Dynamic Positioning Committee

Marine Technology Society

Risk

Growth Stimulates Innovation in DP Technology

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In 2002 Transocean decided to take action to reduce the frequency and severity of DP incidents in our fleet.

Comprehensive DP and power plant audits were performed on the entire fleet.

Equipment, operator knowledge, procedures and practices were measured.

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By mid 2004 the fleet had been assessed.

The audit revealed that:

1. 20 rigs in all regions had similar strengths and weaknesses.
2. The DP System was rarely the root cause of DP Incidents
3. Human Error and power plant were the largest contributors.
4. Most DP Incidents could be prevented by swift action.
5. Human error was a factor in most DP Incidents
    a. DPO mistake causing incident was rare, maybe 10%
    b. DPO failure to act allowing incident to progress, about 30%
    c. DPO wrong action making situations worse, about 60%
6. Nautical Institute DP Certification is of little value for handling faults and failures
7. Vendor training focused on subsystems, not the whole rig
8. Inadequate DPO understanding of how DP systems and power plants operate was the "low hanging fruit".

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A 3 day DP Lessons Learned course was developed. It is mandatory for DPOs, Mates, Captains, and OIMs. Attendance is offered to clients, rig managers, engineers, vendors. More than 200 students have been trained in at our training centers in Macaé, Singapore, Aberdeen, Mumbai and Houston.

1. Human error reduced (est. 80%)
2. 80% is not enough. Limiting factors include:
    a) Low entry level of DP knowledge & training
    b) Limited available gap-filling training (outside classroom)
    c) Bad habits and industry misconceptions persist
    d) High turnover maintains completion at 50%
3. Another approach is required to improve further

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In 2005 it was decided to begin investigations how to further improve the DP Lessons Learned course.

1. Performance measuring
2. Hands-on learning – add advanced simulation of faults and failures to classroom training
3. Move DP basics to Computer or Web Based Training
4. Parallel to well control philosophy used for drillers – focus on concepts.

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Three major DP vendors were invited to participate. Aligned with Kongsberg. Meetings were held in Kongsberg, Horten, and Houston to refine the concept, 2005.

Kongsberg developed an advanced simulator proposal based on Transocean specifications.

Before we look at the goals of the proposal, let's look at what it ISN'T.

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Although we hope this course will encourage our DPOs to become expert operators, the goal of this training program is NOT to teach advanced operating techniques for any particular DP Automation System or Power Plant Automation System.

The course is specifically designed to AVOID teaching the functional details of any particular vessel equipment or Automation System.

Equipment/vessel specific operator training has value, but is best left to small companies or vendors. We want to produce DPOs who can quickly master any rig we assign them to.

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The DPO is expected to leave this course with an improved, and proven understanding of our integrated automation systems and the equipment controlled by these systems, and more importantly the ability to determine the correct action for any type of failure in the equipment and systems he controls.

The DPO will be expected to utilize this knowledge to refine his understanding of his vessel's systems, and become an expert operator.

This is similar to how a driller learns well control. The simulator design was based on well control.

Like well control, simulated DP Incidents are based on the most common incidents we have experienced. This focus will be maintained as we improve training and eliminate incidents.

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- Replicates no single drill floor
- Resembles all drill floors
- Teaches concepts
- Basis Model for the Advanced DP Simulator

Typical Well Control Trainer.

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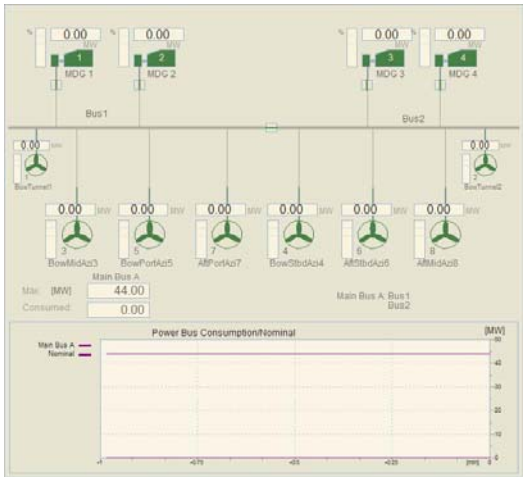

