

PML Plymouth Marine Laboratory

THE MARINE BIOLOGICAL ASSOCIATION

CONTINUOUS PLANKTON RECORDER SURVEY SAHFOS

UNIVERSITY OF EXETER

National Oceanography Centre NATURAL ENVIRONMENT RESEARCH COUNCIL

UNIVERSITY OF Southampton

The South Coast Marine Cluster Concept

UK SOUTH COAST MARINE CLUSTER

Began as a cross- local authority and LEP partnership initiative through the GREAT UK Challenge Fund

£100,000 funding + £114,000 match

International event
- Oceans '15
- Blue Tech San Diego
- METS Amsterdam
- Marintec China
- Miami International Boat Show
- Marseille Trade Mission

21 companies showcased ~ 300 leads

Companies introduced to UKTI export team

£1.2m export and one landed inward investment target – Monitor in November '16

Collaboration with public sector, higher education and research institutions

2017 events

UK SOUTH COAST MARINE CLUSTER

- Oceanology International – San Diego February 2017
- Year of Autonomy – Multiple events across the South Coast
- Ocean Business – Southampton April 2017


UK
SOUTH COAST
MARINE CLUSTER

Tessa Darley

Knowledge Transport Network

Roger Gardner

University of Southampton

Year of Autonomy 2017

UK SOUTH COAST MARINE CLUSTER

Marine – Land -Air Autonomy 2017

A series of events across the south coast to build on the complementarities and contrasts in innovation between water, land and air autonomy

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Vision

To bring together innovators and users from across marine, land and air autonomy to address key challenges and share learning. With the aim of developing cross sector collaboration to address these challenges

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Why?

- Improve industry access to information on cross-sector challenge areas
- Shared understanding of research base and industry approaches to issues they have in common across the autonomy landscape
- Development of cross-sector industry collaborative projects and programmes
- Engage funders and key stakeholders on the key challenge areas
- Create a recognised South Coast Cluster of Excellence for Autonomy

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

How?

- Five Workshops on the common Key Challenge Areas
- Develop a roadmap of capabilities and challenge areas
- Funding
  - Engage Funders (Traditional and User community)
  - Horizon scan funding landscape for opportunities

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Working Group

- Industry and Academia Representation
- Water / Land / Air Representation
- Chair – Tessa Darley – Knowledge Transfer Network

KTN the Knowledge Transfer Network

University of Portsmouth

Hampshire County Council

PLYMOUTH CITY COUNCIL

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Callen-Lenz

UNIVERSITY OF EXETER

SUCCEED WITH PLYMOUTH UNIVERSITY

UNIVERSITY OF Southampton

QinetiQ

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Challenge Area 1 – Collaborative Autonomy

- Swarming
- Command and Control Software
- Artificial Intelligence
- Water / Land / Air Combined Systems

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Challenge Area 2 – Regulation

- Codes of Practice
  - What exists / on the horizon
- Safe Operation
  - Human elements
  - Interactions with infrastructure and transport
- Legal Perspectives

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Challenge Area 3 – Energy Management

- Energy Harvesting
- Battery / Power Management Systems
- Power Storage / Docking and Charging

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Challenge Area 4 – Risk and Reliability

- Testing and Standards
- Safety
- Probability of mission success
- Fault analysis and diagnosis
- Maintenance

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Challenge Area 5 – Societal Acceptance

- Impact of automation on the Workforce
  - Changing and emergent roles
  - Skills
- Public perception – ‘Rise of the Machines’
- Ethics

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Date	Topic	Host Venue
November ‘16	Launch	National Oceanography Centre (NOC)
January ‘17	Collaborative Autonomy	QinetiQ
March ‘17	Regulation	University of Southampton
May ‘17	Energy Management	Plymouth – Venue TBC
July ‘17	Risk and Reliability	University of Portsmouth
September ‘17	Societal Acceptance	Cornwall – Venue TBC
November ‘17	Review & Outcomes	NOC

Website coming soon for registrations

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Additional Elements

- Bi-Monthly Autonomy Community newsletter
- Network Building
- Report on findings and actions

2017 – Year of Autonomy

UK SOUTH COAST MARINE CLUSTER

Questions and Suggestions

Mid Morning Refreshments

30 Minute Break

Mr Dan Hook

Managing Director ASV

MAS Council Survey Review

The UK MAS Industry

November 2016

Dan Hook, CEng, MRINA
Managing Director

MARITIME UK

Society of Maritime Industries

ADS

Marine Robotics

Defence

SUBSEA UK

Marine Robotics

Subsea

British Marine Federation

Marine

Marine Robotics

Composites UK Trade Association

SUSTAINABLE AVIATION Cleaner. Quieter. Smarter. 10 YEAR

Aerospace

Materials

eef UK Steel

Digital

Automotive

automotive council UK

Medical

abhi

Marine Robotics

TECH CITY UK

HM Government

Aerospace Growth Partnership

Aerospace

Supports 230,000 jobs across the breadth of the UK

Contributes £24billion to the economy every year

Every 2.5 seconds an aircraft takes off or lands, powered by a Rolls-Royce engine

Potential growth by 2031 for civil aerospace market is in excess of $4.4trillion

gov.uk/bis/industrial-strategy

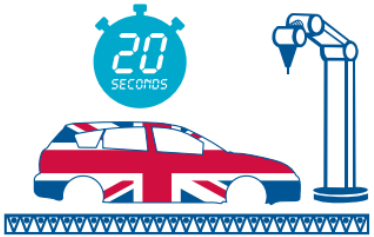
#indstrategy

HM Government

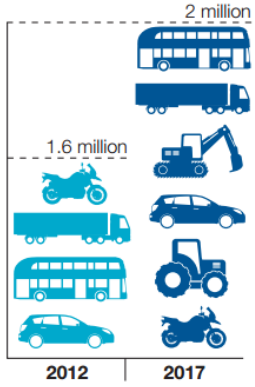
automotive council UK

Automotive

There are **141,000** people directly employed in the UK automotive sector.



A new vehicle rolls off a production line in UK every **20 seconds**.



The UK currently makes nearly 1.6 million vehicles each year, this is expected to **rise to over 2 million by 2017**.

The automotive sector is worth **£10.7 billion** to the UK economy in GVA.

GROWING THE AUTOMOTIVE SUPPLY CHAIN

THE OPPORTUNITY AHEAD

SUBSEA UK™

Subsea Expo | Subseaintel | Online Subsea Course | Follow us:

The voice of the UK subsea industry

Subsea UK is the champion for the UK subsea industry. We act for the entire supply chain bringing together operators, contractors, suppliers and people in the industry.

Subsea Overview Video

over 53,000 employees

£8.9 billion industry

over 750 companies

GOV.UK

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Departments Worldwide How government works Get involved
Policies Publications Consultations Statistics Announcements

News story

UK aerospace industry receives £2 billion investment

From: Department for Business, Innovation & Skills
First published: 18 March 2013
Part of: Industrial strategy

GOV.UK

Search

Departments Worldwide How government works Get involved
Policies Publications Consultations Statistics Announcements

Press release

Billion pound commitment to power UK auto sector to the future

From: Department for Business, Innovation & Skills and The Rt Hon Dr Vince Cable
First published: 12 July 2013
Part of: Industrial strategy

SMI MAS Council

Society of Maritime Industries

“Our activities follow our objectives of presenting members with business opportunities, assisting with research and innovation, lobbying government and NGOs to improve the business environment, facilitating network opportunities and providing marketing and other services.”

Chairman: Dan Hook, ASV Global

Frank Cotton, BAE Systems Naval Ships
David Etherington-Smith, EP Barrus
James Fanshawe, AutoNaut
Kevin Forshaw, National Oceanography Centre
Matthew Hart, Thales
Andy Horler, Lockheed Martin
Neil Hunt, Frazer-Nash Consultancy
Tim Kent, Lloyd's Register
Ryan Mowat, RS Aqua
Frederic Perdrix, Houlder
Chris Pontet, SCISYS
Anita Teo, Rolls-Royce
Stephen Turnock, Southampton University
Mary Vayou, BMT Group
Iain Vincent, Planet Ocean
Geraint West, Sonardyne International
Richard Westgarth, QinetiQ
Nigel Whybrow, Babcock International
Julian Woolley, BMT Cadence

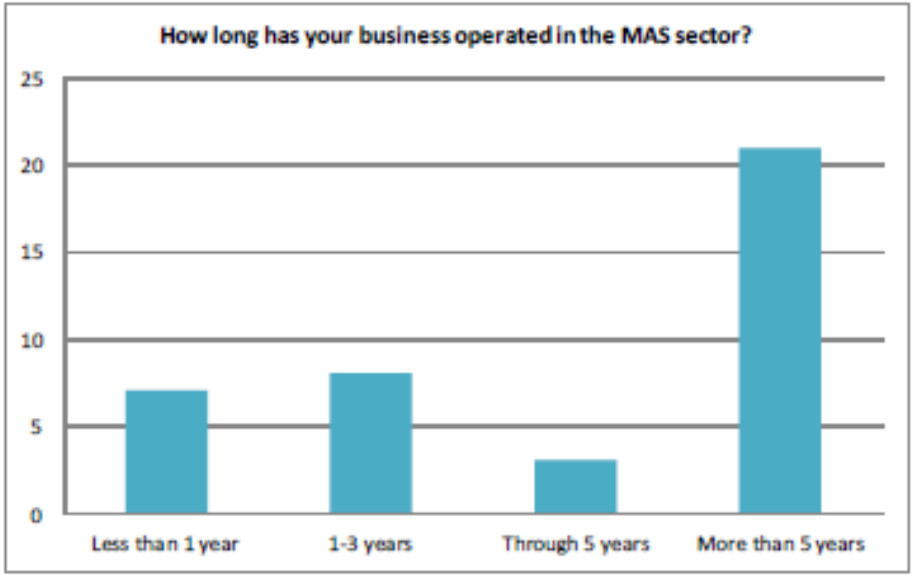
Council Director: John Murray, Society of Maritime Industries (SMI)

Action

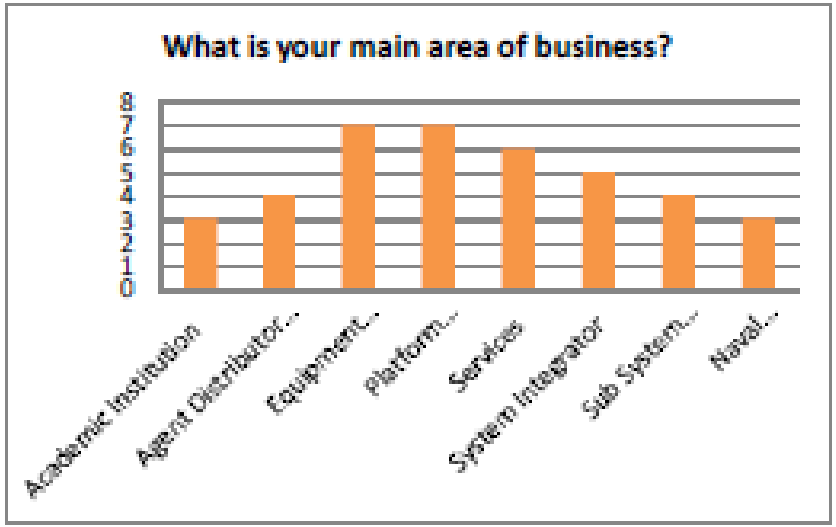
Establish a baseline. What is the industry now?

Identify a target. What could we be?

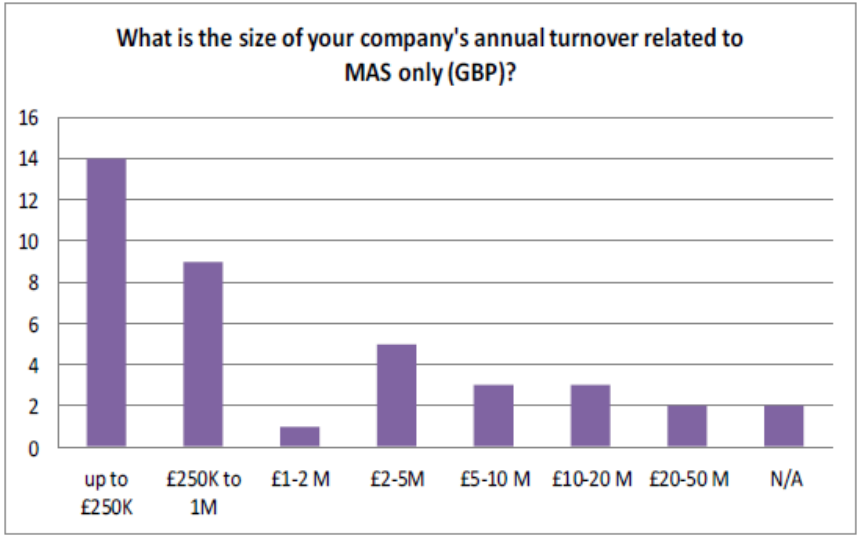
Plan actions to achieve it.



