



Fugro Marine Wind farm Investigation & Foundation Design

Gary Li – Regional GeoConsulting Manager (APAC)

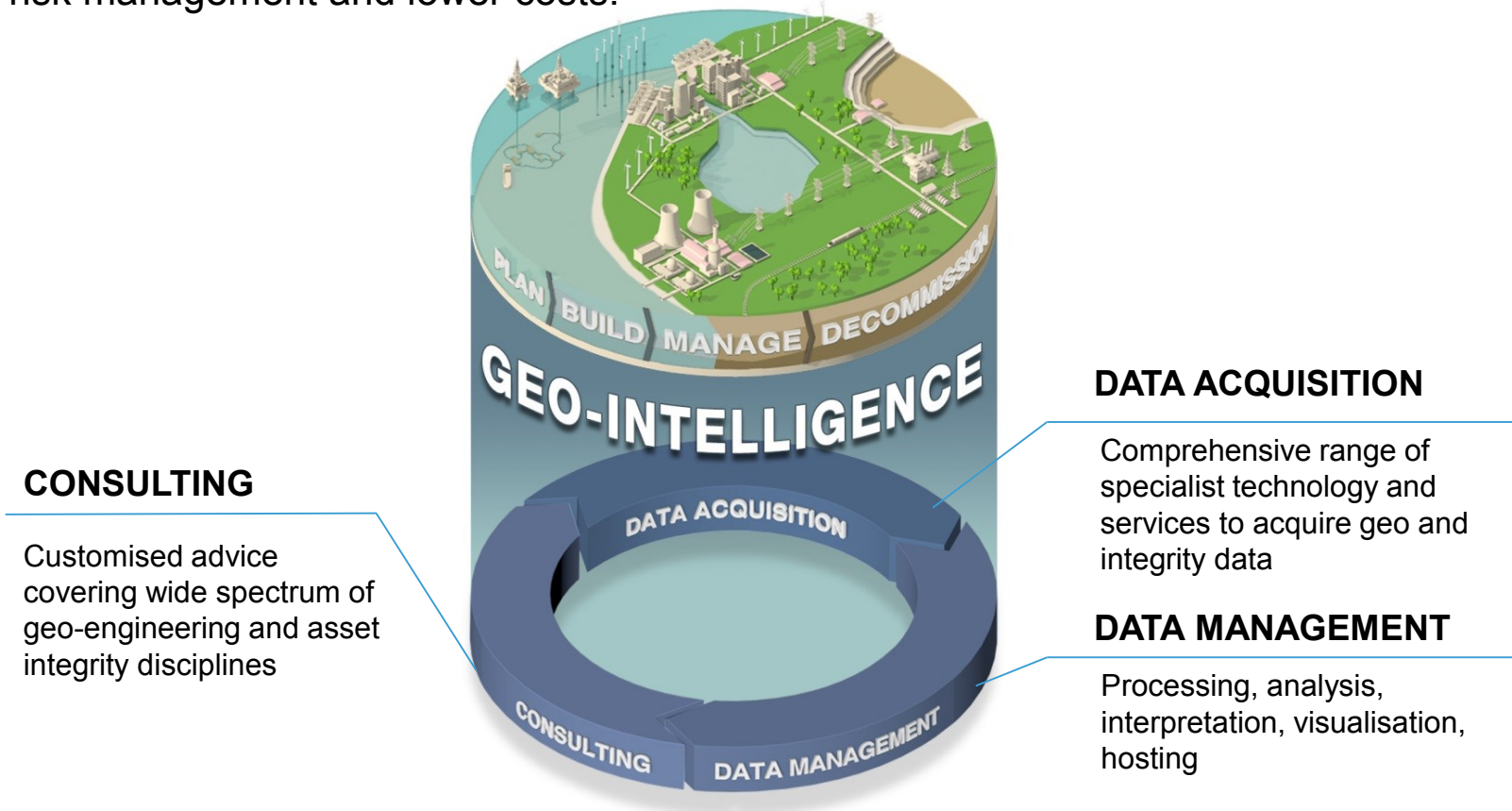
Geo-intelligence & Asset Integrity Solutions

- We are the world's leading, independent provider of geo-intelligence and asset integrity solutions for large constructions, infrastructure and natural resources in marine and land environments.
- By being involved in all stages, during entire asset life cycle, we are a true partner to our clients.