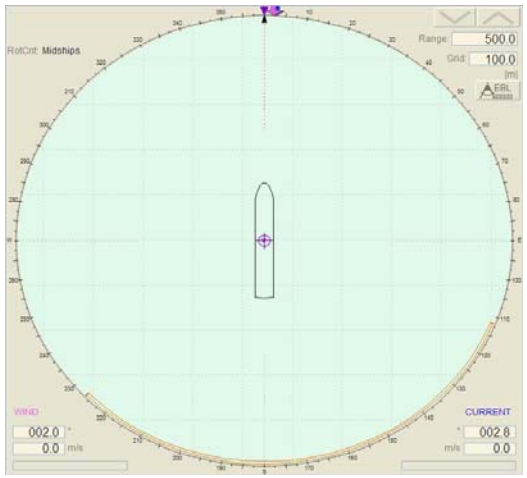

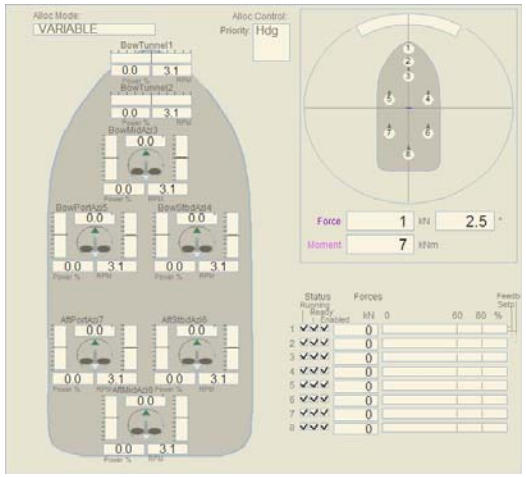

Two "prototype" advanced simulator courses were held in 2007, both at Kongsberg's facility in Houston.

Both courses were held with senior DPOs specifically chosen to challenge the simulator, the course, and the instructors.

Both classes came off far better than we expected. The system simulates real power plant faults and operation very realistically.

Formal rollout is planned for 2008.

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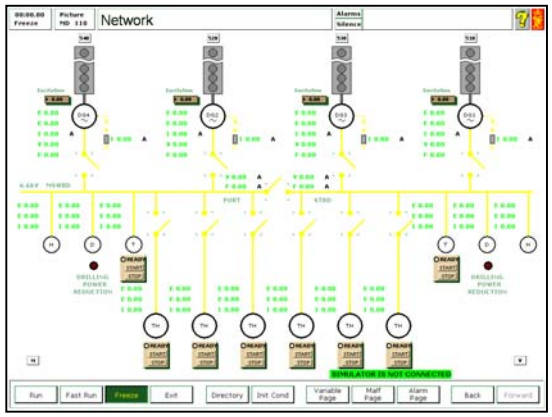

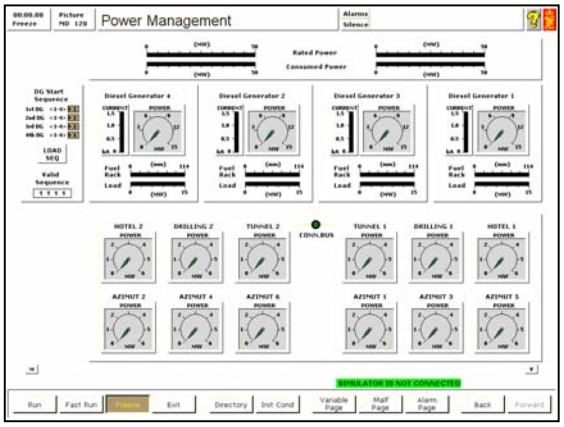

The plant was kept simple so the main focus is detecting, interpreting, and mitigating faults.

We want our DPOs to spend no more than a couple of hours to learn the "rig"

The simulator itself is extremely powerful. We can stop, reverse, restart from any second, slow replay, and cause different events to occur depending on DPO action.

The equipment simulated has the exact performance characteristics of real equipment.

In future, we anticipate having the ability to "insert" different thrusters, diesels, generators with their own characteristics. This will allow testing of equipment specific faults and responses.

This is where the idea of tying simulators and HIL arose.

