ViewPoint by Tom Benwell

ATHENS GROUP

Can You Afford to Take the Risk?

The Case for Collaboration on
Risk Mitigation for High-Specification Offshore Assets

Introduction

Non-Productive Time (NPT) is expensive for both Drilling Contractors and Operators. Drilling Contractors lose day rates; Operators lose time to first oil. Operators know that all types of rig projects are experiencing an unacceptable level of software-related NPT. They also know that the Petroleum Safety Authority (PSA) issues citations when Alarm Management processes are not in place and that the UK Health and Safety Executive (HSE) has provided well-defined technical guidance on the need for Software Configuration Management systems. With long-term contracts being the norm on late generation offshore assets, and with some newbuilds not yet contracted, the Operators expect Drilling Contractors to increase their focus on ensuring that software-dependent, mission-critical control systems and system interfaces are fully tested, meet their requirements and performance expectations, will be delivered on time, and will have minimal downtime. Some Operators are even refusing to accept rigs when the software has not been fully unit or integration tested, or where sound Software Configuration and Alarm Management Plans have not been implemented. The following is typical of the feedback we hear when we perform Customer Satisfaction Surveys with Operators who have paid for our services:

> "*My only regret is that we started too late – this should have been contracted by the shipyard or the drilling contractor earlier in the project. We all benefited*."

Drilling Contractors and Operators share a common expectation: The on time delivery of a drill-ready rig.

Most of the Drilling Contractors we talk with understand the root causes of control system-related NPT. See Table 1 for the ranking of NPT causes as reported by Drilling Contractors, Operators and Equipment Vendors in *The State of NPT on Offshore Rigs: 1st Annual Benchmarking Report*. Because these root causes have not yet been addressed, it is a matter of when - not if - a newbuild, refurb or upgraded rig will experience control system-related equipment failures or safety incidents. Yet, many Drilling Contractors still take large risks:

1. Gambling that "This won't happen to me because:
   - The Equipment Vendors will handle it, or
   - My Electrical Engineer will handle it, or
   - This is the Nth rig with the same design; the shipyards have solved it."

2. Betting that the "Operator will pay for it; this is not in my budget"

However, we are starting to see a better approach: "Let's collaborate on it"

In this approach, the Drilling Contractor and Operator recognize that, given the current situation, a collaborative effort with joint funding and implementation of a formal, proven process for software-specific risk mitigation and problem remediation starting sooner in the newbuild/refurb/upgrade cycle will pay for itself many times over, benefiting both parties for many years.

Collaboration and a formal process for software-specific risk mitigation and problem remediation earlier in the newbuild/refurb cycle is the only viable solution for controlling systems-related NPT.

For most rigs in the shipyard, it is too late to fix the contracts, train the shipyard, recruit and train Software Technicians, or compel the Equipment Vendor to change their software development processes and deliver quality software earlier in the build cycle. Based on our experience in this highly-specialized area, the balance of this paper:

- Outlines what we know does and does NOT work in terms of preventing the high rates of control systems-related NPT
- Describes why collaboration on a formal, software-specific risk mitigation process is the only viable solution

The Equipment Vendors Will Handle It

Much of the control system-related NPT we see is due to the fact that many different systems, sourced from multiple vendors, come together at the Drilling Control System (DCS) without the benefit of standard interfaces. The DCS manages 75 – 95% of the movement and operation of the equipment that causes the most injuries on the rig. See Table 2 for a high-level systems interface diagram.

Each vendor only knows their own equipment. They rarely understand how a failure in another vendor's system impacts their system and they have no control over the availability of other vendor personnel or the configuration of other vendors' systems. Software is routinely delivered well after the equipment is on board - very late in the build cycle. At best, the interfaces are tested at the last minute in a happy path state i.e. with the assumption that no one makes mistakes in the drilling process, power is constant and plentiful, alarms are enunciated correctly, etc. These are the reasons why equipment interfaces are the weakest link in terms of reliability and safety.