Geo-intelligence & Asset Integrity Solutions

- Enhancing and integrated service portfolio with data management services and consulting.
- Transforming data into information, resulting in minimised uncertainty, effective site risk management and lower costs.



Innovation

Through innovation we provide our clients with smarter solutions resulting in improved decision making and cost reduction. We develop new technologies and services together with our clients and partners all over the world.



Health and Safety

Health and safety for our employees and clients during our operations are our top priority. It is part of our culture with everyone working together to ensure that we maintain our excellent record.



Resources

Fugro's **people, vessels, equipment** and **facilities** are continually growing in number and capability in order to meet the demand for continuous high quality services in ever-more challenging regions of the globe.



12,000 Employees



60 Vessels



75 CPT Trucks



27 Laboratories



29 Jack-up Platforms



60 Aircraft



250 Land-based Drill Rigs
15 Offshore Drill Rigs



150 ROVs



8 AUVs



278 Offices

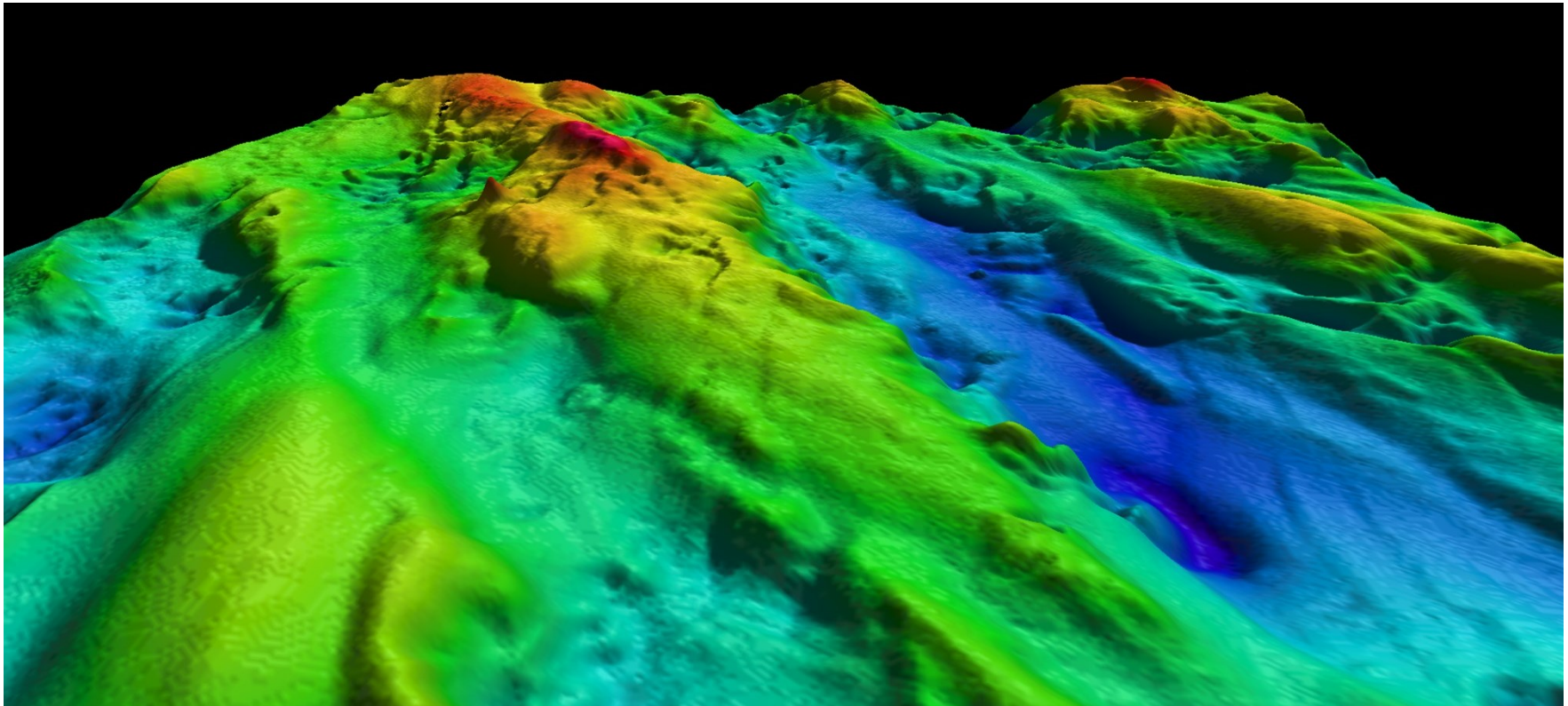
APAC Presence

Fugro's operating companies deliver a wide range of services from several locations. They collaborate to provide integrated solutions in every region of the globe.



Fugro Experiences

- 50 years experience in offshore marine industry
- Extensive OWF experience over the last 15 years
- Track record and marine experience in North Asia (Including Taiwan, Japan, Korea and China)
- Readily available survey and geotechnical equipment and capability in Asia
- GeoConsulting Services – SI planning, data integration and optimize foundation design