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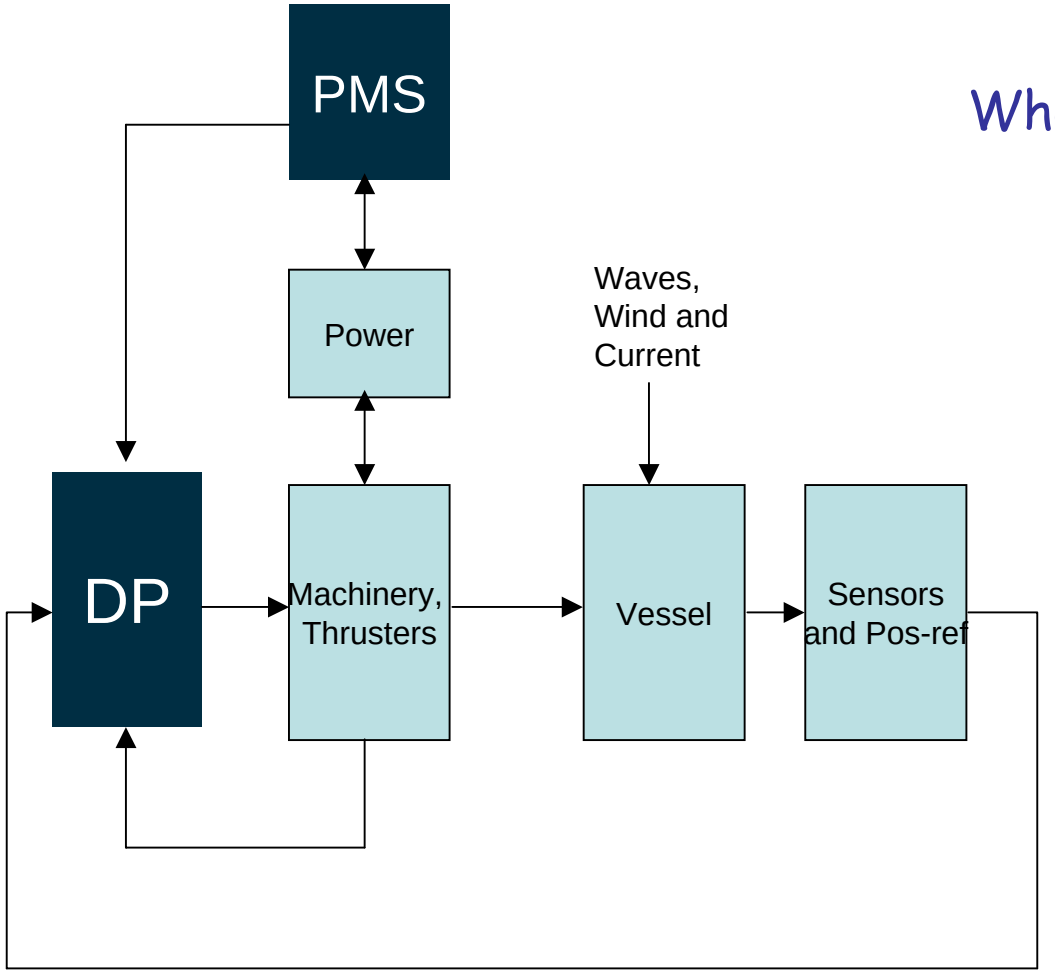

What is HIL Testing?

- Validation of hardware and software performance through software simulation.
- Vessel instruments (inputs) are simulated to force control logic responses as they are actually programmed onboard the vessel.
- Controller outputs are simulated to induce system interaction as they will actually respond onboard the vessel.