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My Electrical Engineer will Handle It

Electrical Engineers are tasked with many critical functions, including management. Extremely busy, they cannot devote enough time to the software. Because software is still a relatively new phenomenon on rigs, their level of training and limited experience with the software aspect of vendor kits and with software risk mitigation and problem remediation methods rarely prepares them to perform the functions needed in this highly specialized area. To uncover and resolve potential failures in a timely manner, Electrical Engineers need experience:

- Evaluating vendor software development and engineering processes
- Leading a FMECA workshop for the Drilling Control Network
- Identifying software-related gaps in requirements and design documents and writing additional Factory Acceptance Test scripts and Commissioning procedures
- Determining when software versus hardware is the root cause of a failure and which component or which interface in a highly-integrated system is causing the problem so that the right vendor can be called
- Creating and maintaining Software Configuration and Alarm Management philosophies and processes

And the time needed to document and refine successful software processes and procedures, enabling lessons learned on others' projects to be applied on your rig.

> "Sameness" is a fallacy when it comes to software which, unlike hardware, is essentially invisible, is rarely planned for or tested properly, and is highly subject to change.

This Is the Nth Rig with the Same Design; the Shipyard Has Solved It

Just like you, the shipyards have not been able to recruit and train personnel capable of control system-specific risk mitigation and problem remediation due to the industry-wide shortage of software expertise. And just like you, this expense was not planned for in their budget. In an attempt to mitigate their lack of topsides experience, shipyards implemented Builder Furnished Equipment (BFE) contracts to standardize equipment. So we often hear "All my rigs are the same design." Unfortunately, this "sameness" is a fallacy when it comes to software which, unlike hardware, is essentially invisible, is rarely planned for or tested properly, and is highly subject to change. Consider how many patches were installed on your last rig — before it left the shipyard. Even on rigs with an identical design, the Programmable Logic Controllers (PLCs) are **never** the same.

For example, the real timeline for a fleet build of four drill ships with the same design begins at acceptance of the specifications for the ship and drill floor, not at cutting first steel in the yard. One of our customers will see the last of a four ship build leave the yard on or about 1 October 2011. The specifications for that last ship were accepted on 21 April 2006. As long as there are no delays - a rarity these days - the elapsed time from specification to delivery from the yard is **5.44 YEARS**. Why is this important?

This is important because the life of a software component is shorter than the life of most hardware components. For example, there are PLCs on every rig, either in the drill floor equipment, the BOPE, or the Vessel Management System, etc. One of the more popular PLCs used for the control of offshore drilling systems is the SIMATIC S7-200, CPU 210, made by Siemens. See Table 3 for the product lifecycle of this PLC - standard for Siemens and most manufacturers of industrial control systems.

Based on the product lifecyle for the customer scenario we described above, the Equipment Vendor (OEM) may no longer be able to order the PLC specified in April 2006 (4 years ago) and will have to order the new version, which may or may not operate or integrate according to expectations, and may or may not create a configuration management issue. This is just one example of how rigs with the same design can end up with different equipment and different software versions.

The number of years to system builder end on Intel-based offshore operating systems from Microsoft ranges from 5.0 to 7.1. See Table 4. If you have single board computers using embedded Linux operating systems to control the code base, the software is discontinued even faster. See Table 5. Release 2.6 of Linux had an average of 67.52 DAYS between versions. Rest assured that there was some fix or capability needed from those releases for your single board computer.

Fixes and software patches issued to the first rig(s) in a series do not always operate the same as the official release the next rig receives.

Equipment differences also occur when an Operator needs the rig to be customized for their particular field or to integrate with some new tool they are testing.

Due to the average real timeline for a fleet build (4^+ years), rigs with the same design can end up with different equipment and different software versions, which may or may not operate or integrate according to expectations, and may or may not create a configuration management issue.

The Operator Will Pay for it; There is No Money in My Budget

You expect the shipyard and the equipment vendors to provide you, their customer, with a reliable, safe, drill-ready rig. So too does your customer. The Operator, your customer, expects to accept a rig that meets their requirements. It is unlikely that the Operator allocated money for all of the needed software-related risk mitigation. With each side betting that the other will pay, the decision to move forward is often made too late to surface and remediate all the reliability and safety problems that could have been prevented when it was more cost effective to do so.

The End Result of these Approaches?