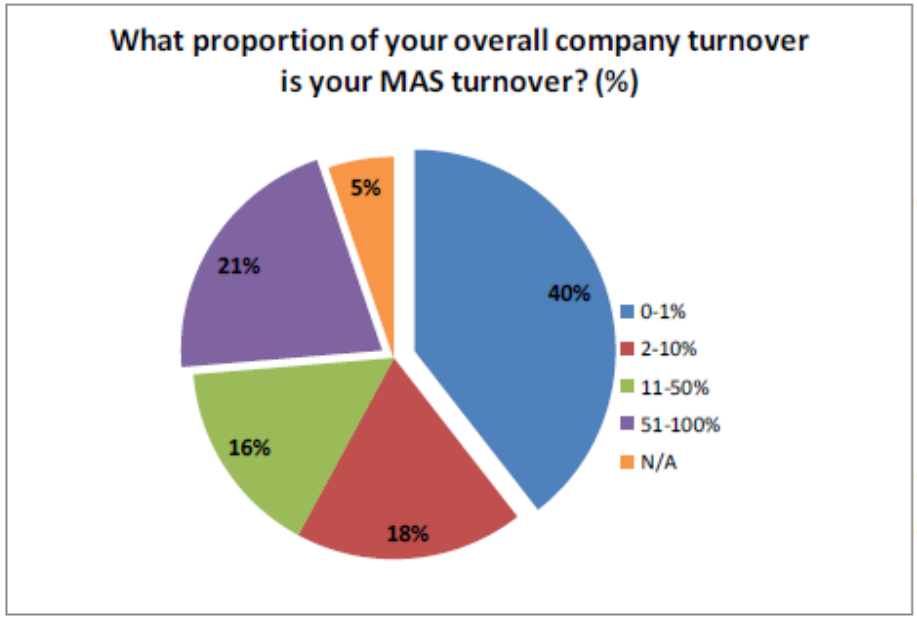
	No of Companies
Less than 1 year	7
1-3 years	8
Through 5 years	3
More than 5 years	21
	39



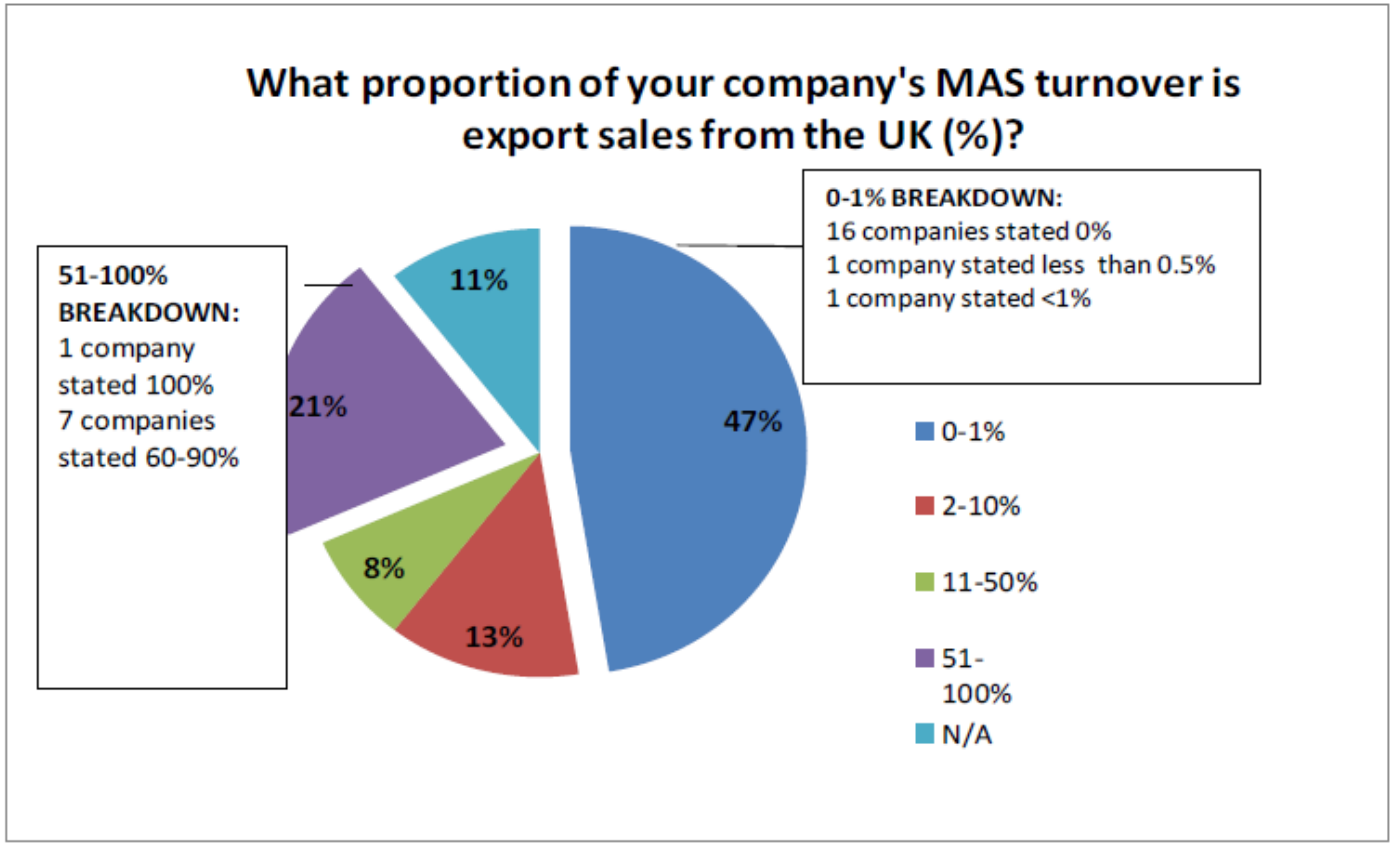
	No of Companies
Academic Institution	3
Agent Distributor (e.g. equipment supplier)	4
Equipment Manufacturer	7
Platform Manufacturer	7
Services	6
System Integrator	5
Sub System Manufacturer	4
Naval Architecture/Design	3
	39

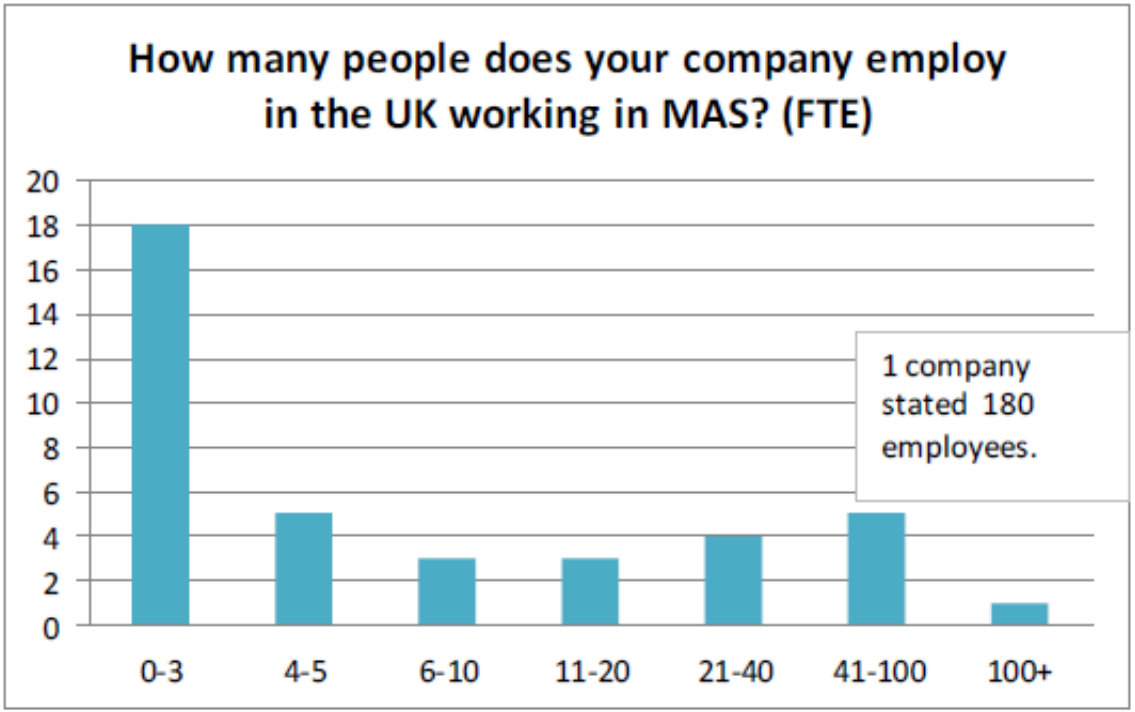


	No of Companies
up to £250K	14
£250K to 1M	9
£1-2 M	1
£2-5M	5
£5-10 M	3
£10-20 M	3
£20-50 M	2
N/A	2
	39

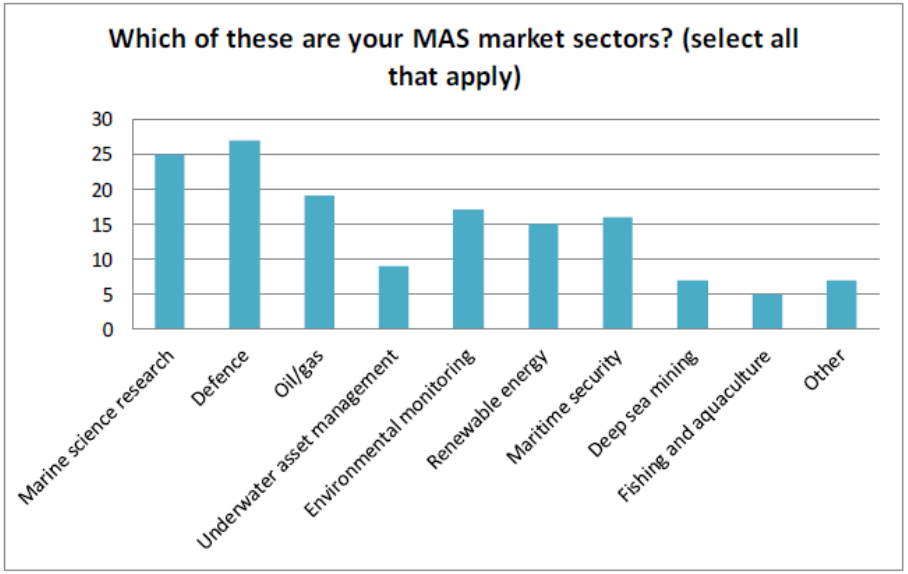


	No of Companies	
0-1%	15	(incl. negible)
2-10%	7	
11-50%	6	
51-100%	8	
N/A	2	
	38	
Varies too much to give a figure	(not incl.)	



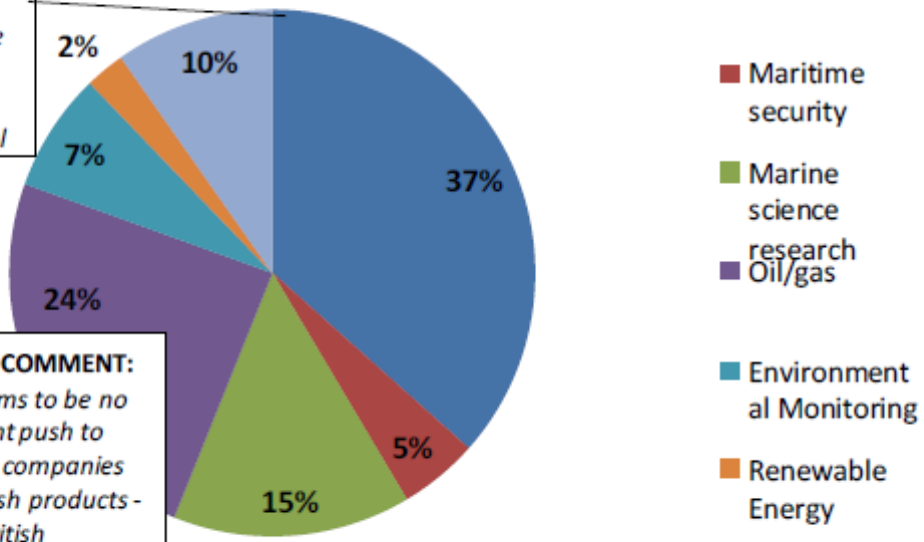


	No of Companies
0-3	18
4-5	5
6-10	3
11-20	3
21-40	4
41-100	5
100+	1
	39



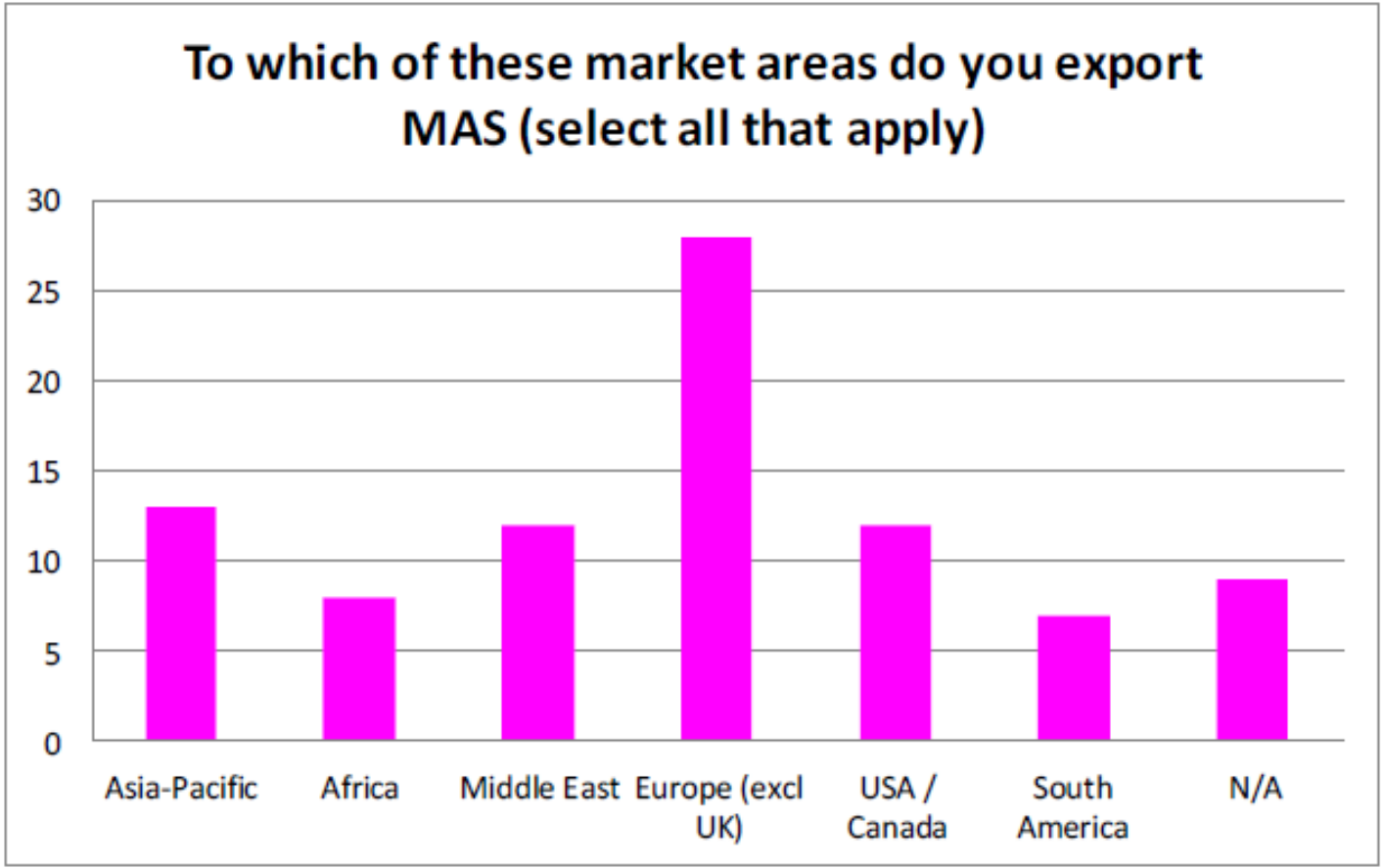
	No of Companies
Marine science research	25
Defence	27
Oil/gas	19
Underwater asset management	9
Environmental monitoring	17
Renewable energy	15
Maritime security	16
Deep sea mining	7
Fishing and aquaculture	5
Other	7