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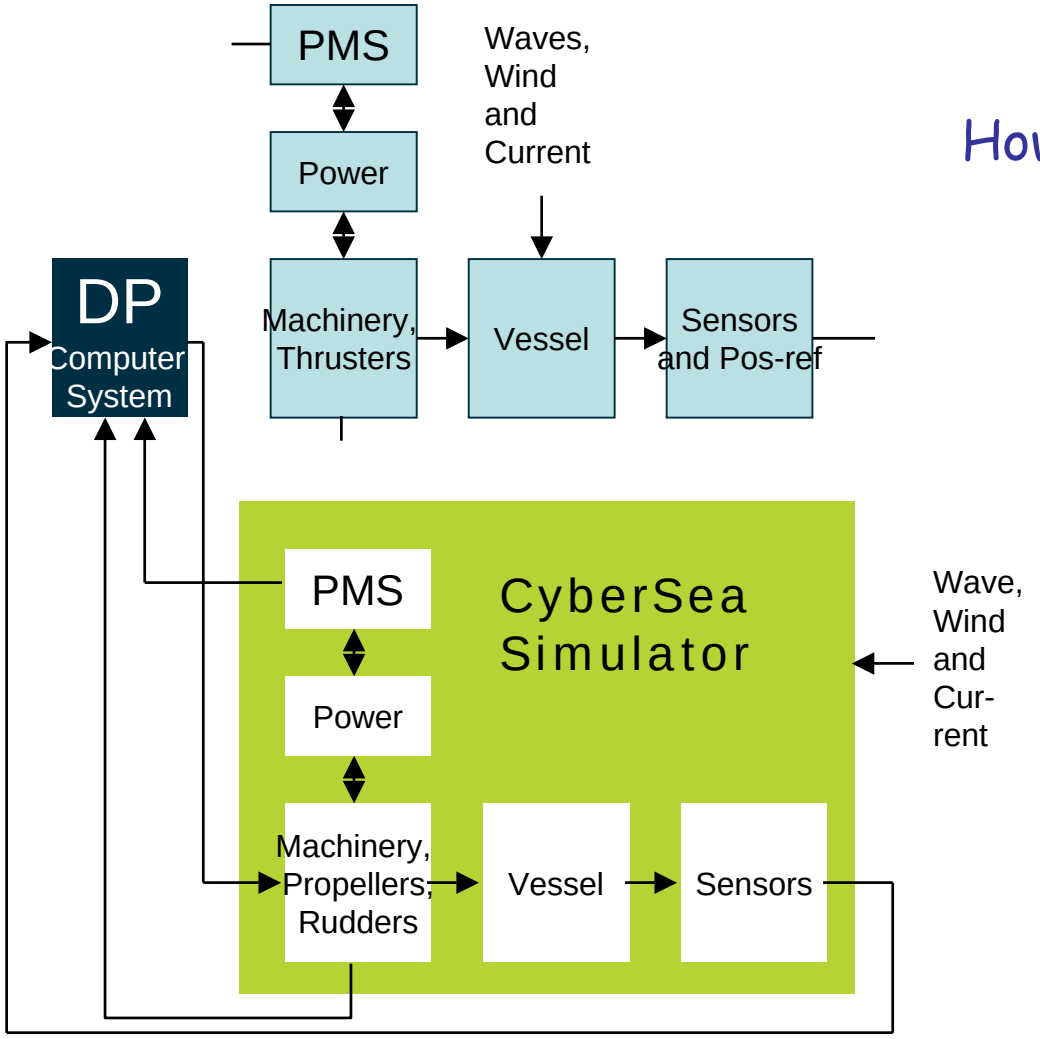

How does HIL Testing work?

- A simulation PC is inserted in the system's communication network.
- Inputs and Outputs are simulated (inserted) before and/or after the equipment under test.
- The controllers respond as they would in a dynamic environment.
- Software or hardware (calibration, wiring, etc.) configuration errors are exposed.

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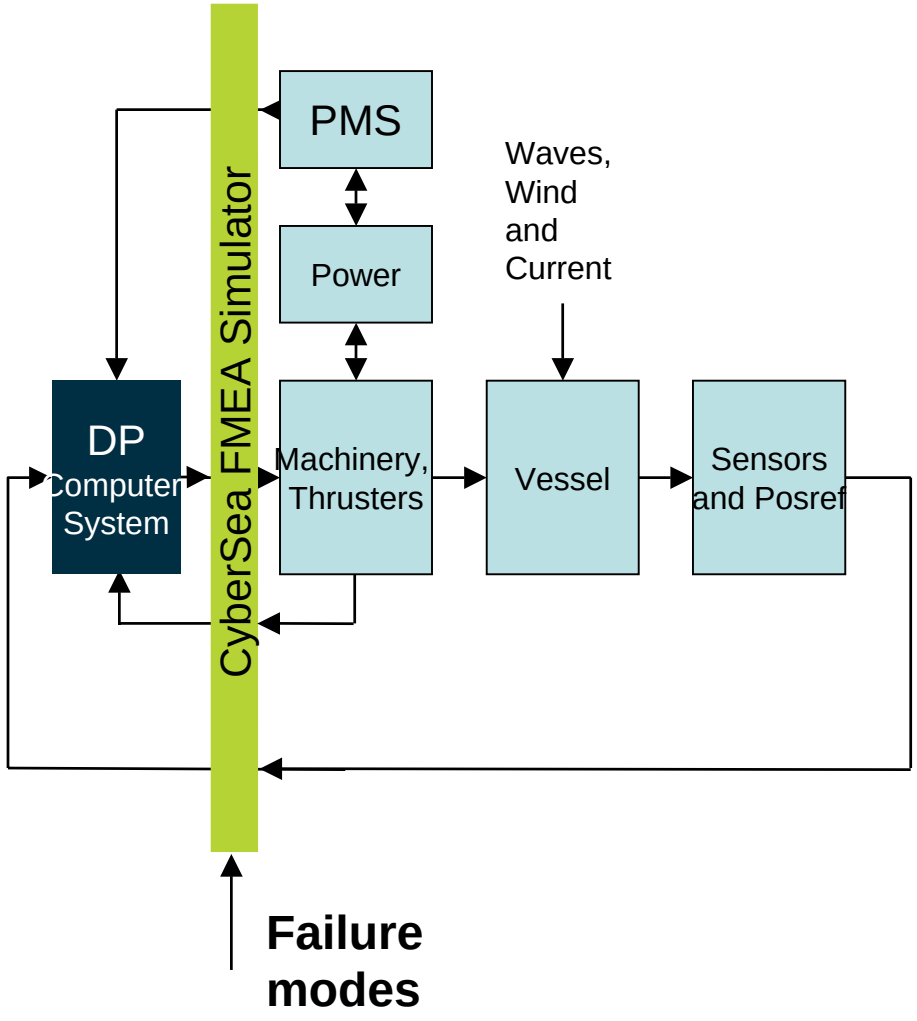

