Drilling Rig Digital Twin and Virtual Well Construction Simulation

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The project consists of building a digital twin of a drilling rig encompassing a virtual model of relevant rig processes, system functions and equipment states leveraging multimethod modeling methods and system of systems analysis techniques. This pairing of the virtual and physical worlds allows in-depth analysis of real time operational data and enables performance monitoring of equipment, systems and processes. This enables identification of problems before they occur helping to reduce downtime, and invisible lost time (ILT). The simulation engine leverages statistical distributions based on vast amounts of historical well and machine data enabling prediction and advanced planning capabilities to optimize the well construction process across the fleet.

In addition, proposed changes in equipment or process can be configured in the model to show the impacts in operational efficiency and costs to verify if the change sufficiently justifies the associated initial capital and continuous operational expenditure.

This presentation highlights the complex challenge of developing a model and simulation encompassing the well construction process and subprocess for a given type of well, well program and rig class. The presentation will discuss the analysis of historical well plan data, machine data and IADC sub codes, and how the well construction process was codified capturing key information including, activity durations, sequencing and interdependencies between well states.

The development of the process model, simulation results and verification against historical well data will be discussed. A few 'what-if' scenarios will be highlighted to show the impact of changes in the equipment and processes to observe the efficiency impacts in the overall process.

The combination of system dynamics modeling, agent based modeling, and discrete event modeling has had limited application in the Offshore Oil and Gas domain. These simulation and modeling methods are powerful tools in understanding true system behavior and performance, predicting future performance and optimizing new and current system designs. This presentation highlights a practical application in the offshore oil and gas domain leveraging the AnyLogic software platform.