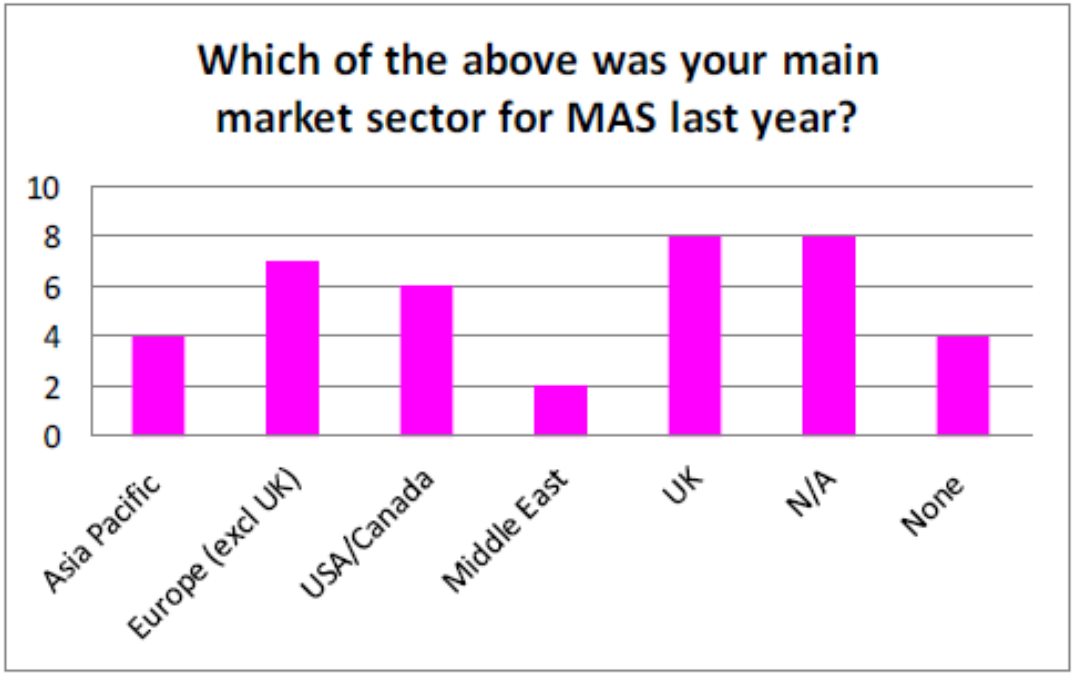
Which of the above was your main market sector?



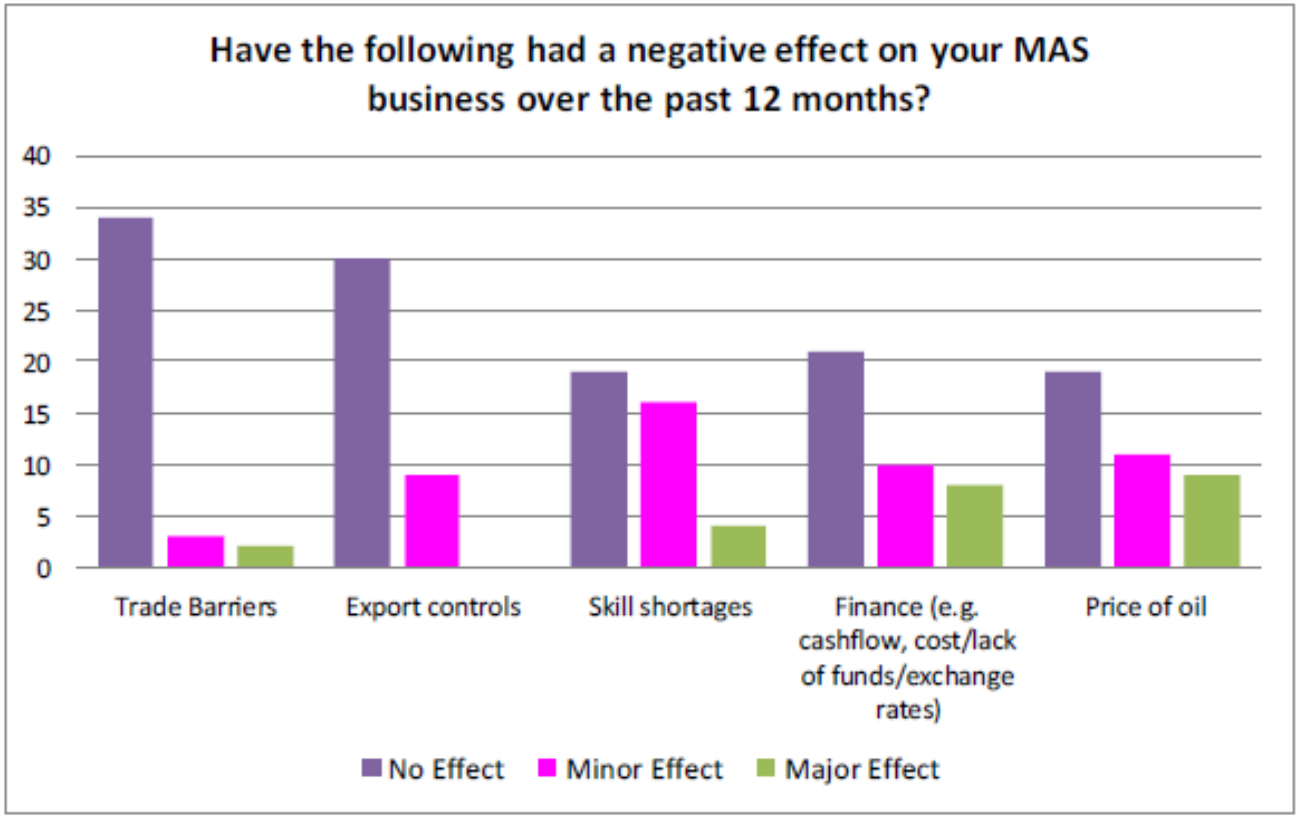
OTHER:
ICT Enterprise Solutions.
Fire alarm.
Meteorlogical
.

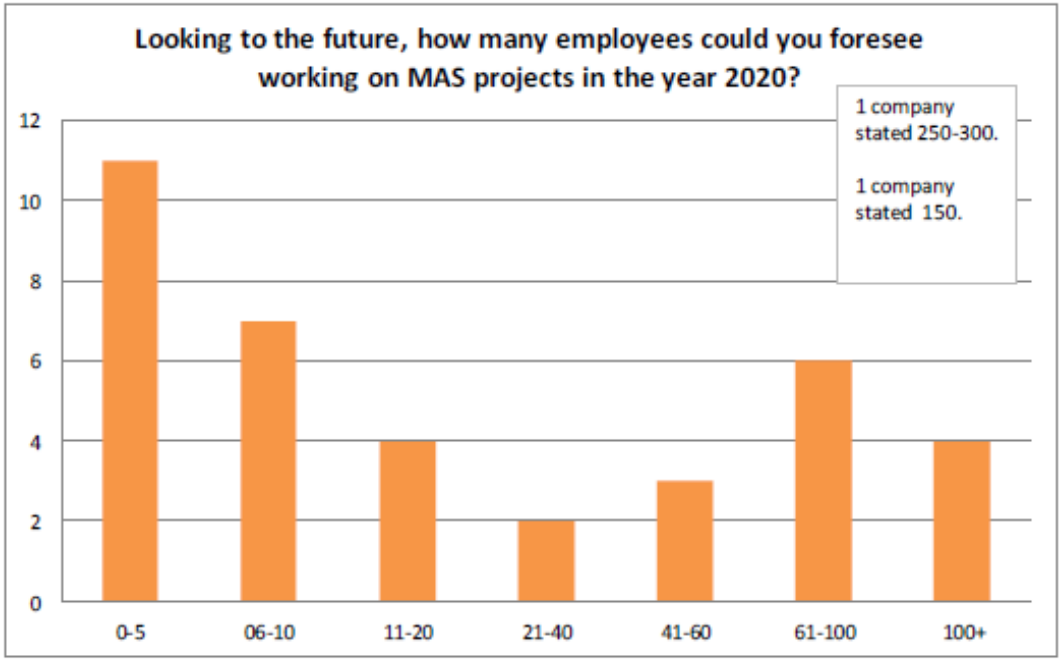
OIL & GAS COMMENT:
"There seems to be no government push to encourage companies to use British products - even for British windfarms."





	No of Companies
Asia Pacific	4
Europe (excl UK)	7
USA/Canada	6
Middle East	2
UK	8
N/A	8
None	4
	39





	No of Companies
0-5	11
06-10	7
11-20	4
21-40	2
41-60	3
61-100	6
100+	4
	37

Fig. 12 : Looking to the future, how many employees could you foresee working on MAS projects in the year 2020?

Summary

- 40 respondents. We know we are missing many of the ROV related companies.
- It will be repeated, improved and grown.
- Principally design, build and supply companies have responded.
- Annual Revenue of approximately £200m.
- Approximately 500 people employed directly in MAS.
- 1000+ employees by 2020.
- 2020 Revenue target of £500m+

Look at other countries

The global unmanned surface vehicle (USV) market is projected to grow from USD 437.57 Million in 2016 to USD 861.37 Million by 2021, at a CAGR of 14.51% during the forecast period from 2016 to 2021 – marketsandmarkets.com

The autonomous underwater vehicles (AUV) market is expected to grow from USD 211.8 Million in 2016 to USD 497.9 Million by 2022, at a CAGR of 15.31% during the forecast period. – marketsandmarkets.com

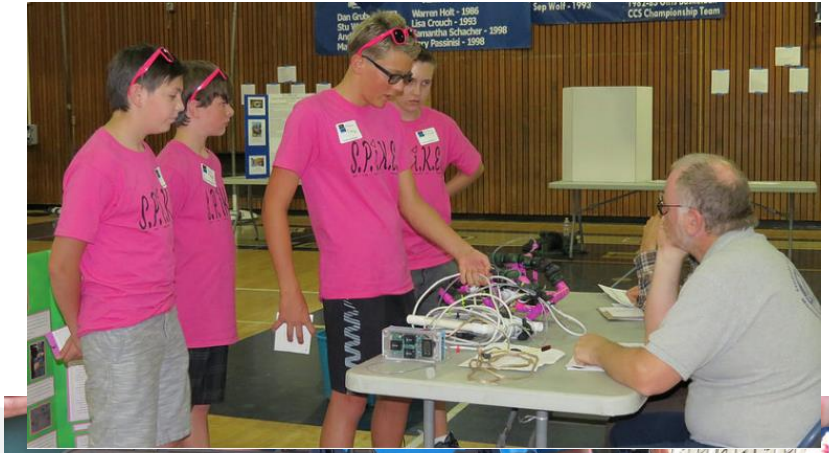
2014- 2019. ROV operational expenditure for the forecast period is expected to total $14.2 billion, an increase of nearly 19% over the previous five-year period.- Douglas Westwood

Worldwide MAS market ~ $3.5bn
UK – 8% of this.

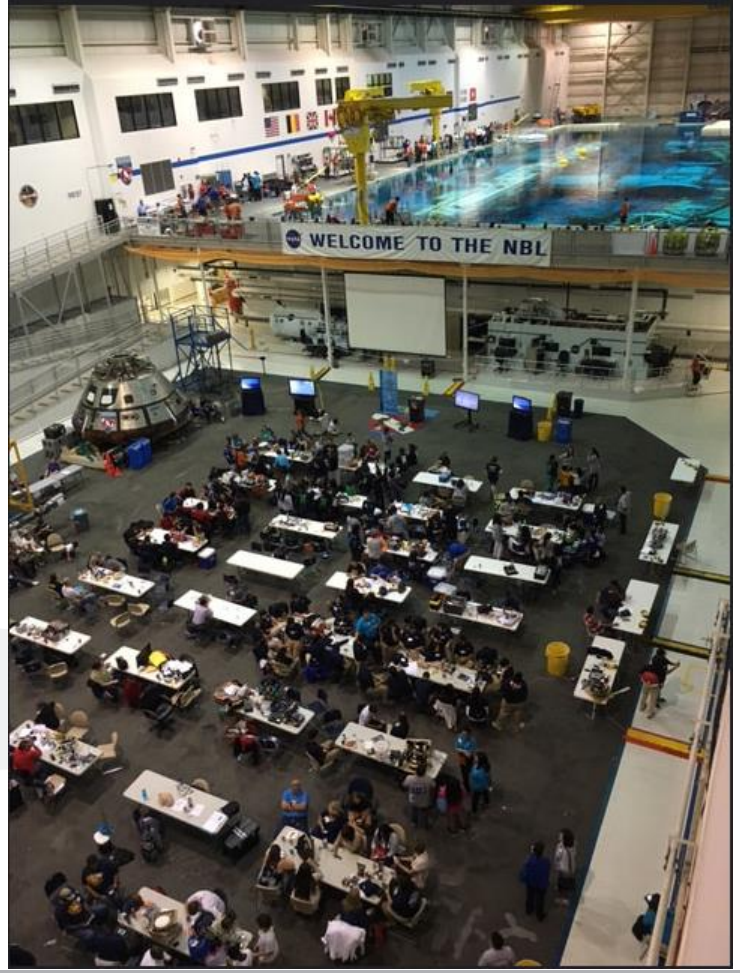

Maritime Autonomous Systems
MADE IN BRITAIN
2016
£200m +
500 People
50 Companies
SEA
BUILD
AIR
SCIENCE
SUBSEA
OFFSHORE ENERGY
EXPORT
LAND
DESIGN
COMMUNICATIONS
SENSORS
ENERGY
2020
£500m +
1000 People
60 Companies

Personal Note

- Many of us have been in this MAS industry for a while, some are new
- This is the most exciting time and this period will be remembered.
- The market is growing fast, faster than any of us can grow.
- Encourage collaboration. Share information. Form a UK MAS community and culture.
- I promise to pass on opportunities I find, lets all help each other.