To be utilized at FAT (Factory Acceptance Tests), Sea Trials, Annual Trials, periodic trials or after software upgrades.

HIL Testing of Control Systems:

- Dynamic Positioning:
  - DP-HIL (since 2004)
- Power Management Systems:
  - PMS-HIL (since 2006)
- FMEA HIL (Verification of findings/assumptions)

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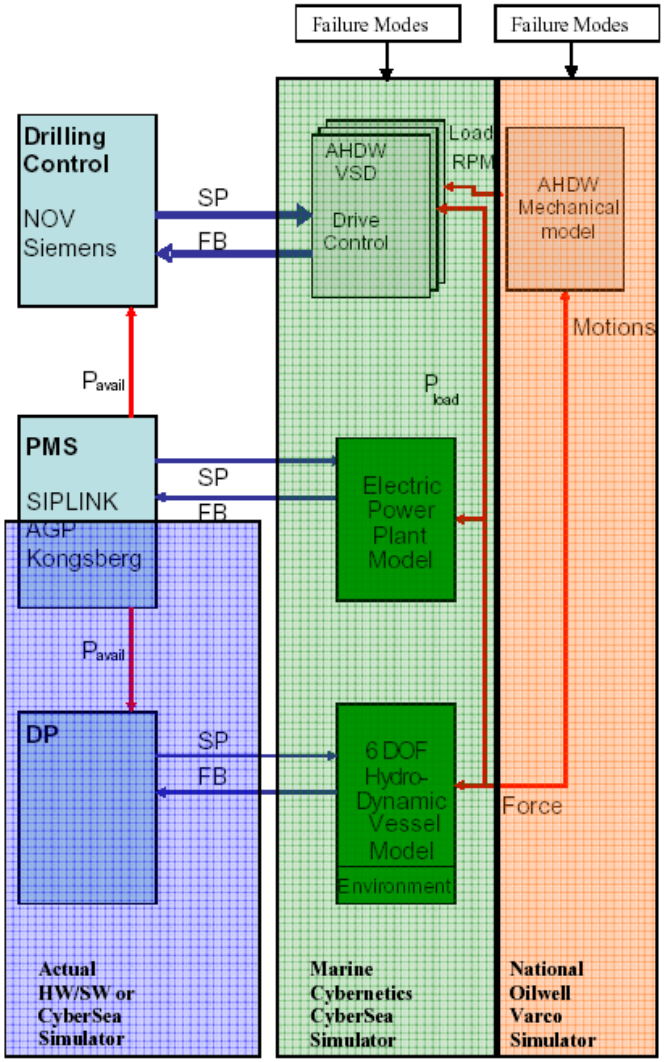

In considering DP, PMS and FMEA HIL testing for Discoverer Clear Leader, Transocean also considered expanding the PMS-HIL variables to include drill-floor equipment, specifically the Active heave Drawworks, as it constitutes major load variations on the 11KV grid.

In exploring such variation, a second simulation and CPU would be introduced.

This is where the idea of tying HIL and an OPC-based database server arose.

