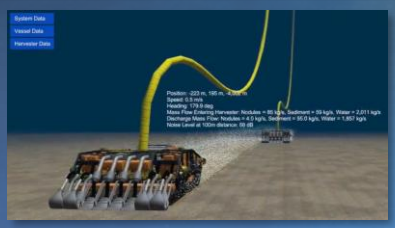
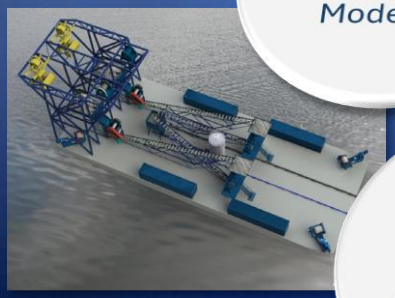
Computational Modeling Services for the Maritime Industry

With roots dating back 50 years, Deep Reach Technology, Inc. (DRT) stands as the industry's only maritime emerging markets (DSMC) specialty consulting firm. With extensive computational modeling (CM) experience, deploying a host of simulation platforms, DRT provides project owner's a **credible scientific and engineering foundation** for the development of critical sub-structures, inter-connected systems and mission critical technologies. DRT's CM services are tailored to each client's specific project objectives, operating environment, and risk profile, providing a bespoke level of technical insight and support at every stage.





DRT's CM work is critical to any project owner looking to mitigate project risk. Maritime emerging markets **present unique challenges.** Operations involve complex, fully integrated system-of-systems - under **extreme conditions**, **limited operating precedent**, **evolving regulatory frameworks,** and **heightened environmental scrutiny**. DRT's unique experience and core competencies provide an invaluable advantage. All DRT CM services are tailored to each operating environment and project need. Depending on project scope and complexity, DRT can expand its role to provide full turn-key systems engineering oversight.

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DRT Computational Modeling Services

1

Hydrodynamic & Ocean Environment Modeling

DRT helps project owners predict how structures interact with waves, currents, and wind.

Key Services:

- Wave loading and motion response (e.g., RAOs, time-domain simulations)
- Coupled wind-wave-current modeling
- Vortex-induced motion (VIM) and drag analysis
- Green water, slamming, and extreme event simulation
- Wake effects (critical for floating wind arrays)

2

Structural & Fatigue Analysis

DRT ensures systems survivability over 20 to 30 year design life.

Key Services:

- Global and local FEA of hulls, frames, and subsea structures
- Fatigue life prediction under cyclic loading
- Fracture mechanics and crack propagation modeling
- Mooring line and riser tension analysis
- Shock and impact (e.g., dropped object, equipment contact

3

Mooring, Riser and Umbilical Modeling

DRT models the "lifelines" connecting seabed to surface critical for DSM lift systems, FLOW anchoring and FPSO / FLNG production systems.

Key Services:

- Dynamic mooring analysis (e.g., catenary, taut, hybrid systems)
- Riser fatigue and vortex-induced vibration (VIV)
- Internal multiphase flow modeling (i.e., slurry, nodules, hydrocarbons)
- Umbilical routing and load analysis
- Coupled vessel–riser–seabed interaction

4

Seabed Interaction & Geotechnical Modeling

DRT provides an understanding of how equipment behaves on, or in, the seabed.

Key Services:

- Soil-structure interaction (SSI)
- Anchor design (e.g., drag anchors, suction piles, driven piles)
- Bearing capacity and settlement modeling
- Deep-sea mining collector mobility and traction
- Sediment disturbance and plume modeling

5

Multiphysics & Process Modeling

DRT can model interacting physical systems simultaneously.

Key Services:

- Slurry transport modeling (e.g., sediments, nodules, tailings)
- Multiphase flow
- Thermal modeling (e.g., subsea electronics, hydrate risk)
- Pump and lift system optimization
- Integrated system simulations (digital twins)

6

Floating System Design Optimization

DRT keeps the project financially grounded.

Key Services:

- Hull form optimization (e.g., spar, semi-sub, TLP)
- Stability and ballast design
- Weight reduction via topology optimization
- Wind farm array layout optimization
- Sensitivity analysis and parametric studies

7

Reliability, Risk & Probabilistic Modeling

DRT quantifies uncertainty and failure risk.

Key Services:

- Monte Carlo simulations of environmental loading
- Reliability-based design (RBDO)
- Failure mode and effects modeling (FMEA/FMECA)
- Extreme event probability (100-year / 1000-year storms)
- Operational uptime modeling

8

Digital Twins & Real-Time Monitoring Integration

DRT bridges design models with real-world operations.

Key Services:

- Creation of physics-based digital twins
- Sensor integration and data assimilation
- Predictive maintenance algorithms
- Remaining useful life (RUL) estimation
- Fleet-wide performance benchmarking

DRT Computational Modeling Service Tools

DRT team of experienced engineers have a host of computational modeling tools at their disposal. Depending on the application, DRT's team will work to determine the best tool to ensure that you obtain credible analysis that will ensure project success. Common computational modeling tools utilized by DRT include:

MATLAB

MATLAB is a powerful programming and numeric computing platform widely used by engineers and scientists.

