International Association of Drilling Contractors

IADC Advanced Rig Technology (ART) Committee
10.00-11.30 Tuesday, 21 January 2025
Online meeting

Minutes

IADC Advanced Rig Technology Committee Co-Chairs Alex Groh, Patterson-UTI, and Trent Martin, Transocean, opened the meeting and welcomed the attendees. IADC's Linda Hsieh gave an overview of the IADC antitrust policy.

The service of former ART Co-Chairs Blaine Dow and Sarah Kern from 2023-2024 was recognized. Service plaques were due to be presented at this meeting, but due to the last-minute cancellation of the in-person portion of the meeting, the plaque presentation will be postponed to a later date.

ART Conference update: Sponsorship opportunities for the conference were noted, and meeting participants were encouraged to submit abstracts by the February 24 deadline. It was noted that the conference will be held for the first time in Reykjavík, Iceland, and discussion is ongoing to organize a geothermal site tour for conference participants in conjunction with the conference.

Existing Projects update

Bit Dull Grading: the project is on hold for review, with the drill bit portions of the document mostly finalized; however, Paul Pastusek noted there is still significant work to be done with the BHA portions of the document since that part was started from scratch. However, the bits portion can be published first and the BHA portion can be published later once it's completed.

DDR+: The committee is waiting to see what next steps to take to help improve industry adoption. Matt Isbell noted his effort last year leading a small workgroup within ART to review the landscape around DDR/DDR+ and drafting a roadmap process for what would be needed if IADC decides to update the DDR+. Recognizing that a significant number of drilling contractors already have their own internal subcodes and that adopting the IADC DDR+ would not be an insignificant effort, the group ultimately recommended that the DDR+ update be reviewed by the committee annually to see if there becomes any strong calls for action, since any action would require a dedicated committee of members. See attached documents.

Emission Forecasting and Reporting: Mr Groh and Mr Martin will reach out to Mike Party, who was leading this efforts a few years prior, to understand where the project stood, then a decision could be made on how to move forward.

Alternative Fuel Overview: This project has been on hold for a while so the committee could focus on the other two energy efficiency projects (Emissions Reduction RP and Emissions Reporting and Forecasting). The project did receive conditional approval to move forward, so with volunteer support work can begin. Michael Weidenfeller with Caterpillar volunteered to assist. Mr Groh and Mr Martin agreed to follow up with Mr Weidenfeller offline. It was noted that it will be important for drilling contractors to also be involved in this project to provide an end user perspective.

DSATS/ART at IADC/SPE International Drilling Conference: Ms Kern and Mr Dow will represent ART at the DSATS/ART symposium on 3 March at the International Drilling Conference in March in Stavanger, Norway. There will also be a D-WIS event on 7 March in Stavanger; this event, hosted by Aker BP, will focus on interoperability, and ART members are encouraged to attend.

New 2025 projects

Industry training/best practices for control systems: This aims to provide additional material to augment training for drillers to increase their awareness of different control systems. No standard will be developed; it only aims to increase awareness. Mr Martin noted that any interested members should reach out to him to volunteer to assist with this project. Paul Pastusek offered to provide some reference materials for this project based on his SPE Distinguished Lecture Series on autodrillers. Dmitry Kuravskiy also offered to help from SLB, providing some practical data from the field. The group agreed this would be a valuable project for ART to tackle. The project proposal needs to be refined and then submitted to IADC Division VPs for approval.

Documenting Environmental Gains from Rig Performance: The idea is primarily around developing a fact sheet that summarizes how rig performance improvements have reduced greenhouse gas emissions for the industry. A big motivator for this project is advocacy for the drilling industry. Ms Kern noted that she and Konstantin Puskarskij have been working to drafting a proposal for this project. Once that's ready for review, it will be sent to Mr Groh/Mr Martin for review, and further consideration by the overall ART Committee, after which it can be sent to the IADC Division VPs for approval.

ART Spark Tank: These events were started around 2015/2016 within the ART Committee to give entrepreneurs and startups the opportunity to present their ideas to a panel of operators and drilling contractors. The events have been paused since Covid, but it may be timely to start it up again. Mr Martin/Mr Groh will further discuss how to approach this offline.