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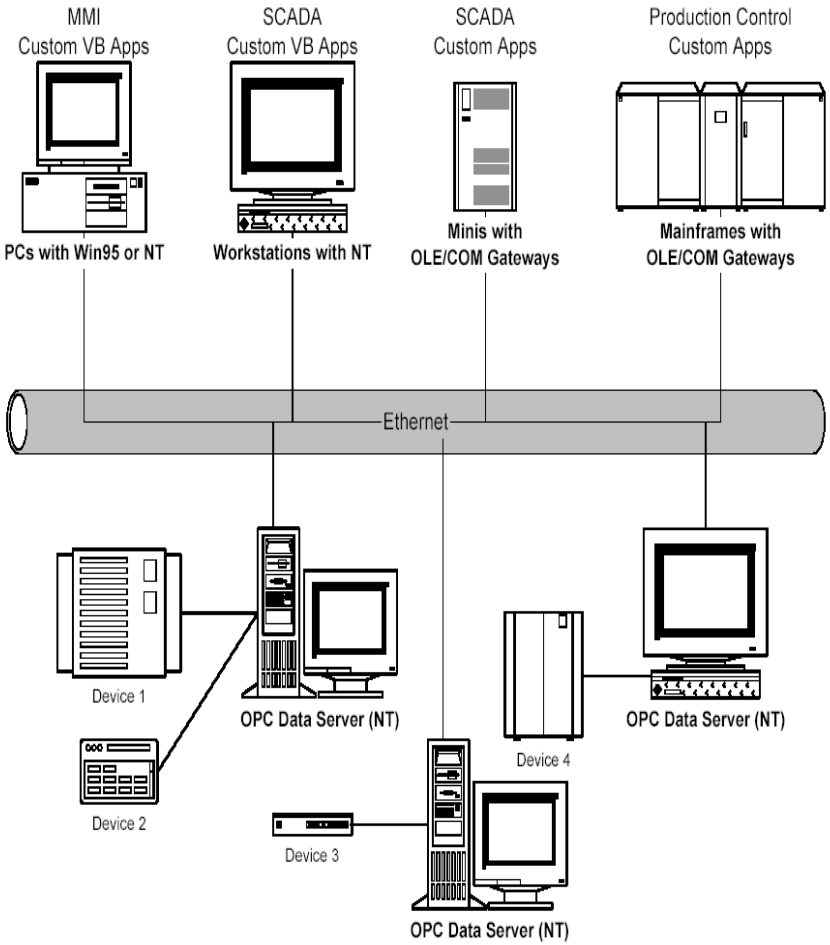

Figure 1-3. Heterogeneous Computing Environment

What is OPC?

- For a detailed, technical explanation, please refer to the OPC Foundation (www.opcfoundation.org/) .
- The organization strives to adapt or create standards and specifications in support of open data "connectivity in industrial automation and the enterprise systems that support industry" .
- As an end-user, uniform OPC compliance by vendor systems facilitates read(/write) access to the datum of discrete systems.

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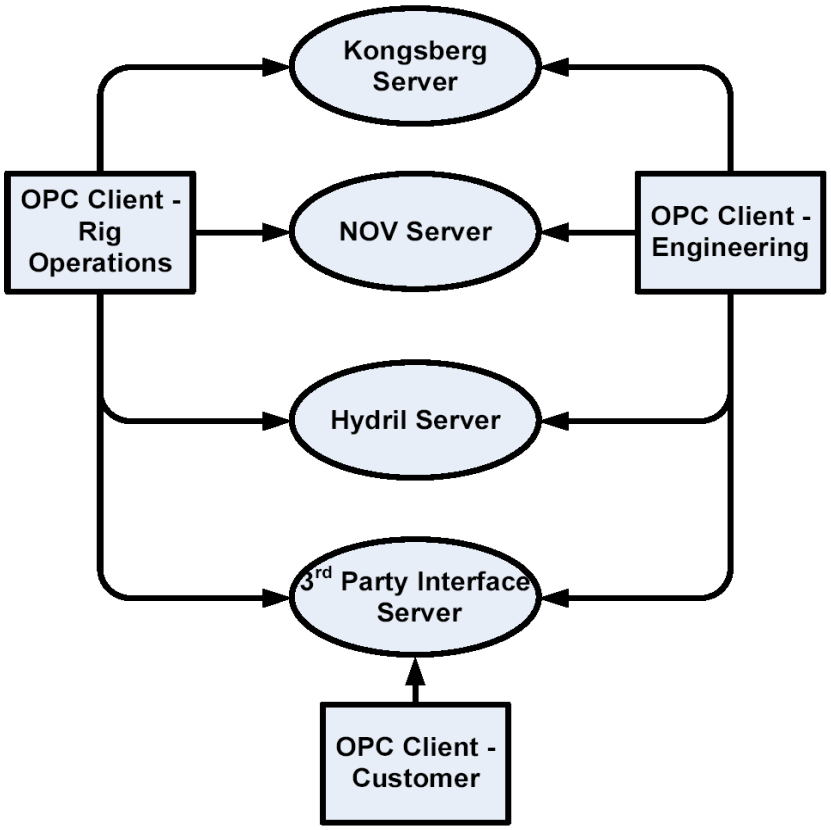