Marine Wind farm Project - Geo-risk Management Life Cycle



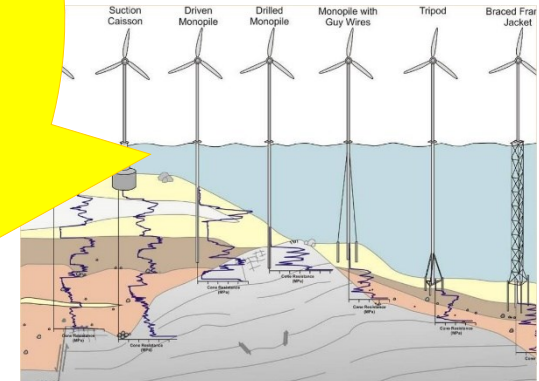
Geotech Survey



Geophy Survey



Metocean & LiDAR Buoy



Foundation Engineering and Construction supports



GeoConsulting Services

Desk Top Studies

Geology / Geophysics

Risk Assessment

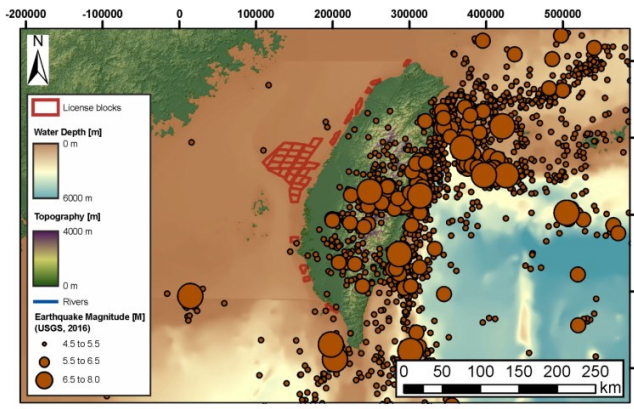
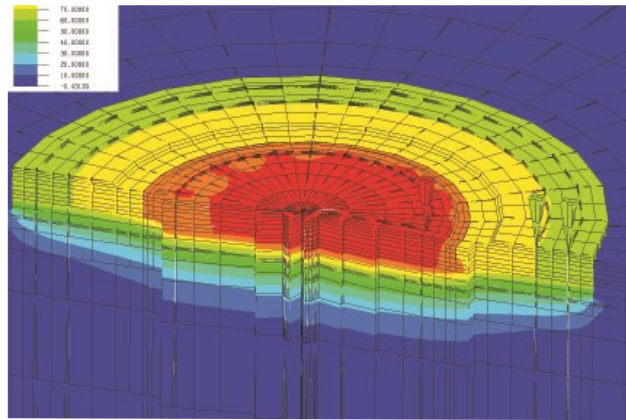
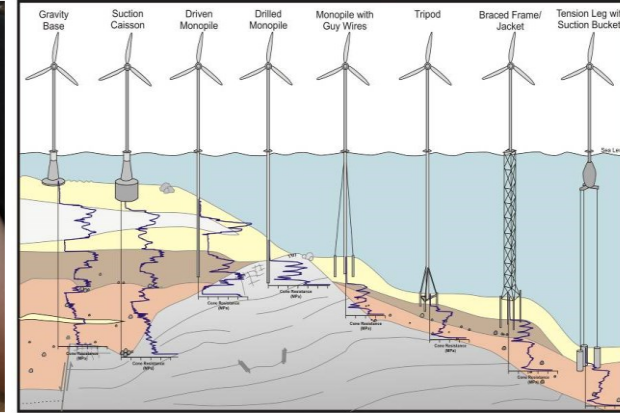
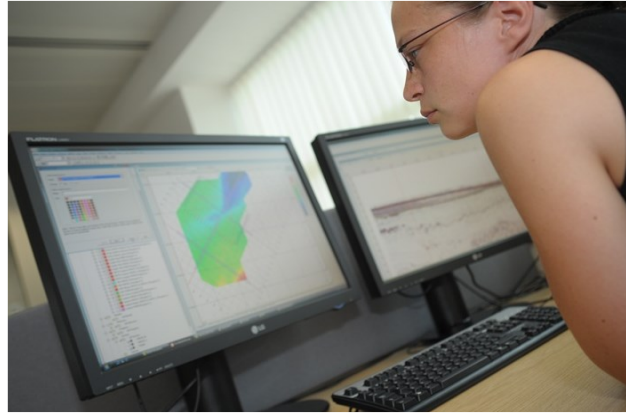
Survey Planning and Optimisation