Report on AI landscape in drilling: The idea is to create a general education document on AI – what is it and what is it not? This can help drilling professionals to talk more intelligently about AI. The project can also look at different applications of AI, giving examples of how it's being integrated into automation systems, as well as future applications. Mr Groh noted that he aims to draft a project proposal within the next few weeks, and asked the meeting participants for their feedback. General consensus among the group was that there would be a lot of value in this project. Several

participants note their interest in assisting with the project: Steve O'Neal with Capsher Technology, William Fox with Corva, Hussein Anifowose with Noble, Dmitry Kuravskiy with SLB.

Meeting guest speakers: Mr Groh/Mr Martin suggested that guest speakers could be invited for future ART meetings to boost attendance and generate more interest, as well as provide educational value. They noted that they're open to suggestions from members as to guest speaker invitations or even topics. Suggestions mentioned included: Professor Roman Shore with Texas A&M (Paul Pastusek); someone from the aircraft industry to look at what's on the horizon for 2026 (Sriram Vengalathur, Slb); rig floor equipment, failure predictions, novel technologies, what's next for MPD (Dustin Torkay, Seadrill).

Lastly it was noted that the next ART Committee meeting will be held on 1 May.

The meeting was adjourned at 11.30.

Attendance:
Agnaldo Silva, Petrobras
Alawi Alalsayednassir, Aramco Drilling
Alex Groh, Patterson-UTI
Andres Aguel, NOV Grant Prideco
Azarudeen K
Blair Paul, Nabors Drilling
Brendan Young
Brian Sherman, Precision Drilling
Chris Rom, Noble Corp
Clifton Wade
Dan Gudall, HMH
David Murfin, Murfin Drilling Co
Dimitrios Pirovolou, Weatherford
Dmitry Kuravskiy, SLB
Duane Cuku, Volant
Dustin Torkay, Seadrill Floating Operational Unit
Earl Hersh, No More Carbon USA
Fred Florence
Hussein Anifowose, Chevron Nigeria
Jeff Walker
Joanne Lii, NOV
John de Wardt, DE WARDT & COMPANY
Jonathan Lightfoot, Oxy
Juan Andres Hernandez, Nabors Global Drilling & Engineering
Juan Pablo Arias Tamayo, Training Consultors
Kamal Sanjakdar
Konstantin Puskarijk, Copenhagen Energy Partners
Lee Womble, SLB
Linda Hsieh, IADC
Manoj Tripathi, Shelf Drilling
Martin Kershman, Teqnisolutions
Matt Isbell, Hess
Matt Kvalo, Stasis Drilling Solutions
Michael Weidenfeller, Caterpillar
Naveed Khan, Iron Horse Tools
Paul Pastusek
Robert van Kuilenburg, Noble
Ryan Hanford, Speedcast
Sarah Kern, H&P
Sriram Vengalathur, HMH
Steven O'Neal, Capsher Technology
Tony Beebe
Trent Martin, Transocean
Trevor Braswell, Pason Systems
Walker Hubbard, Pason Systems
William Fox, Corva

IADC Committee Project Proposal Template

IADC Committee

IADC Advanced Rig Technology

Project Proposal Title

Drilling Data and Information Roadmap

IADC Committee Officer/Lead Proposal Contact (with contact information)

Blaine Dow and Sarah Kern

Project Description (including the purpose and beneficiary of the project proposal) *Please limit your description to 250 words or less.*

The IADC code system (DDR Plus) was last updated in 2020 with the capability to import digital data in a standardized format to enable greater levels of automation from industry advancements in sensor capability and computing power. The rate of industry digitalization adoption continues to increase and now digital drilling data from design, planning, and operational systems is available from many different platforms with varying formats. The need to further modernize the DDR Plus system is apparent to adapt along with the new systems and position it as the preferred drilling data collection and reporting system.

An initiative is proposed to study the current industry needs and determine options to respond to the changing needs with a method to manage the DDR Plus system going forward by:

a) Identify the current industry state for systems relevant to collecting and communicating drilling data for reporting systems.
b) Use a roadmap process to detail the following steps and deliverables.
c) Articulate a vision for DDR Plus maximizing benefit to industry stakeholders.
d) Illustrate scenarios describing possible future states supporting the vision
e) Assess the scenarios and recommend a path benefiting industry stakeholders
f) Recommend a method for IADC to manage implementing the preferred path

This work includes digitization and digitalization of drilling, completing (excluding stimulation), and P&A work including data from planning through execution and reporting. The desired outcome of this work is delivering an actionable plan to informed IADC decision makers to work with as they determine future industry actions.