How would OPC be applied to a Transocean Drillship?

- All Vendor data accessed by Rig and Engineering .
- Rig and Engineering would write specific Drilling, Vessel and/or calculated data to a 3rd Party Interface Server.
- Contractor and specified subcontractors would access data through the 3rd Party Interface Server.

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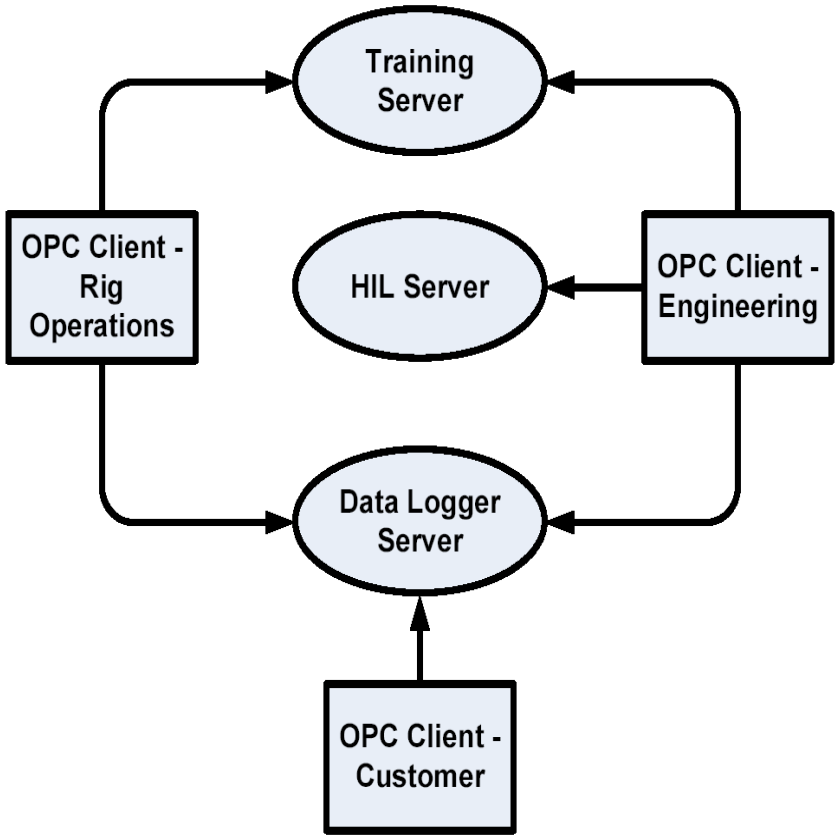

Exploring the data-exchange possibilities:

- Playback of incidents on a Training Simulator.
- Playback of incidents on an HIL Simulator.
- Data of logged events/data utilized for development of Training and HIL Simulators.
- High speed data exchange may facilitate utilization of the HIL 'test-bed' (e.g. the actual, operating hardware and software) as the DP Training Console, or vice-versa.
- The OPC data logger could serve as an archive for Trainee assessment and performance.
- The OPC data logger could serve as an archive for HIL Verification Testing.
- HIL could utilize equipment models to emulate real world plant response and failure modes – as detailed by data logger records. Failure mode simulation verified against known rig model by comparing results to actual data logging records. If the predicted and historical results agree, the same failure mode can be retested with different diesels, generators, or thrusters. This has the potential to speed up the design process.

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References:

Kongsberg Maritime (http://www.km.kongsberg.com/)
Marine Cybernetics (http://www.marinecybernetics.com/)
OPC Foundation (http://www.opcfoundation.org/)

Thanks for your attention!