MATE




ASV
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marine systems
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dan@asvglobal.com
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Innovate UK

Louise Mothersole

Innovate UK

European Union Funding for Research, Development and Innovation

EU Funding for Research Development and Innovation

Louise Mothersole
Horizon 2020 UK National Contact Point for Transport

Innovate UK

What is Horizon 2020?

- The biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020)
- The goal is to ensure Europe
  - produces world-class science,
  - removes barriers to innovation
  - makes it easier for the public and private sectors to work together in delivering innovation.
- Emphasis on excellent science, industrial leadership and tackling societal challenges

Post EU Referendum (1)

From Jo Johnson, Minister of State for Universities and Science:

"The referendum result has no immediate effect on those applying to or participating in Horizon 2020. UK researchers and businesses can continue to apply to the programme in the usual way. The future of UK access to European research and innovation funding will be a matter for future discussions. Government is determined to ensure that the UK continues to play a leading role in European and international research and innovation"

From European Commission:

"The Statement of 29 June of the Heads of State or Government of 27 Member States, as well as the Presidents of the European Council and the European Commission, confirms that until the UK leaves the EU, EU law continues to apply to and within the UK, both when it comes to rights and obligations. This includes the eligibility of UK legal entities to participate and receive funding in Horizon 2020 actions"

Post EU Referendum (2)

From European Commission, instructions to evaluators:

“Until the UK leaves the EU, EU law continues to apply to and within the UK, both when it comes to rights and obligations. This includes the eligibility of UK legal entities to participate and receive funding in Horizon 2020 actions. Experts should not evaluate proposals with UK participants any differently than before.”

From HM Government:

“the Treasury will underwrite funding for approved Horizon 2020 projects applied for before the UK leaves the European Union”

Post EU Referendum (2)

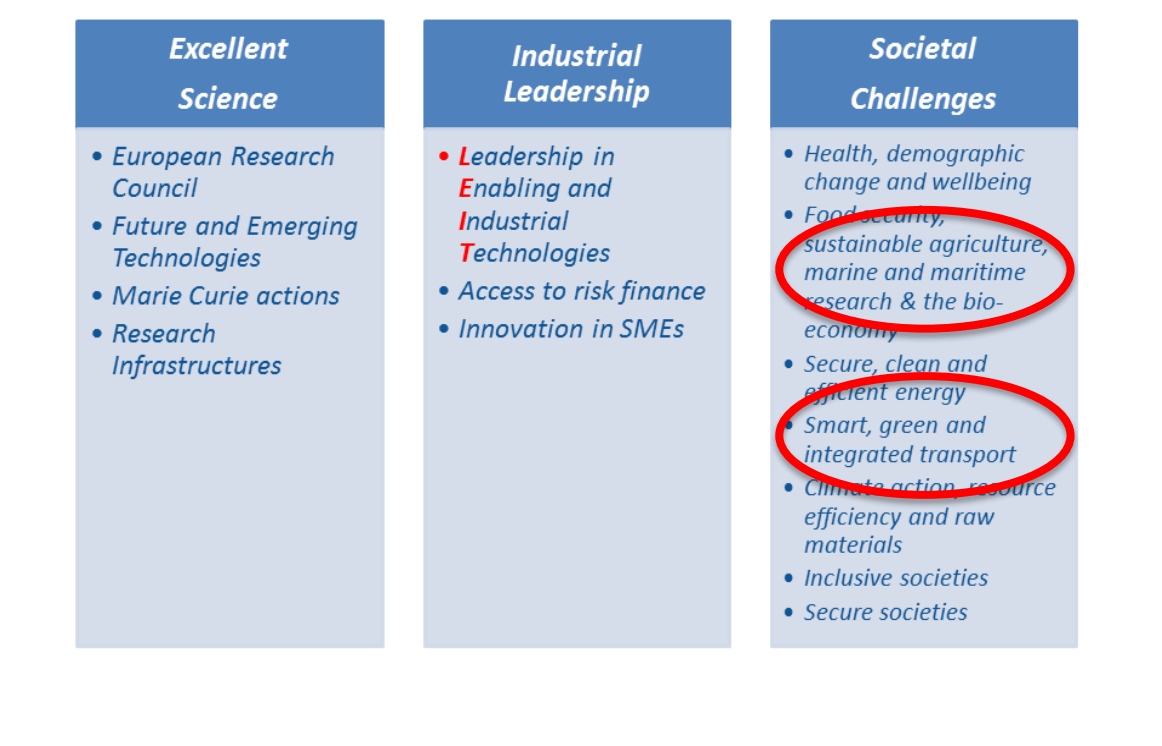
From European Commission, instructions to evaluators:

"Until the UK leaves the EU, EU law continues to apply to and within the UK, both when it comes to rights and obligations. This includes the eligibility of UK legal entities to participate and receive funding in Horizon 2020 actions. **Experts should not evaluate proposals with UK participants any differently than before**."

From HM Government:

"the Treasury will underwrite funding for approved Horizon 2020 projects **applied for** before the UK leaves the European Union"

Horizon 2020



Specific Programme Activities in Blue Growth (part of Food Security, Sustainable Agriculture & Forestry, Marine & Maritime and Inland Water Research and the Bioeconomy)

- Demonstrate the innovative potential of the Oceans by bringing technology to market
- Foster innovation and business opportunities for rural and coastal areas through new approaches and business models

Specific Programme Activities in Mobility for Growth (part of Smart, green and integrated transport)

- Resource efficient transport that respects the environment
- Better mobility, less congestion, more safety and security
- Global leadership for European transport industry
- Socio-economic and behavioural research and forward looking activities for policy making

2017 topics open 20th Sept (MG) and 4th Oct (BG)

- BG-02-2016-2017: High value-added specialised vessel concepts enabling more efficient servicing of emerging coastal and offshore activities
- BG-04-2017: Multi-use of the oceans marine space, offshore and near-shore: Enabling technologies
- BG-07-2017: Blue green innovation for clean coasts and seas

- MG-2.1-2017: Innovations in energy efficiency and emission control in waterborne transport
- MG-2.4-2017: Complex and value-added specialised vessels
- MG-7.3-2017: The Port of the future

Types of Action

Main types of action:

- Research and Innovation Action
- Innovation Action
- Coordination and Support Action
- SME Instrument (subject of separate presentation – ask me for details)

Research and Innovation Action (RIA)

- Complete definition of RIA can be found in Part D of the General Annexes of the General Work Programme
- Relatively low(ish) Technology Readiness Level (TRL)
  - EU definitions can be seen here
- Basic eligibility is at least three independent organisations from three different qualifying countries
  - Full list of eligible nations (not just European Member States) can be seen here
- Funding level for all participants is 100% of all Direct Costs plus additional 25% to cover Indirect Costs
- Template for proposals can be downloaded here

Innovation Action (IA)

- Complete definition of IA can be found in Part D of the General Annexes of the General Work Programme
- Relatively high(er) Technology Readiness Level (TRL)
  - EU definitions can be seen here
- Basic eligibility is at least three independent organisations from three different qualifying countries
  - Full list of eligible nations (not just European Member States) can be seen here
- Funding level for
  - all non-profit participants is 100% of all Direct Costs plus additional 25% to cover Indirect Costs
  - All for-profit participants is 70% of all Direct Costs plus additional 25% to cover Indirect Costs

Coordination and Support Action (CSA)

- Complete definition of CSA can be found in Part D of the General Annexes of the General Work Programme
- Activities generally include standardisation, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues, mutual learning exercises and studies, etc.
- Basic eligibility is one organisation from one qualifying country
  - Full list of eligible nations (not just European Member States) can be seen here
- Funding level for all participants is 100% of all Direct Costs plus additional 25% to cover Indirect Costs
- Template for proposals can be downloaded here

Evaluation

- Three Criteria each scored out of 5
  - Excellence (how good is the idea)
  - Impact (what will it achieve)
  - Quality and Efficiency of the Implementation
- Minimum threshold is 10 out of 15
- Proposals over threshold are ranked (within declared budget allocation) with the top ones funded until all budget is allocated
- For Innovation Actions, Impact is weighted 1.5 times when proposals are ranked

What is a National Contact Point (NCP)?

- Team of Government funded, UK based individuals (many, but not all, are part of Innovate UK)
- Free help, support, advice and guidance to any UK organisation considering participating in Horizon 2020
- One specifically for Transport: Louise Mothersole louise.mothersole@innovateuk.gov.uk
- One specifically for Blue Growth: Ian Holmes ian.holmes@innovateuk.gov.uk
- Full list with contact details of all UK NCPs

Any Questions?

Louise.Mothersole@innovateuk.gov.uk

Follow me on Twitter @NCP_Transport

Thank You

Innovate UK

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Tel: +44 (0)1793 442 700
Email: support@innovateuk.gov.uk
www.innovateuk.gov.uk

Innovate UK

Mr Andrew Tyrer

Innovate UK

Innovate UK Autonomy Roadmap and Funding

Robotics and Artificial Intelligence

Autonomy Roadmap and Funding

Nov'16

Innovate UK

Andrew Tyrer
Head of Enabling Capabilities, Emerging and Enabling Technologies

Innovate UK

- Innovate UK is the UK's Innovation Agency

- We work with companies, researchers and other partners to support innovative companies and sectors that will grow the UK economy - delivering new jobs and boosting productivity.

Innovation is difficult …… we're here to help
……. so please do talk to us.

up to
£13.1bn

return to the economy

7,600

organisations
supported

£ up to £7.30

of GVA for every
£1 invested

helped to
create
55,000
jobs

> 7 jobs created for every business invested in

Our 5-point plan

1. Turn scientific excellence into economic impact
2. Scale up high-potential businesses into highly-productive, mid-sized companies
3. Build innovation excellence throughout the UK
4. Develop Catapults at the heart of a high-impact national innovation network
5. Find new ways of funding innovation

The 4 Investment Criteria

- WW Market Size
  - What is the current and projected size, growth, competition?
- UK Capability to address it
  - Does the UK have a strong research base in the area, the skills, the business capacity?
- Timing and Impact
  - When and how big?
- Added-Value of an Innovate UK Programme
  - Why should the taxpayer support this project?

Sector Groups

Emerging and Enabling Technologies

Emerging Technologies, Space, Digital, Electronics, Photonics, Sensors, Robotics and Autonomous Systems, Design, Creative Economy, Open (former “Smart”/KTP)

Health and Life Sciences

Health, Healthcare, Agriculture & Food, Biosciences

Infrastructure Systems

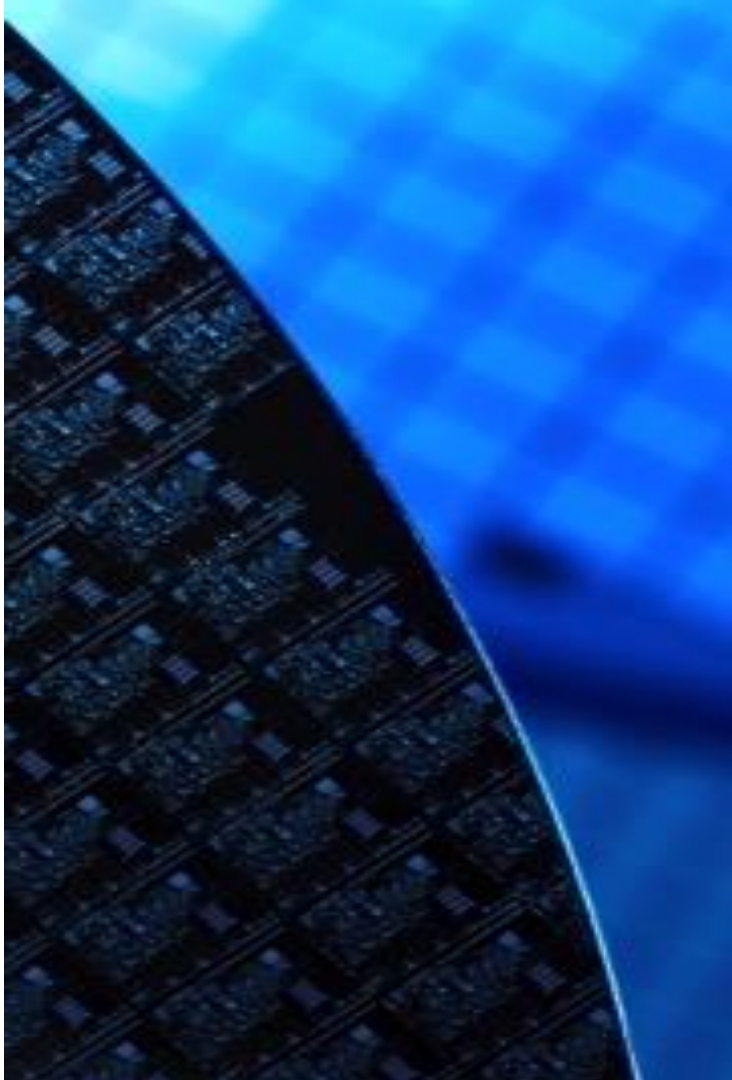
Energy, Transport, Future Cities, Urban Living