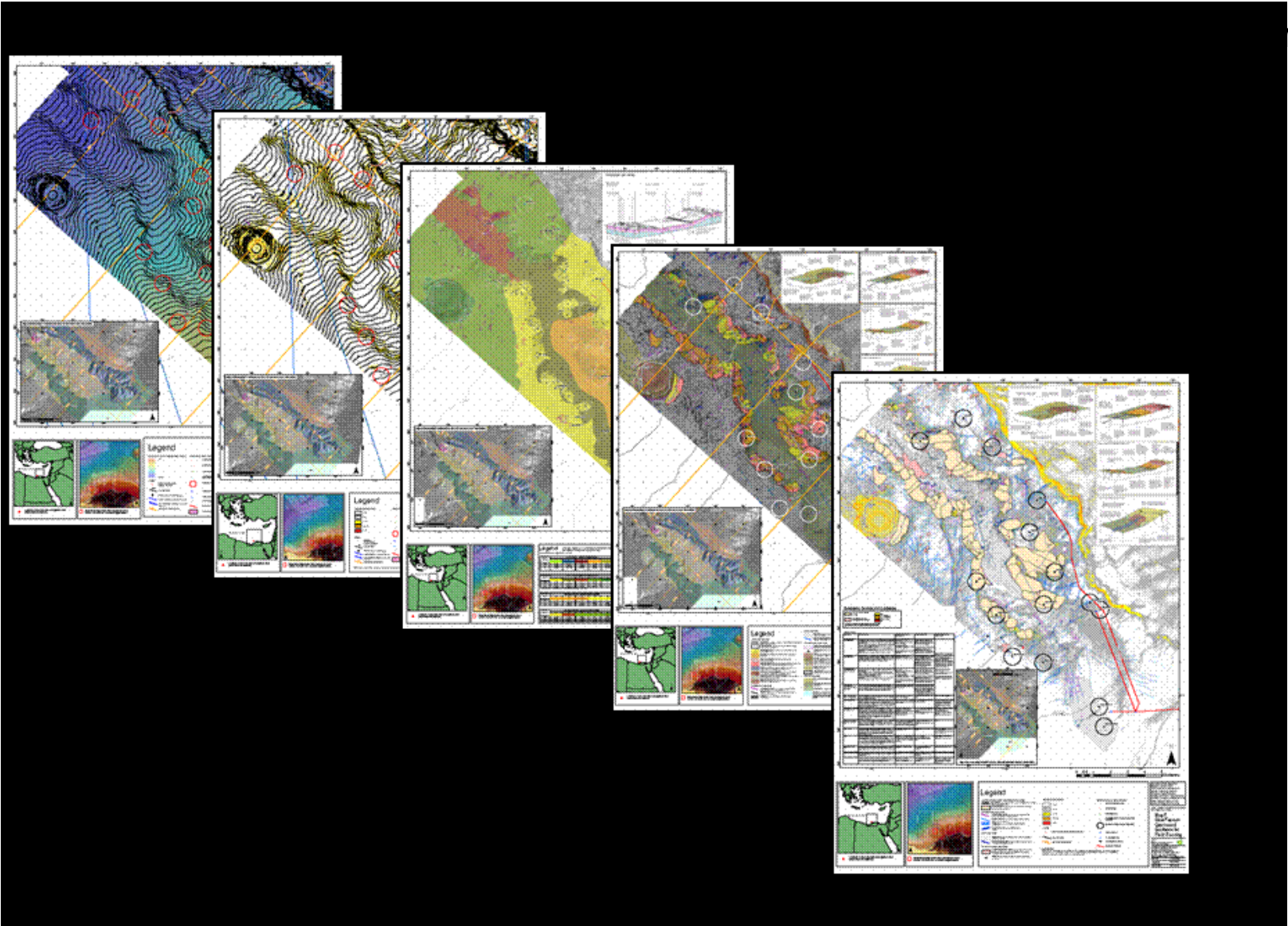
Data Integration / GIS Ground Model

Geotechnical Engineering

Reporting & Data Management

Detailed Foundation Design