Because none of the prior approaches are viable:

- Testing must continue at additional cost in another area of the shipyard after the rig has been pushed out of the slip
- Personnel from many vendors camp out on the rig as testing continues during the voyage and on site. Welcome to the Flotel Gulf of Mexico, North Sea, Campos Basin...
- Problems are patched as they arise and after they have caused NPT
- Downtime in the first 2 years is unacceptably high
- Rig utilization rates suffer, time to first oil is delayed and Wall Street exacts a penalty from both the Drilling Contractor and the Operator

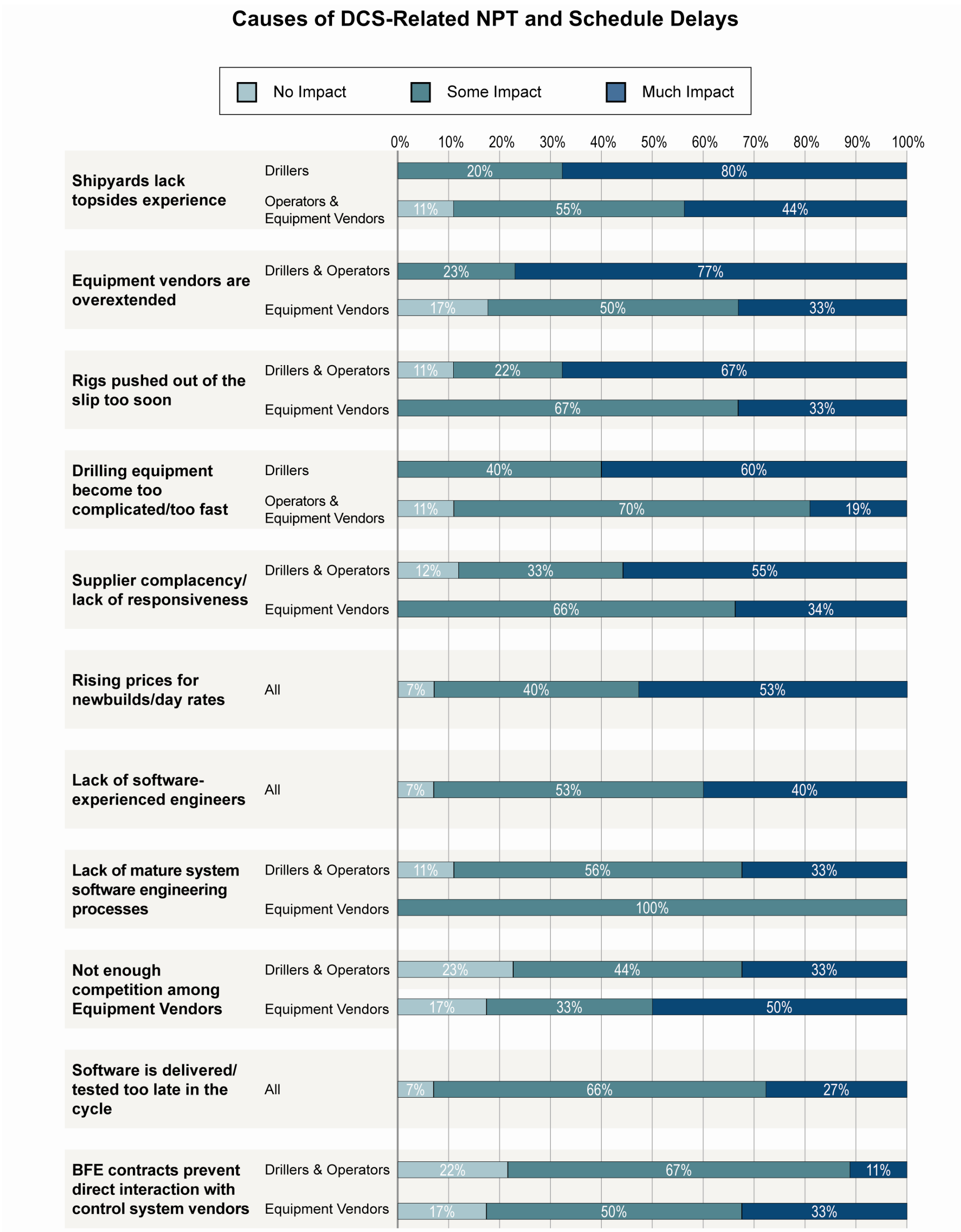
Let's Collaborate and Address it Now

Multiple Operators share the risks of developing new fields through joint ventures. We're starting to see Operators in joint ventures share the costs of speeding time to first oil by jointly funding the costs for software-specific risk mitigation and problem remediation services. We're also starting to see Operators and Drilling Contractors accept the fact that the current state of NPT on high-specification assets requires a different approach - joint funding throughout the newbuild/refurb/upgrade cycle.