Manufacturing and Materials

High Value Manufacturing, Advanced Materials (including nanotechnology)

In Emerging & Enabling Technologies

- **Two Foundation Competitions**
- Additional competitions in 2016:
  - Quantum Technologies (Open)
  - **Robotics & Autonomous Systems (Closed)**
  - Compound Semiconductor Applications (Closed)
  - Others in planning
- Infrastructure:
  - CSIT IKC
  - Digital Catapult
  - Satellite Applications Catapult
  - Compound Semiconductors Catapult
  - Open Data Institute
  - Others in planning
- Entrepreneur missions: Space III
- Partnerships: UKSA/ESA



Live funding competitions (www.gov.uk)

- Funding competition: technology solutions for society in India
- SBRI funding competition: advanced nuclear manufacturing and materials
- Funding competition: urban innovation in Brazil
- SBRI funding competition: using technology to improve dermatology
- Improving care for stroke patients: apply for innovation funding
- Funding competition: manufacturing and materials round 2
- Managing sickness absence: funding available for innovative solutions
- CDE themed competition: the future of aviation security
- SBRI funding competition: vaccines for global epidemics - preclinical
- GP practices of the future: apply for business contracts
- Funding competition: cell & gene therapies industrial manufacture
- Funding competition: emerging & enabling technologies round 1
- Funding competition: innovation in health and life sciences round 1
- Funding competition: Agri-Tech Catalyst
- CDE themed competition: autonomy in hazardous scene assessment
- Reducing animal use in research: apply for innovation funding
- Funding competition: agri-food innovation in Turkey
- Knowledge Transfer Partnerships: what they are and how to apply
- Funding competition: Aerospace Technology Institute R&T programme

Emerging & Enabling Technologies

Foundation Competition Round 1

- **Competition brief: emerging & enabling technologies round 1**
- Competition opens Monday 3 October 2016
- Launch event for applicants London, Friday 30 September 2016
- Briefing events Manchester Monday 10 October 2016
- Belfast Friday 14 October 2016
- Cardiff Thursday 20 October 2016
- Bristol Wednesday 26 October 2016
- Glasgow Wednesday 26 October 2016
- Registration deadline Noon on Wednesday 30 November 2016
- Application deadline Noon on Wednesday 7 December 2016

- https://www.gov.uk/government/collections/innovation-grants-for-business-apply-for-funding#live-funding-competitions

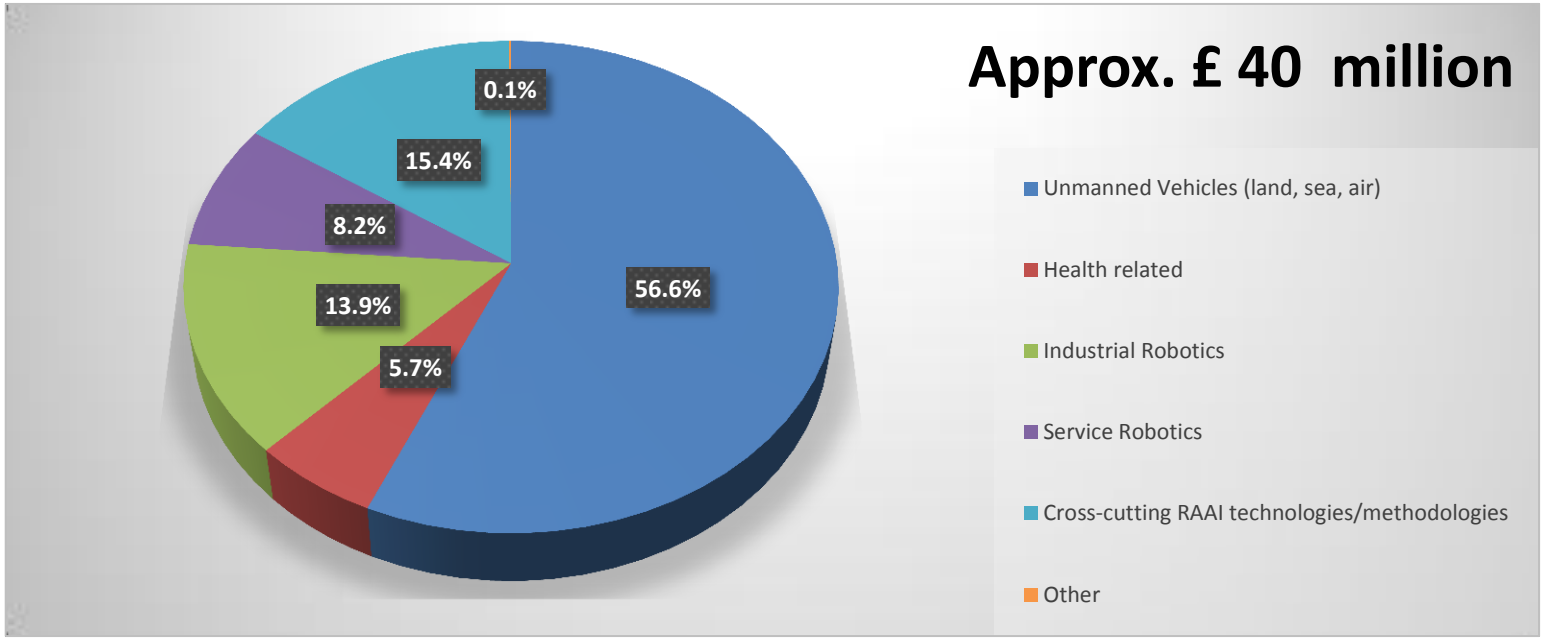
RAS applications competition Autumn 2016

- Innovate UK and EPSRC are to invest up to £5m in innovation projects to stimulate new partnerships across robotics and autonomous systems.
  - Competition opened Monday 18 July 2016
  - Application deadline Wednesday 26 October 2016
- The aim of this competition is to enable the development of successful RAS products, services or processes. Examples of the application areas for RAS include, but are not limited to: service robotics, demanding environments, agriculture, healthcare, mobile production, and logistics.
- The systems can be physical (for example, a next generation robot) or digital only (for example, an automated decision-making system).
- Developing RAS involves combining many complementary disciplines. These must work seamlessly together to achieve the necessary functionality.
- Proposals should show how they can speed up the development of RAS technologies towards demonstration and commercialisation.
- Range in size from total costs of £50,000 to £500,000.
- A business must lead the project. Projects with costs of £100,000 or above must be collaborative.

Innovate UK RAS related funding

- The Robotics & Autonomous Systems (RAS) is a broad area, with unclear boundaries
- Over £40m has been allocated since 2009 including co-funding
- Most of this funding allocation has been committed during since 2014, with focussed competitions that may involve RAS technology
  - 2013:
    - Developing novel concepts in autonomous service robotics £0.8m
  - 2014:
    - Flexible manufacturing £5.6m
    - Maritime Autonomous Systems £5m
  - 2015:
    - Next generation autonomous vehicles £15.4m
    - CHIRON Revolutionising Long Term Care Phase 2 £2m
    - Software Verification & Validation for Complex Systems £0.6m
  - 2016 - Currently in progress
    - Robotics & Autonomous Systems Applications £5m

RAS related Innovate UK funding 2009-16

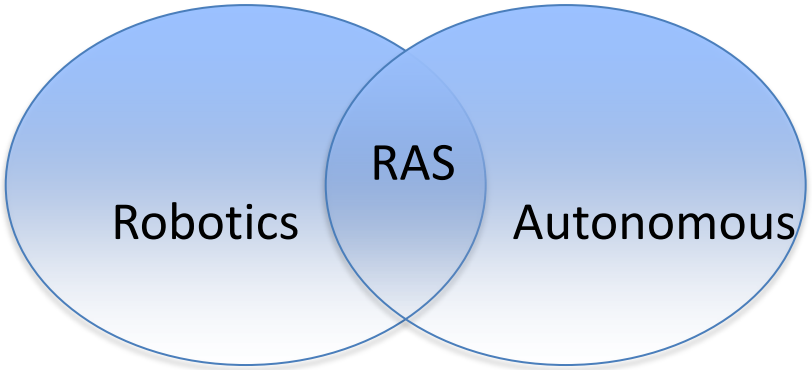


Maritime Autonomous Systems Projects

	Project
1	Unmanned Safe Maritime Operation Over The Horizon (USMOOTH)
2	Autonomous Surface/Sub-surface Survey System
3	Safe Intelligent Launch and Recovery Solution (SILARS)
4	Launch & Recovery of Multiple AUVs from an USV
5	Robust Machine Executable Collision Regulations at Sea
6	Pressure Tolerant Lithium Sulphur Battery for Marine Autonomous Systems
7	Autonomous Operation and Collision Avoidance
8	USV Environmental Efficiency

What is RAS?

- Robotics
  - Robotics is the branch of science and engineering & technology that deals with the design, construction, operation, and application of robots/robotic systems, which in turn are machines capable of carrying out a series of actions on behalf of humans.
- Autonomous systems
  - Broad view: systems that operate without a Human-in-the-Loop during the execution of their tasks
  - Narrow view: systems that can “learn” and thus create their own logic, situation awareness, planning capabilities and their “own” laws or logic



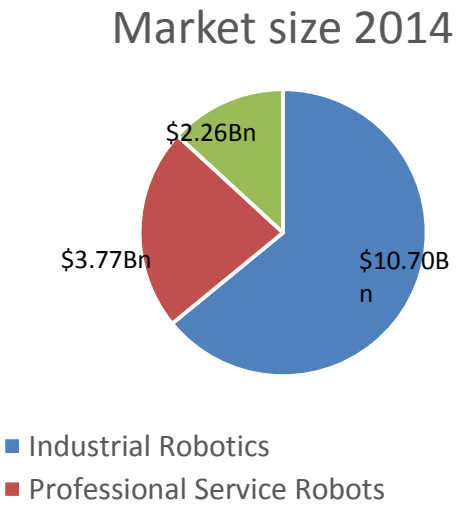
Current status of RAS

- Robotic systems are heavily used for repetitive industrial applications
  - Manufacturing
    - Automotive, packaging and process industries
    - Mainly in guarded and interlocked environments
    - 80% of cost is programming, guarding and H&S, 20% cost of the Robot
  - Also used in some Hazardous Environments
    - Nuclear, Deep Sea
    - Normally controlled directly by a human
- Autonomous Systems are mainly used in a virtual environment
  - High Frequency Trading, Chat Bot's
  - Autonomous Systems are not prevalent but are emerging
    - NEST, Dyson Vacuum, Military Applications (Drones, Missiles), DLR
    - Typified by ability to learn and make independent decisions

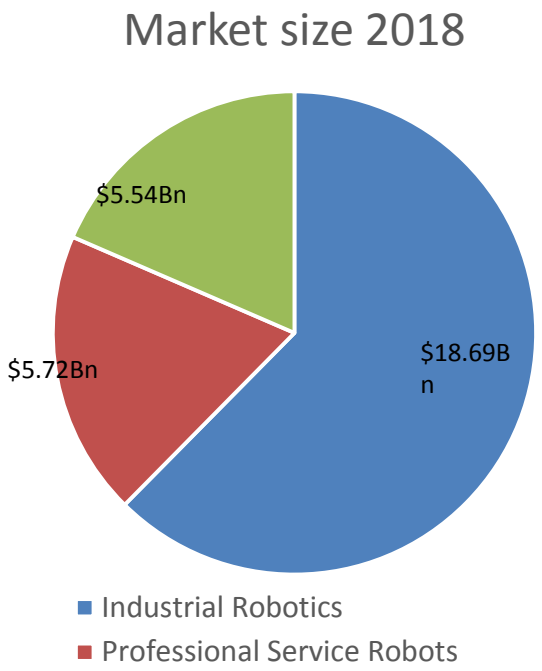
Future Opportunities in RAS

- RAS technologies are estimated to have a potential global economic impact of $1.9 - $6.4 trillion by 2025 and to impact UK sectors by £218 billion (15% of GVA)
- A whole new set of application areas are emerging where the UK can be at the forefront of technology development;
    - Demanding and hazardous areas
    - Assistive robots
    - Companion robots
    - Mobile production
- Need to develop core competences;
    - Soft solids handling technology; non-guarded environments; spatial awareness and management; power management; autonomy

Market Size 2014-2018



Total Market size $16.73BN



Total Market size $29.95BN

* All figures taken from The International Federation of Robotics market analysis and forecast reports

RAS 2020 strategy

- **Recommended the following next steps:**
- Invest further in the five RAS strategy strands: assets, challenges, coordination, clusters and skills
- Establish the means for funding agencies to formally work together
- Establish a RAS Leadership Council
- Further develop engagement with EU, Investors and UK/overseas corporate resources
- Consult more widely on potential Asset and cross sector Grand Challenges.
- Further develop dialogue with those involved in standards and regulation
- Extend outreach and public engagement activities to continue changing public perceptions.
- Articulate internationally to make businesses and investors aware that UK aims to be the best place to invest in taking RAS technologies to market.