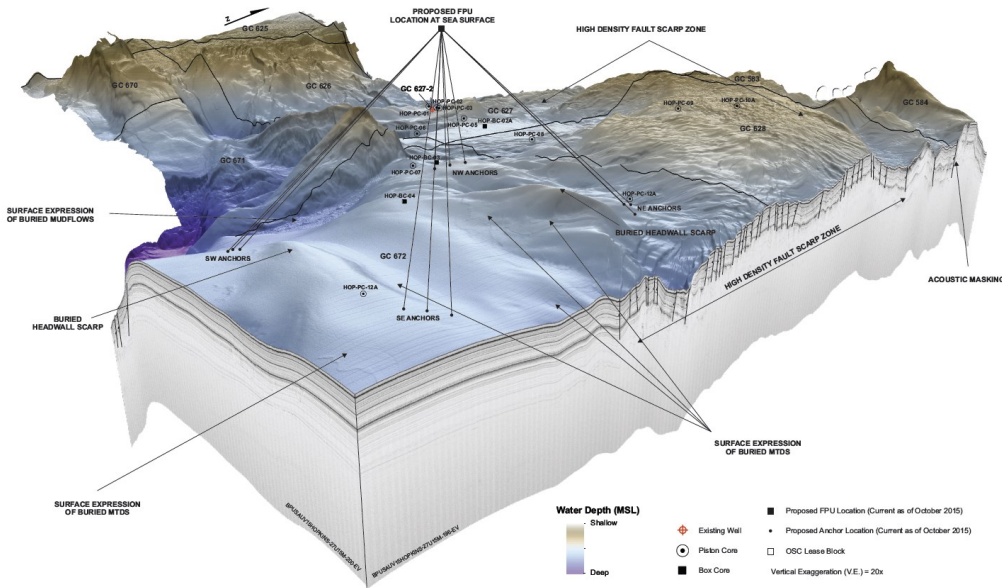


Figure 1: Creation of Ground model for a floating structure development

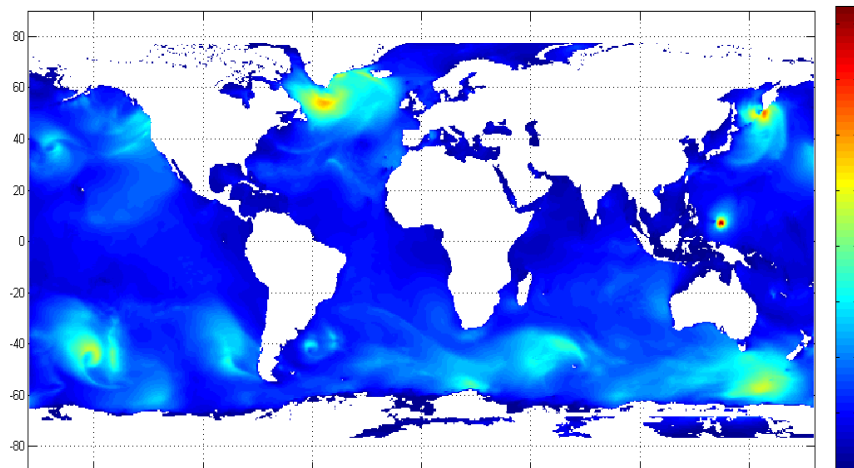
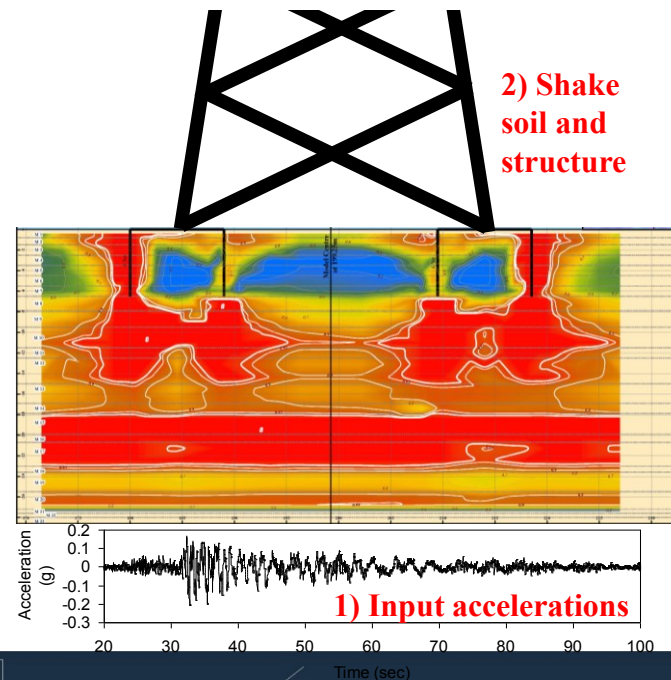