Does the proposed project impact commercial advantage of companies operating in a specific sector of the oil and gas drilling industry? If 'Yes', please elaborate.

No

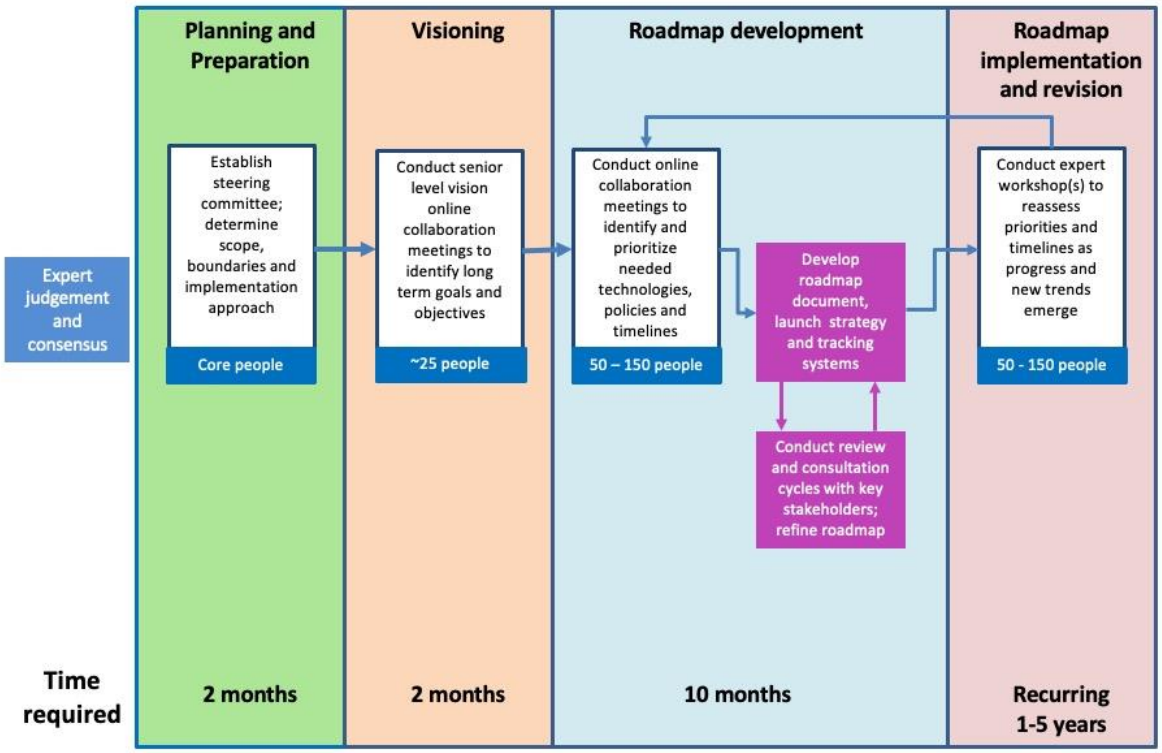
Please state what sector(s) this project will impact – Offshore, Drilling Services, International Onshore, North America Onshore

All sectors

Project Plan

This document outlines the intended process for an IADC DDR Plus proposal to assess and recommend how to modernize and sustain the IADC code system and keep it synchronized with current industry digitalization needs. The project is intended to be completed in steps as follows.

a) Identify the current industry state for systems relevant to collecting and communicating drilling data for reporting systems.
    a. DDR Plus is a subset of industry reporting and its relationship to other industry systems is changing. See the DDIR Current State document for an initial draft of an industry landscape document for describing the current state. The basic premise in describing this landscape using this method is operating on the theory stakeholders can manage what they measure.
    b. Deliverable: A document summarizing industry landscape to inform the project work group and later for decision makers.
b) Use a roadmap process to deliver steps c) – f) .
    a. The Sandia National Labs process for conducting roadmap is suggested. Details can be found at (https://dsaroadmap.org/roadmap-process/).



b. Deliverable: Use this method as needed to deliver the project deliverables.