For the UK to lead:

- Build a critical mass of expertise and equipment in:

Hardware	Software	Cross-cutting
Sensors, electronics, power management, valves, motors, haptics	Data, control, autonomy, machine learning, artificial intelligence	Integrating Hardware and Software, and broader capability: test, validation, security, cyber, legislative, standards, processes, missions, design, usability, ethics, user acceptance

- Take a lead in key areas;
  - Service Robotics (health, services, IoT etc.)
  - Demanding Environments (off-shore energy, chemicals, O&G)
  - Mobile Production (agriculture, power distribution, etc.)
- Understand the user environment
  - Cities, Farm, Factory, Home – we know well from our sectors
- Providing a higher level of integration across current activities
- See outputs of recent House of Commons science and technology committee on RAS http://bit.ly/2fNytPG

RAS Summary

Key points:

- UK is underinvested in use of robotics by industry – holding back national productivity - UK should use more industrial robots
- Some markets already well served, and developing:
  - Industrial Robots (HVM)
  - RPAS (HVM, ATI) and Satellites (SAC)
  - Autonomous Vehicles (TSC, NOC)
  - Nuclear (UK AEA)
- Supply of existing industrial robots mainly dominated by overseas companies (ABB, iRobot, Yaskawa Electric, Kawasaki Heavy Industries, KUKA)
- UK has potential to:
  - Increase sales to industrial robots supply chain
  - Develop and supply next generation robots (such as service robots)
  - Create a strong position in service robots supply chain (software, hardware etc.)
- Integrated UK programme proposed, including a UKRI funded facilities to realise this potential

Overall Summary

- There is significant change:
  - Brexit
  - Machinery of Government
  - UKRI
- But the opportunities for business remain significant
  - in global markets,
  - from advances in technology
- Collaboration is key for success
- We remain committed to help UK business

We can’t stop thinking about the future

Innovate UK

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Email: support@innovateuk.gov.uk
www.innovateuk.gov.uk

Networking Lunch

1 Hour Break

Commander Peter Pipkin

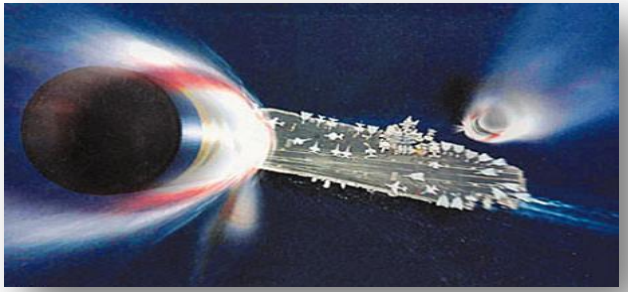
Royal Navy

Use of Autonomous Systems and Technologies in Defence Applications

Maritime Capability
From Concept to Reality

Commander Peter Pipkin

Maritime Capability



Rise of Autonomous Systems

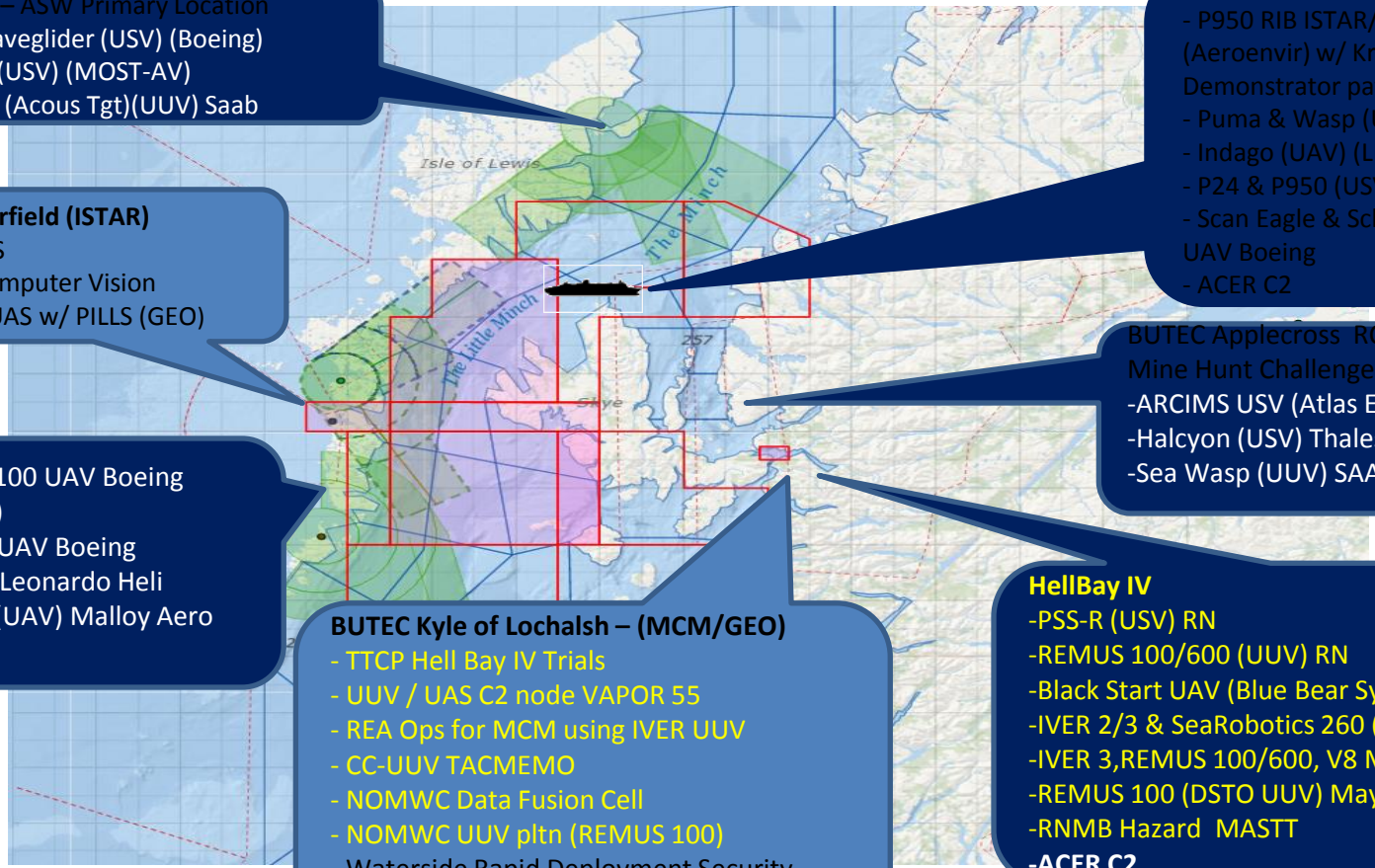
Bad guys have this stuff

Unmanned Warrior

“The Royal Navy will lead and win through the innovative and robust exploitation of Maritime Autonomous Systems.”

Aim: Through collaborative MAS Enterprise behaviours, collective effort and clear leadership; to demonstrate, trial and experiment with the tactical employment of unmanned and autonomous systems in the maritime and littoral environments in order to mature credible capability choices for the mainstream adoption of MAS.

Operating Locations



Stornoway – ASW Primary Location
- SHARC/waveglider (USV) (Boeing)
- Autonaut (USV) (MOST-AV)
- AUV 62AT (Acous Tgt)(UUV) Saab

Benbecula Airfield (ISTAR)
- NRQ-21 UAS
- Airborne Computer Vision
- Seahunter UAS w/ PILLS (GEO)

- Schiebel S-100 UAV Boeing (ASW/ISTAR)
- Scan Eagle UAV Boeing
- Solo (UAV) Leonardo Heli
- Hoverbike (UAV) Malloy Aero
- ACER C2

Northern River
- P950 RIB ISTAR/ASW (Aeroenvir) w/ KraitArray Demonstrator payload (SEA)
- Puma & Wasp (UAV) (BAE)
- Indago (UAV) (LM)
- P24 & P950 (USV)
- Scan Eagle & Schiebel S-100 UAV Boeing
- ACER C2

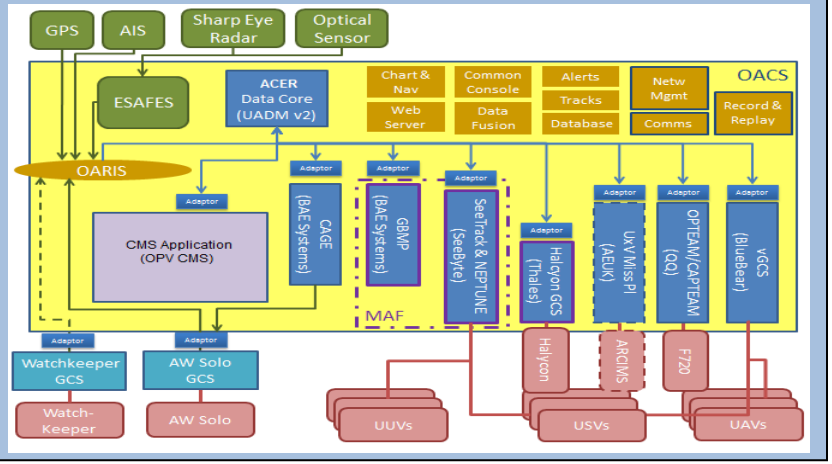
BUTEC Applecross RCB
Mine Hunt Challenge
-ARCIMS USV (Atlas Electronik)
-Halcyon (USV) Thales
-Sea Wasp (UUV) SAAB Seaeye

BUTEC Kyle of Lochalsh – (MCM/GEO)
- TTCP Hell Bay IV Trials
- UUV / UAS C2 node VAPOR 55
- REA Ops for MCM using IVER UUV
- CC-UUV TACMEMO
- NOMWC Data Fusion Cell
- NOMWC UUV pltn (REMUS 100)
- Waterside Rapid Deployment Security System (ASW)

HellBay IV
-PSS-R (USV) RN
-REMUS 100/600 (UUV) RN
-Black Start UAV (Blue Bear Sys)
-IVER 2/3 & SeaRobotics 260 (DRDC UUV)
-IVER 3,REMUS 100/600, V8 M500 (UUV)
-REMUS 100 (DSTO UUV) Maybe
-RNMB Hazard MASTT
-ACER C2

C2 - UXV Integration and Automation

Build once, use many times.

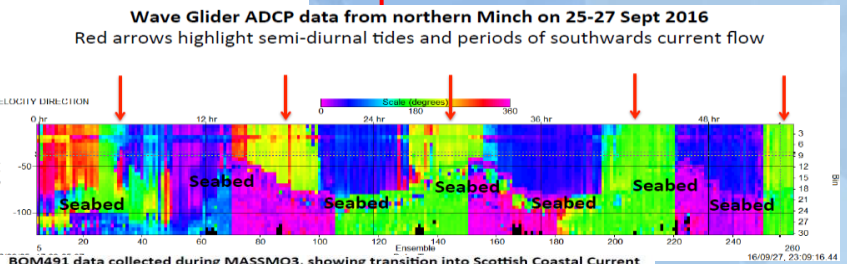


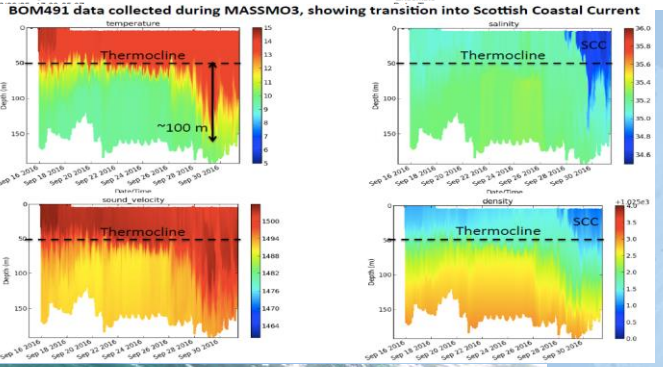
Serials conducted:

ISTAR serials
- Cardigan Bay
- Outer Hebrides
- The Minches

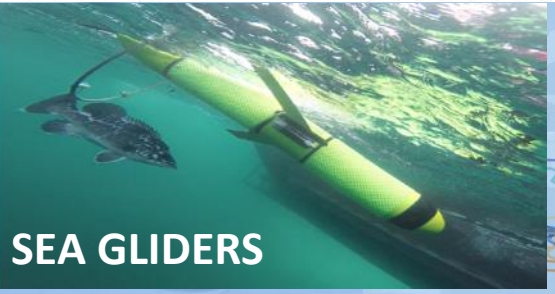
MCM serials
- BUTEC

Geographical Intelligence





SHARC

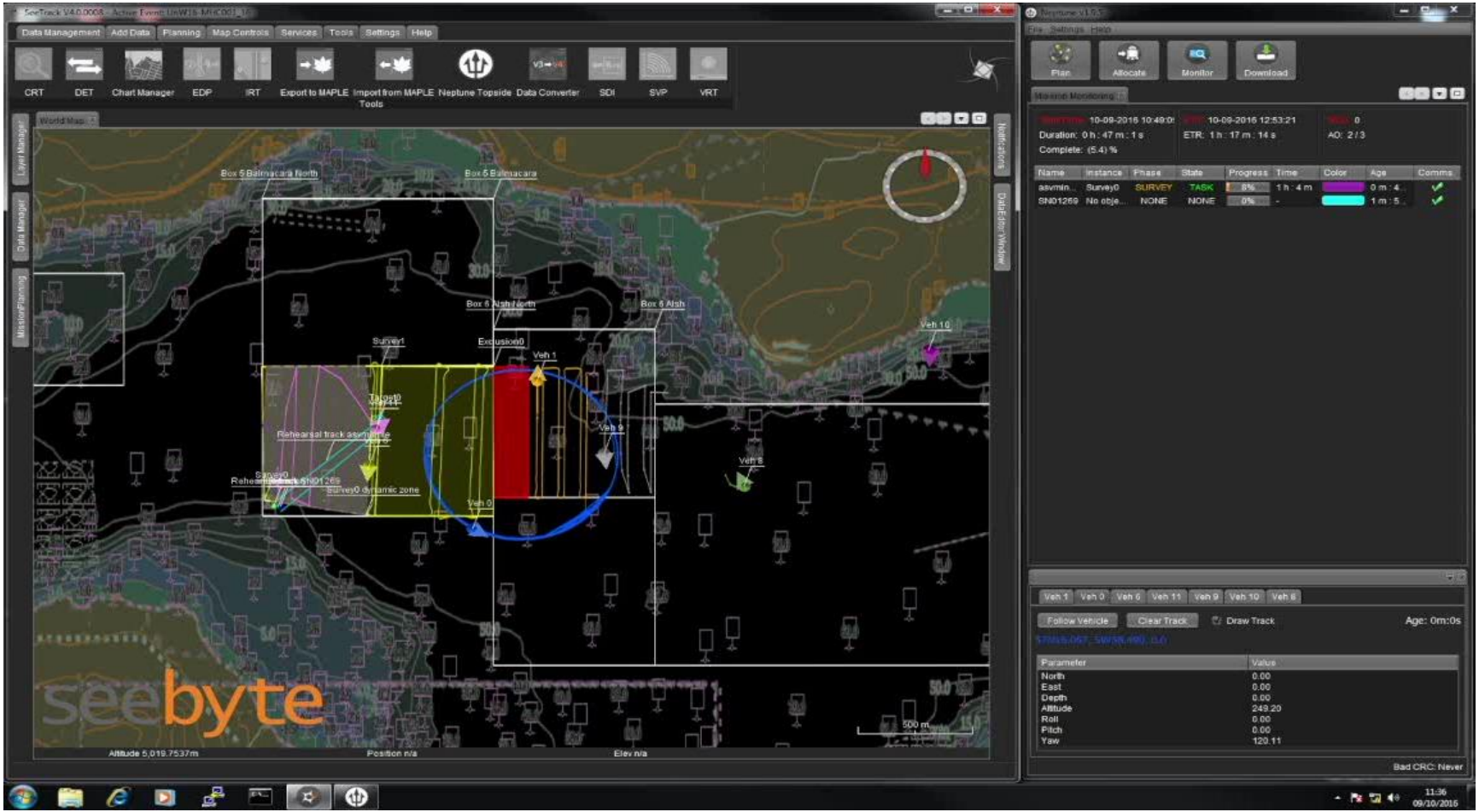


SEA GLIDERS

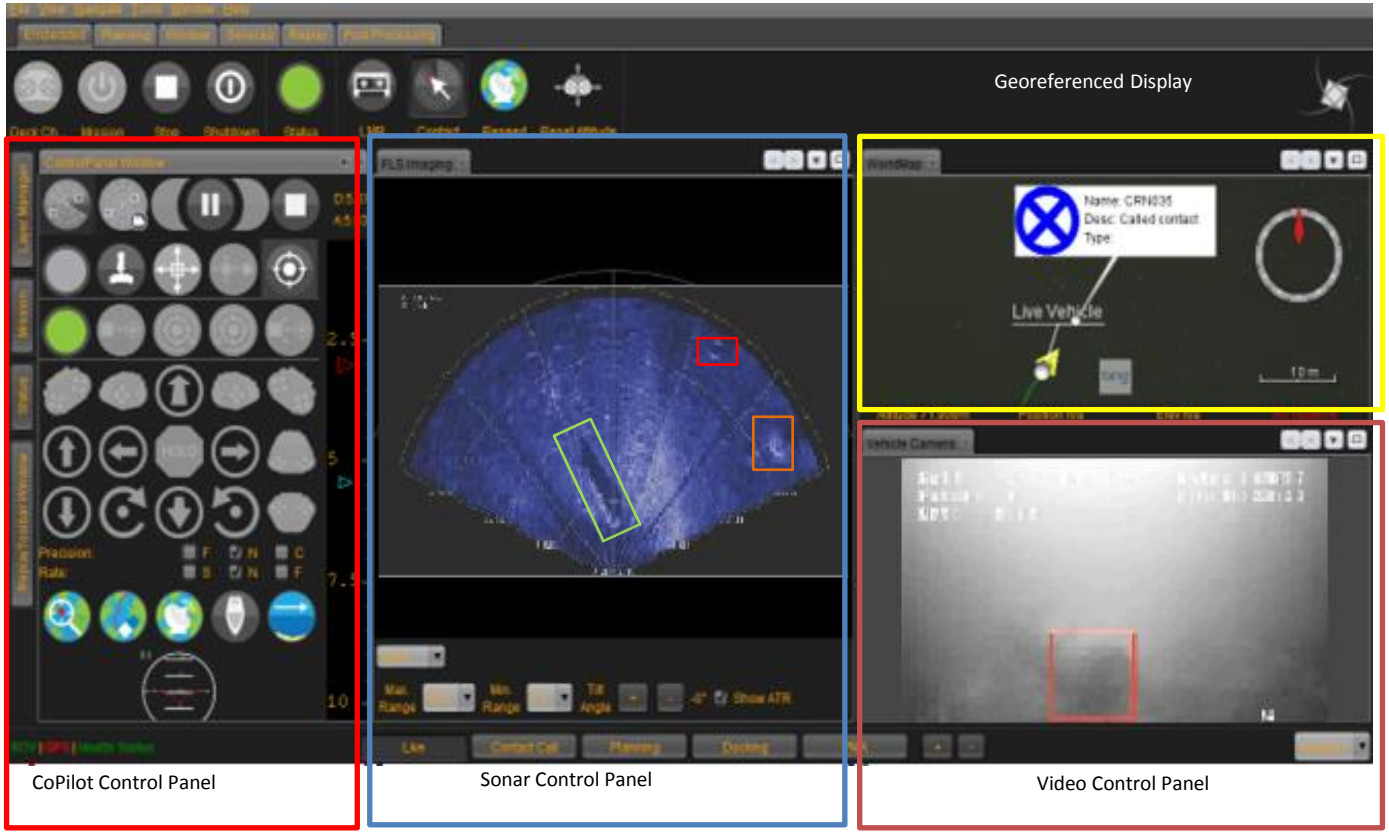
REMUS

Anti-Submarine Warfare (ASW)

MCM at BUTEC


Data Management
Add Data
Planning
Map Controls
Services
Tools
Settings
Help
CRT
DET
Chart Manager
EDP
IRT
Export to MAPLE
Import from MAPLE
Neptune Topside
Data Converter
SDI
SVP
VRT
Box 5 Balmaceara North
Box 5 Balmaceara
Box 6 Alish North
Box 6 Alish
Survey1
Exclusion0
Veh 1
Veh 10
Veh 9
Veh 8
Veh 0
Rehearsal track assumptive
Survey0 dynamic zone
seebyte
Altitude 5,019.7537m
Position n/a
Elev n/a
Plan
Allocate
Monitor
Download
Duration: 0 h : 47 m : 1 s
Complete: (5.4) %
10-09-2015 12:53:21
ETR: 1 h : 17 m : 14 s
AO: 2 / 3
Follow Vehicle
Clear Track
Draw Track
Age: 0m:0s
Parameter
Value
North 0.00
East 0.00
Depth 0.00
Altitude 249.20
Roll 0.00
Pitch 0.00
Yaw 120.11
Bad CRC: Never

MCM at BUTEC



Autonomy Developed

- Waypoint navigation
- Sonar ATR
- Video ATR
- Target homing

ISTAR – Radar & Electro Optic

VIDAR

Exploiting Innovation in the Air

From this

High Cost
Resource Intensive
Bespoke UK Solutions

Through this

Operational Concept Demonstration of current platforms to inform……

To this

Investment in high persistence, lower cost of ownership capabilities

Working with UK Industry to develop exportable solutions to a global requirement

Force Development Capability Plans

Mine Countermeasures & Hydrographic Capability

- Offboard systems
- Non-complex mothership

Type 26 Global Combat Ship

- Versatile Flightdeck
- Modular Mission Bay

Anti Submarine Warfare Vision

- Manned & unmanned systems
- Networked
- Big Data

Adaptability – Mission Modules

- NATO interface standards
- Agility
- Force Multiplier

“The Royal Navy will lead and win through the innovative and robust exploitation of Maritime Autonomous Systems.”

Commander Peter Pipkin

Fleet Robotics Officer
Navymarcap-sccs@mod.uk

Mr Simon Cheeseman

Offshore Renewable Energy Catapult

Marine Autonomous Systems Helping Mix Water and Electricity

CATAPULT
Offshore Renewable Energy

Marine Autonomy & Technology Showcase

Mixing Water and Electricity

Simon Cheeseman

Wave & Tidal sector Specialist

16 November 2016

Agenda

1. Offshore Renewables – Wind, Tidal and Wave Energy

2. Introduction to the Offshore Renewable Energy Catapult
   - ORE Catapult Impact (You Tube clip)
   - Our skills and capabilities

3. AUV support across the project life cycle
   - Ste investigation
   - Installation
   - Operations & Maintenance
   - Disposal

4. Summary

5. Questions

Offshore Renewables

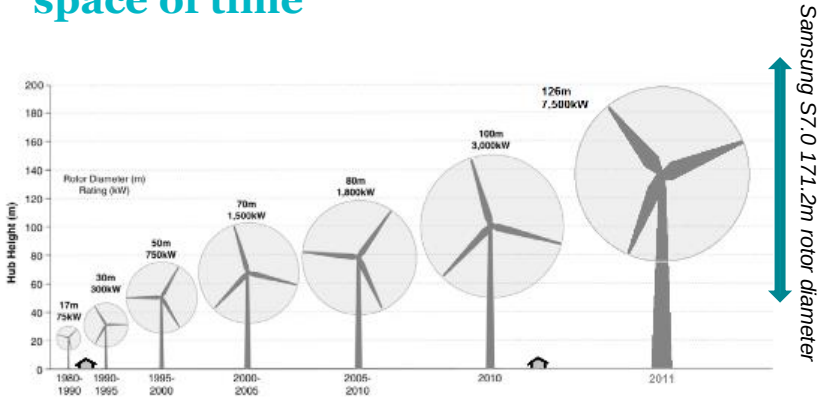
Wind, Tidal and Wave

Offshore Renewables - The Size of the Prize

- UK has a large natural energy resource comprising offshore wind, wave, tidal energy sources. This resource is free, emits zero carbon, is secure, and is largely predictable
- The Renewable Energy Association (REA) predicts that meeting the UK's mandatory target of producing 15 per cent of its energy from renewable sources by 2020 would result in annual revenues across the sector rising from £12.5bn currently to £50bn by the end of the decade
- **Offshore Wind**: The UK already has the most Offshore Wind installations of any country
- **Wave & Tidal**: The UK is currently the global leader in marine energy, with around 10MW of wave and tidal stream devices being tested in UK waters, more than the rest of the world combined. The UK currently leads the way in the development and testing of wave and tidal stream technology.

The Challenges

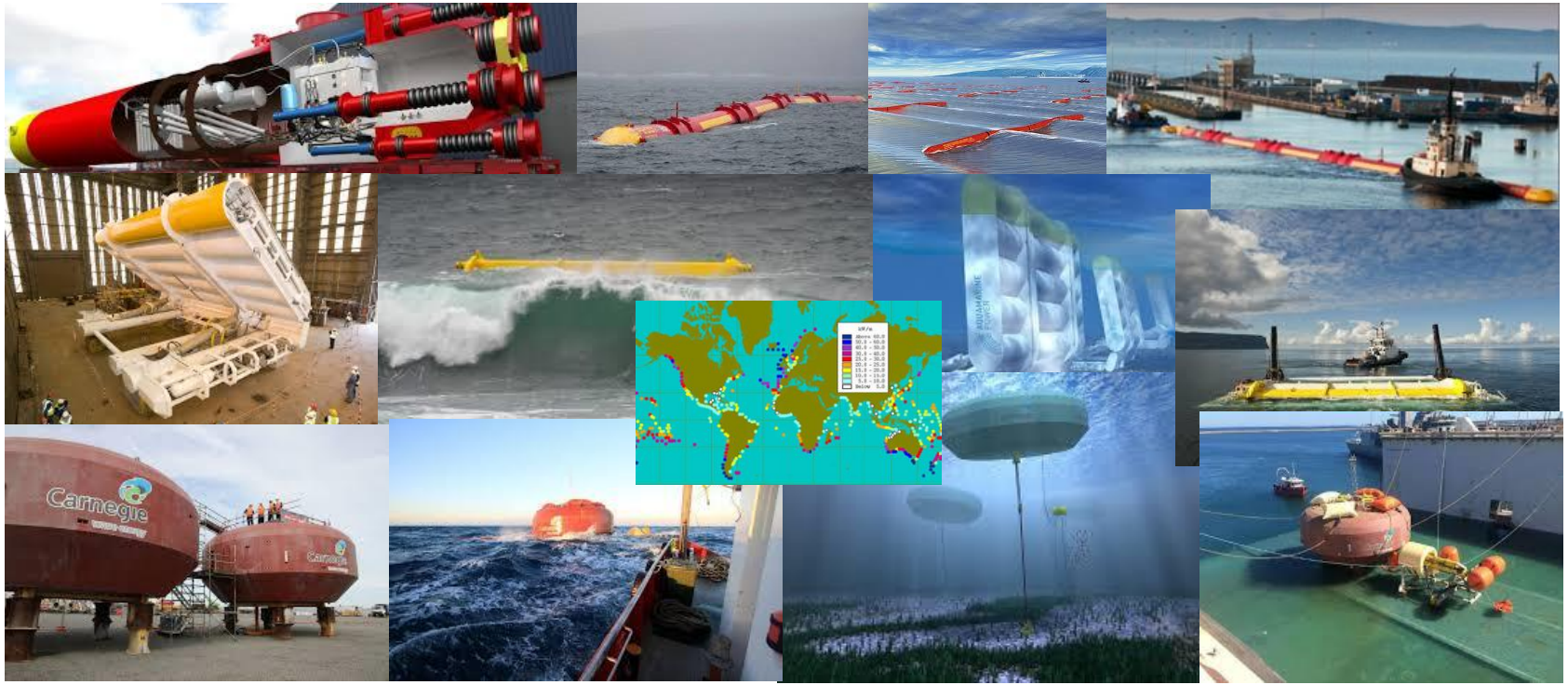
State of the art technology is taking a large leap in a short space of time



Images: Vestas V164 8MW and the Samsung S7.0 prototypes

Tidal Energy

Wave Devices



Introduction to ORE Catapult

Offshore Renewable Energy Catapult

Advice, collaboration, design, industrial research, testing

Assets

Skills

Offshore Renewable Energy Catapult

Our Delivery

Our Knowledge Areas

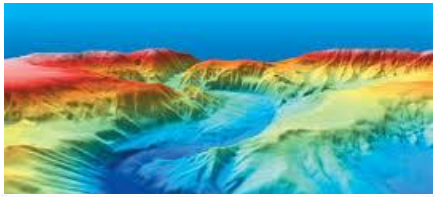
- We focus on 6 Knowledge Areas
- Key areas to drive technology innovation to lower the cost of offshore renewable energy

AUV support across a project lifecycle

AUVs – Support to Site Investigation

- Environmental Impact Assessment
  - Environmental data collection
  - Resource analysis
    - Wave height, tidal velocity, turbidity, salinity, temperature