The many causes of NPT are introduced in every phase of the rig lifecycle, from contract through operations. Starting software-specific risk mitigation and problem remediation sooner saves time and money. Drilling Contractors and Operators are recognizing that through collaboration, joint funding, and implementation of a formal, proven process throughout the entire cycle, their investment will benefit both parties and pay for itself many times over, as it reduces the costs associated with NPT and helps safeguard their workers and the environment for many years to come.

Working together, Operators and Drilling Contractors can change the status quo by sharing the costs of implementing a formal, proven process for software-specific risk mitigation and problem remediation on high-specification offshore assets.

Table 1

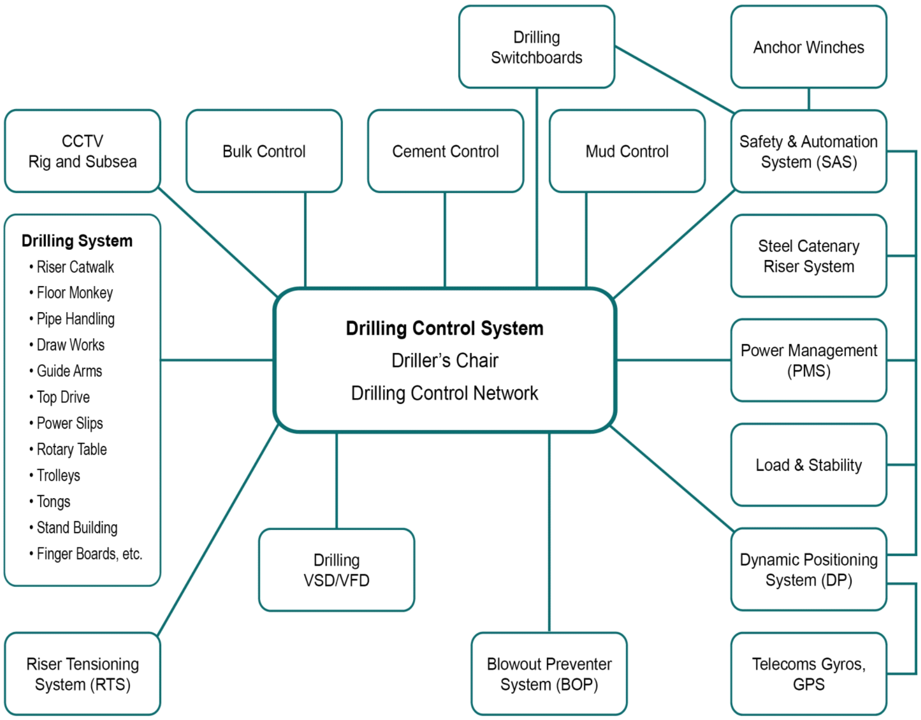


Three key industry-wide dynamics underlie the causes of DCS NPT:

- More drilling and drilling support functions are being automated and DCS software is integrated throughout all of these functions
- Software on offshore drilling rigs is still a relatively new phenomena
- More offshore rigs are under construction today than at any other time in history

Table 2

High-Level Composite Systems Interface Diagram



Equipment interfaces are the weakest link in terms of reliability and safety due to lack of standards and insufficient testing.

Table 3

Siemens Product	Delivery Release	Years to OEM End	Enter Product Discontinuation Phase	Years to System Builder End	Product Cancellation
SIMATIC S7-200, CPU	1-Jul-97	2.3	1-Oct-99	5.3	1-Oct-2009

Table 4

Microsoft Operating System	Generally Available	Years to OEM End	OEM/Retail End Date	Years to System Builder End	System Builder End Date	Years to Last Update
Windows NT Workstation 4.xx	29-Jul-96	5.9	30-Jun-02	6.9	30-Jun-03	3.3
Windows 2000 Professional	31-Mar-00	4	31-Mar-04	5	31-Mar-05	5.2
Windows XP Professional	31-Dec-01	6.5	30-Jun-08	7.1	31-Jan-09	6.4

Table 5

Linux Operating System Release Number	Date	Years Between Releases
1.0.0	1-Mar-95	
2.0.0	9-Jun-96	1.28
2.2.0	25-Jan-99	2.63
2.4.0	4-Jan-01	1.95
2.6.0	17-Dec-03	2.95
2.6.31	9-Sep-09	5.73