Figure 3: Metocean Modelling

Figure 2: Cyclic shear deformation under seismic and storm loading



4) Calculate excess pore pressures

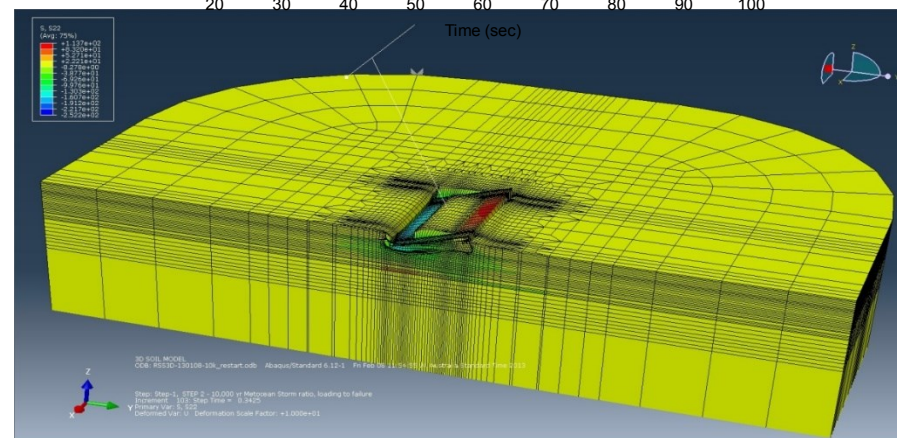


Figure 4: Full 3D Numerical Seismic Analysis

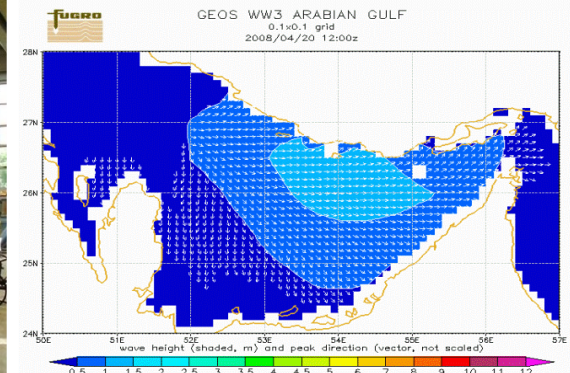
Metocean

Meteorological Instrumentation

Measurement

Consultancy

Weather forecasting



Geophysical Survey

Geophysical
 Bathymetry & Hydrographic
 Detailed Survey
 Cable Route
 Pre-Construction
 Post-Construction



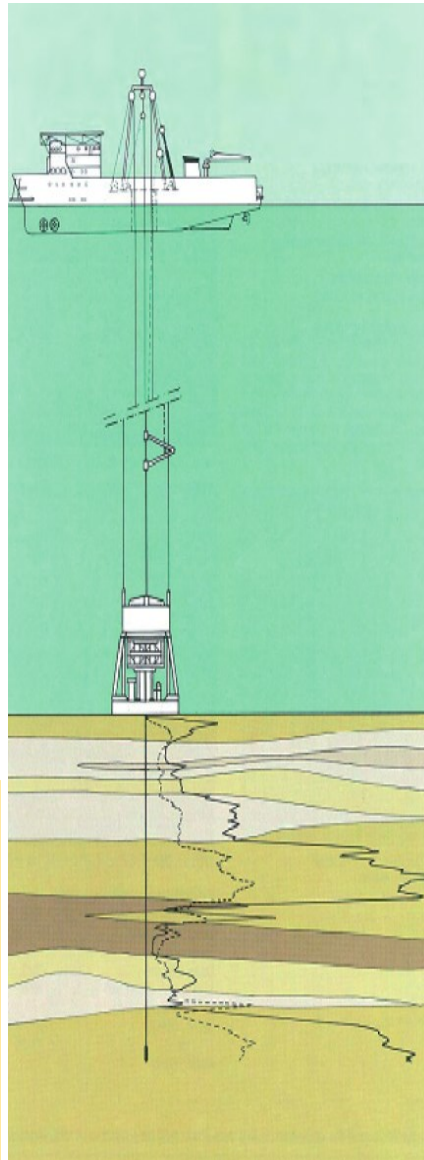
Geotechnical and Geological Survey

Geotechnical Drilling

Mariner & Voyager
(Dedicated Geotechnical Vessel)

Skate 3
(Marine Jack-Up)

Sandpiper
(Floating Marine Barge)