Data Analysis & Visualization Processing large datasets, creating graphs, and identifying trends.

Algorithm Development Designing and testing mathematical models for various applications.

Simulation & Modeling Used in engineering fields to simulate real-world systems.

Financial & Economic Analysis Used in quantitative finance for risk assessment and portfolio optimization.

Ansys

Ansys is a powerful simulation software used to analyze and optimize designs before physical production. It simulates real-world conditions to test the performance, durability, and efficiency.

Structural Analysis Evaluating the strength and stability of materials and components.

Fluid Dynamics Simulating airflow, heat transfer, and fluid interactions.

Thermal Analysis Assessing how temperature affects materials and systems.

Multiphysics Simulation Combining multiple physical phenomena for complex engineering problems.

orcaflex

OrcaFlex is a leading software used for dynamic analysis of offshore marine systems. It simulates and evaluates complex structures, ensuring their performance under various conditions.

Risers & Moorings Analyzing the behavior of flexible risers and mooring systems.

Installation Analysis Simulating offshore installation processes to optimize efficiency.

Buoy & Hose Systems Evaluating the performance of floating structures.

Towed Systems Assessing the dynamics of underwater cables and equipment.

Renewables Used in offshore wind energy projects.

CHARM3D / HARP

Provides global performance analysis including fully coupled dynamics of multiple hulls, respective mooring systems including hawsers or tendons, and various risers in time domain.

Multi-Body Simulation Can accommodate a variety of hulls and various mooring-riser system connections, including linear spring, pneumatic tensioner, or MR damper.

Hydrodynamic Modelling Interactions between proximate floating bodies are included up to the second order, and the mooring-riser systems are realized by nonlinear dynamics.

Multiple Variable Considerations Including rapid wave heading change, extended synthetic mooring lines, winch dynamics, anchor dynamics, and deck structure dynamics.

python

Python is widely used for data analytics due to its flexibility, efficiency, and vast ecosystem of libraries.

Data Processing & Cleaning Helps structure large datasets, prepares data for analysis & removes inconsistencies.

Exploratory Data Analysis (EDA) Summarize data, detect patterns, and assess trends.

Statistical Analysis Predictive models, classification, and clustering.

Big Data Integrates with databases and cloud platforms.

Financial & Business Analytics Risk assessment, forecasting for business strategies.

OpenFOAM

OpenForm simulates metal forming via a GUI for industrial forming processes, helping engineers and manufacturers analyze and optimize metal forming techniques.

Deep Drawing & Hydroforming Simulating complex metal shaping processes.

Bending & Bonding Evaluating the behavior of materials under stress.

Quality Control Comparing production results with numerical simulations.

Process Optimization Improving efficiency in manufacturing workflows

FLOATSIZE

Proprietary offshore platform sizing tool designed to optimize the commercial economics of such packages for the marine and offshore renewables energy markets.

System Optimization Provides quantitative evaluation based on defined system constraints.

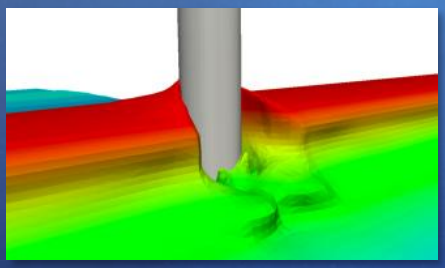
Process Optimization Improving efficiency in manufacturing workflows.

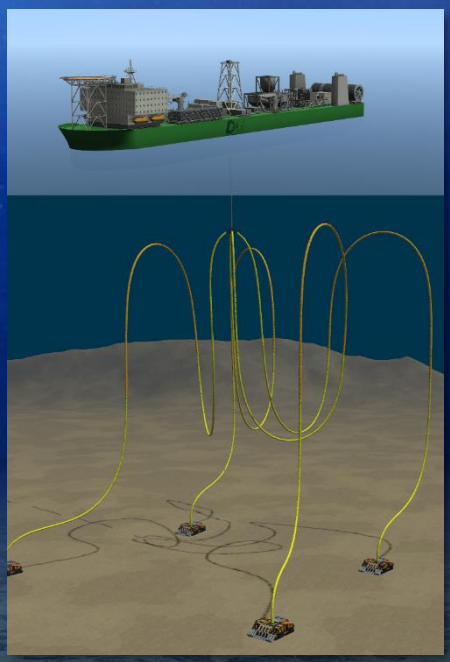
Financial & Business Analytics Risk assessment, forecasting, and optimizing business strategies.

DRT Full-Service Support

As a full-service specialty consulting firm, DRT provides a comprehensive suite of complementary services in support of emerging maritime markets, including floating offshore wind, offshore energy and offshore thermal energy conversion.

- Owner's Engineering Services
- Lab Scale Testing and Prototyping
- Geotechnical, Marine, and Mechanical Design Services
- Permit and Application Preparation Services





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