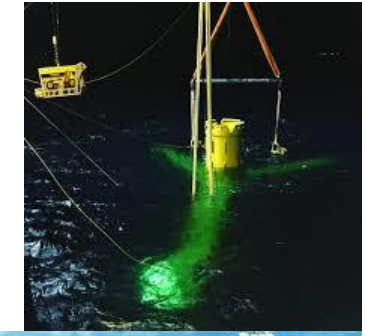
- Seabed survey
  - Topography
  - Obstructions
  - Cable routes
  - Foundation positions



AUVs – Support to Installation

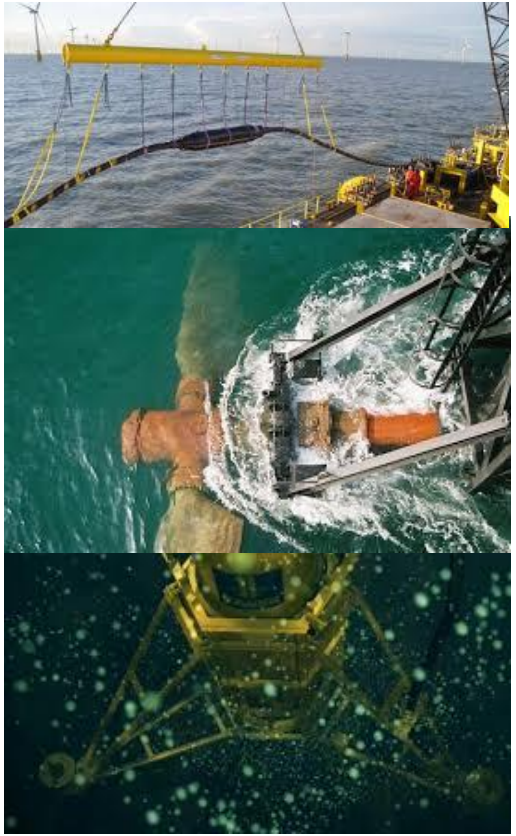
- Eyes on
- Light weight lift and handling operations

- Concerns generally:
  - Power (battery technology) – options for seabed garage/charging?
  - Station keeping in high tidal flows
  - Payload capability



AUVs – Support to Operations & Maintenance

- Asset surveillance
  - Seabed cabling stability
  - Foundations/scour
  - Fatigue analysis - imaging
  - Tidal turbine blade erosion/damage
  - Marine growth monitoring
    - (and cleaning - tooling ports?)
  - Security
    - Anchor drag
    - Sensors, marker buoys
    - Communications relay (with ASV)



AUVs – Support to Disposal

- Eyes on:
  - recording for record keeping
  - monitoring drifting debris
  - cleared site monitoring

Summary

Summary

Pros	Cons
Potential wide utility in ORE	Battery life
Does the dull, dangerous, repetitive	Performance in high tidal flow
Fire and forget from the shore (no mother ship)	No umbilical cable (safety chain)
Disposable asset?	Limited mechanical power
Variety of vehicle types – gliders, sledges, vessels	
Payload capability	

Way ahead: *We are interested in carrying out a more detailed comparative analysis of capability, cost, and service provision options*

Contact us

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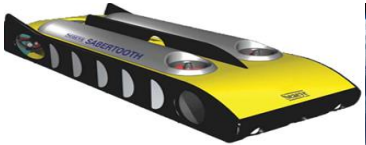
F +44 (0)1670 359 666

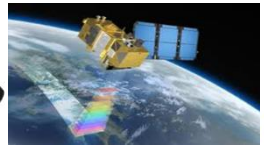
info@ore.catapult.org.uk
ore.catapult.org.uk

Peter Collinson, Joe Little & Alastair Fox

BP

Use of Marine Autonomous Systems and Technologies for the Oil and Gas Industry



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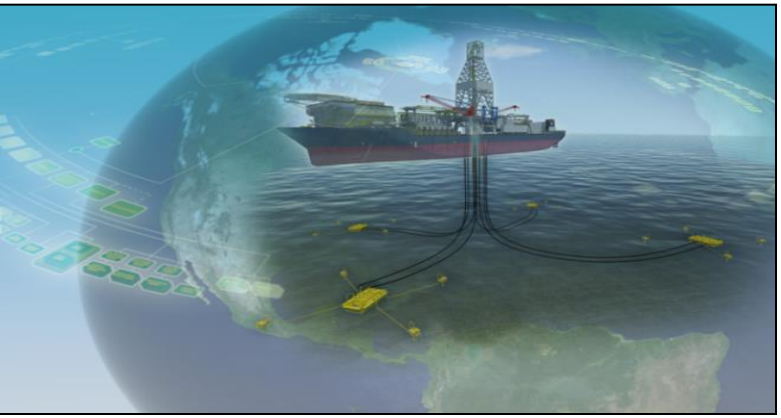
Peter Collinson, Joe Little and Al Fox
BP International Ltd.

The oil and gas business environment

- The reduced oil price has produced a shock to the industry
- O&G companies are still re-basing themselves in the financial environment
- All options to increase efficiency, profitability and survivability are being examined
- Relevant not only to O&G operators but also the key players who provide essential support services

Two main areas of opportunity for marine autonomous systems



Subsea production - inspection

- Significant capital expenditure.
- High reliability needed.
- Scope for efficiency through Marine Autonomous Systems (MAS).

Environmental & regulatory

- Increasing legislation.
- Improved understanding of environmental ‘baseline’.
- MAS to deliver regulatory compliance tasks (e.g. ‘in-perpetuity’ monitoring).

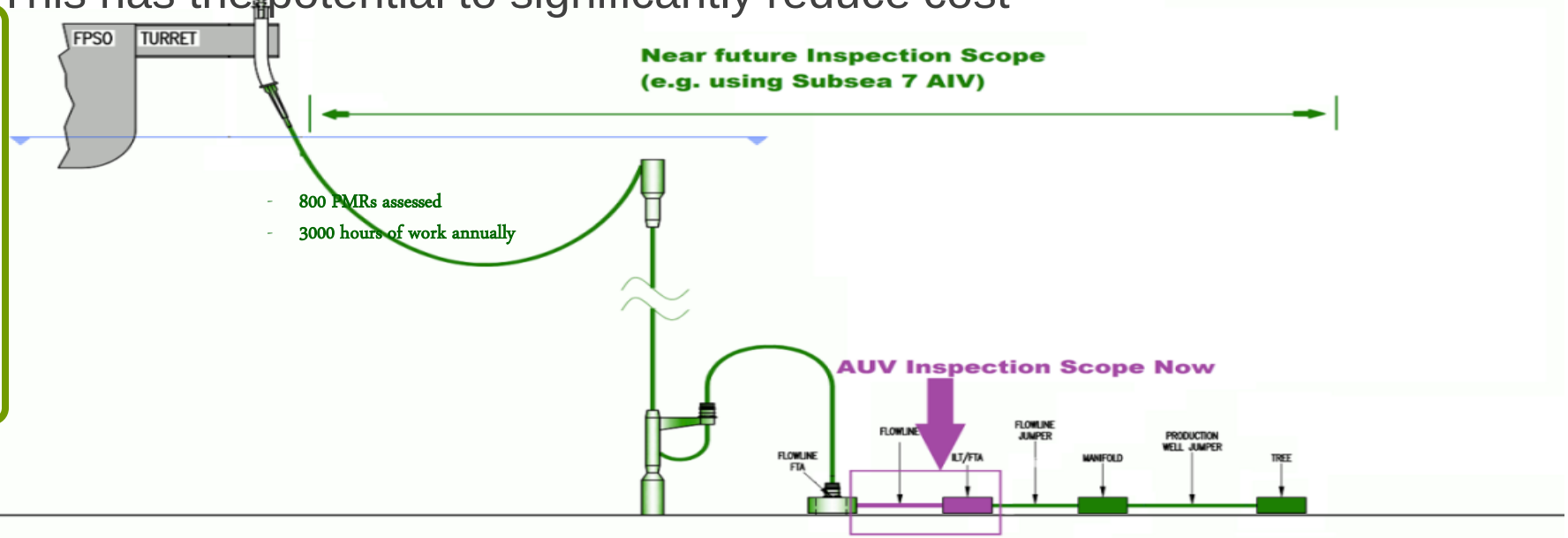
Key issues for the use of MAS

- Subsea (infrastructure) inspection
  - A lot of activity SUBSEA = $$$.
  - Understanding the infrastructure failure modes – more precisely.
  - Knowing what DATA is required – more precisely.
  - Focus on the DATA AND ANALYTICS – not so much hardware and logistics.
  - Cultural change.
- Environmental
  - Business and safety cases
  - What will the future look like? Can we continue to use ‘operations’ ship time?
  - Data, data, data – transparency and timeliness to inform decision making for business, investment community and regulatory audiences.
  - Cultural change.

Use case for subsea inspection

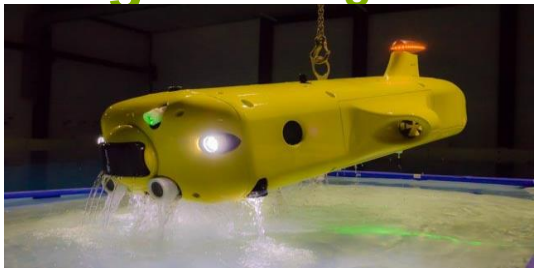
- Analysis based on current inspection plan+, 39 out of 140 days (per annum) could be moved to AUVs (28% of inspection work share)
- This has the potential to significantly reduce cost

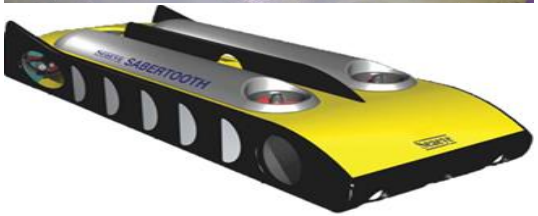
Opportunity



The approach…

Large and high cost





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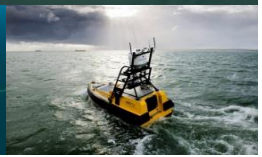
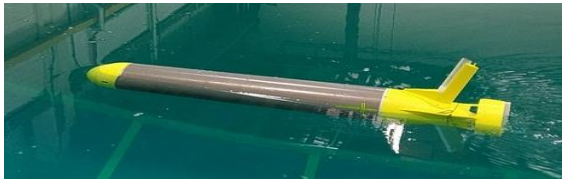
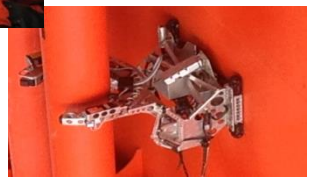
Small and low cost



Selected project activity in 2016

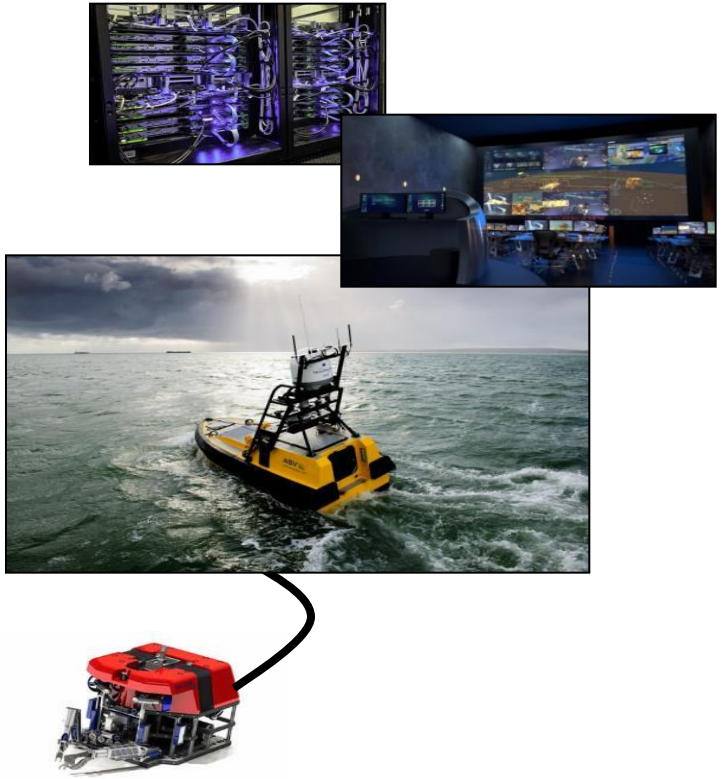
- **Micro AUV development:** Ultra low cost, small inspection vehicle for pipeline monitoring, environmental monitoring and crisis response.
- **Autonomous Surface Vehicle (ASV):** Persistent and low cost, data gathering (PAM, Metocean, visual) and monitoring platform.
- **Micro ROV/Crawlers:** Mooring chain inspections, diver replacement work and riser inspection.





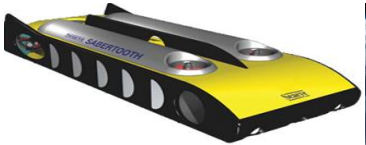
Where do we want to get to?

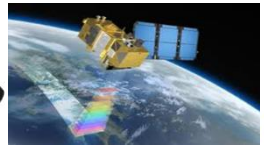
- We want safe, reliable, fit for purpose systems.
- Focus on Data NOT Activity.
- Obtain only the data we need when we need it.
- Use low risk / low cost methods to obtain it.
- Drive out risk and cost and deliver new agile operating model.



Summary

- We have **STARTED** the ‘journey’, there is much to play for.
- We need to change the paradigm from **ACTIVITY (logistics) UTILISATION to DATA FOCUS.**
- There is a significant prize in cost efficiency, data quality and **RISK REDUCTION.**
- We are still **LEARNING** and exploring how these new systems will integrate/replace existing ways of how we do things.



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Afternoon Refreshments

30 Minute Break

Discussion Sessions

- Engaging with NOC Christine Sams and Sofia Alexiou NOC
- South Coast Marine Cluster Mr Kevin Forshaw NOC Amanda Beable HCC
- Funding in General Andrew Tyrer and Louise Mothersole Innovate UK

Sessions will operate on a 30 minute rotation enabling all to attend each session

Session Close

Thank You