Geotechnical and Geological Survey

Seabed Sampling

Insitu Testing

Laboratory Testing

Analysis

Reporting



Construction Support

Positioning

Pre-Construction Survey

Post-Construction Survey

Cable Burial Survey

ROV

Maintenance and Inspection

Structural Monitoring

GIS Asset Data Management

Extensive Construction Experience

Large Diameter Drilling /
Rock Socketing



Fugro Lesson Learnt in Europe

- Skilled and experienced contractors
- HSE planning and risk assessment of all phases
- Financial implication and project delay



Lessons Learned : Fugro Offshore Wind Experience

- Fugro has worked on European offshore wind projects in UK, Germany, France, Belgium, Netherlands, Denmark and Norway;
- Also involved in OWF projects in the US (East coast, Gulf of Mexico and the Great Lakes), Hong Kong, China, Taiwan and Japan;
- Involved in more than 100 offshore wind farm worldwide.



Lessons Learnt (01) – SI planning

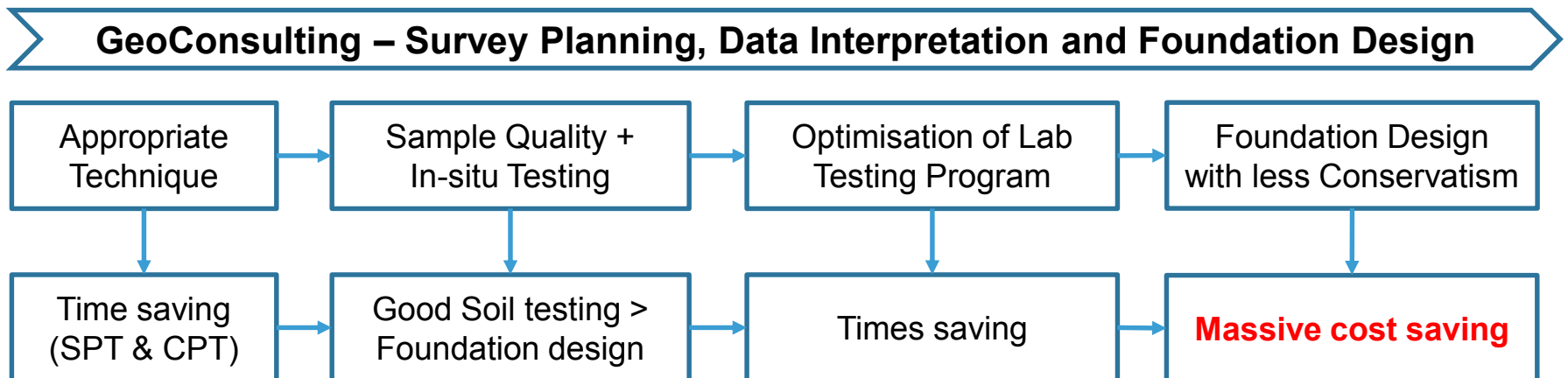
- Appropriate geophysical and geotechnical vessel
- Detailed desktop study
- Ensure sufficient time
- Prevent excessive SI and Survey Cost



Good understanding of SI and Survey requirements

- Sampling and in-situ testing tools
- Limitation of vessels
- Foundation concept selection
- Environmental permit application / conceptual design
- Advance laboratory testing program
- Identify potential geohazards to prevent any “surprise”

Project Impact





Detailed design & installation feasibility

- Seismicity and soil liquefaction
- Advance numerical analysis
- Foundation design conservatism
- Reduce surprise during construction
- A team with different expertise
- Good and certified QA/QC system
- Foundation installability assessment

Project Impact

- Consultancy cost vs installation vessel day rate;
- European OWF Experience indicated good foundation design reduce the pile length or foundation dimension (steel cost), foundation installation (vessel cost), construction program (weather downtime)

Our Objectives



We aim to create **partnerships** with Clients to provide the most **accessible, reliable, safe & cost effective** Survey & GeoConsulting services in Taiwan. We also provide **flexible, multi-disciplinary & fit-for-purpose solutions** in tune with your needs.



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Thank You



Metmast Structure with Fugro's instruments,
foundation design and marine site investigation