c) Articulate a vision for DDR Plus maximizing benefit to industry stakeholders.
    a. Consider use cases including the following:
        i. Fit into digital drilling and wells ecosystem as part of the end to end value stream management systems under development in the industry.
        ii. Fit into interoperable wellsite systems under development that introduce additional data layers and services (ex. OSDU/Energistics, D-WIS, PPDM, …).
        iii. Linkage of IADC reporting and other reports (ex. Operator daily drilling report) – using rig states (including concurrent activities) and other measurements.
        iv. Standardization of definitions. There is much variation in basic definitions of states, activities, and measurements across operators and contractors (examples: when does spud occur in time?, When does drill-out start/stop?, When does a connection start/stop?,…)
        v. Role of IADC codes and subcodes in Smart Contracts.
        vi. Role of IADC codes in planning and operations with the increasing use of drilling operation automation. As this results in additional states/activities to be considered in a standardized way, how can this best be supported?
    b. Deliverable: A document describing the vision for IADC code system, its role, value, and management in the industry systems under development.
d) Illustrate scenarios describing possible future states supporting the vision
    a. This step is intended to describe how the work group sees implementing steps to fulfill the vision. By describing these scenarios, decision makers will better understand the technology, process, tools, and people required to work in the way the work group believes will deliver a resulting value. See Appendix for examples of scenarios brainstormed while working on the proposal.
    b. Deliverable: A document describing likely scenarios the project work group sees as a method to use and manage the IADC code system.
e) Assess the scenarios and recommend a path benefiting industry stakeholders
    a. Select and refine one or more scenarios from step d) with a value proposition and an action plan for implementation.
    b. Deliverable: A document describing an implementation action plan.
f) Recommend a method for IADC to manage implementing the preferred path considering stakeholders
    a. Summarize the project work and resulting recommendation for delivery to the IADC Advanced Rig Technology Committee, IADC executive committee, and other industry stakeholders.
    b. Deliverable: A presentation and document describing and summarizing the body of work completed for this project and resulting recommendation.

APPENDIX

Drilling Data and Information Roadmap (DDIR) Scenarios

Scenarios are a useful method to analyze potential alternative futures in n uncertain environment. The DDIR scenarios will be used to map potential outcomes in a roadmap format for insights. Into an industry way forward and the future application of DDR Plus.

Pre-Determineds

Drilling data and information systems are spread amongst 'islands' that are poorly connected due to both incompatible data / information structures and competitive ownership.

OSDU, as part of the Open Group, is in the process of developing and implementing structured data sources which everyone on a project can access with differentiation transferring from data ownership to applications processing the data.

Drilling state engines, systems that identify the activity underway from analysis of sensor data, have proliferated in recent years. Each system has its own definitions of the detected activities – some commonality exists through industry common terms but overall, there is no standardization.

Uncertainties

The industry has held various discussions on developing a common definition of drilling states and their transitions but has failed to launch such initiatives. Is the time ripe for development and adoption of a common industry standard.

Digitalization of drilling can logically lead to collaboration amongst suppliers on a project however resistance. To change. Leaves an uncertain path forward.

I Momentum Minus

The current state of data usage and management continues however efforts to develop interoperability across systems / companies fails to materialize. Data / information remains in islands of usage driven by ownership with limited collaboration.

II Momentum Plus

Enthusiastic practitioners and start up entrepreneurs add capabilities in data processing and interoperability leading to an advancement in deliverables from data usage. Major service companies invest in and deliver advancements in their digital offerings. Automation expands across most drilling operations as rig operating systems become common applications. The D-WIS initiative is successfully adopted creating true interoperability across data streams and automation instructions.

III Drilling State Engines Deliver Universal Granular Activity Data

Momentum plus is driven further by industry agreed states for state engines. In the mode of the OSDU initiative to develop common structures to share data, the industry decides to develop common definitions of drilling (or rig) states (drilling, tripping, reaming, making a connection, circulating, rotating, etc.). The initiative defines higher levels of states and key transitions leaving granularity and non-critical transitions to user choice. Rapidly adopted by operators who realize value through ability to make comparisons across their global operations regardless of suppliers and compare performance against industry collaborators. The “industry state definitions” become the norm for automated drilling reporting.

These drilling state engines feed all reporting systems through translators enabling DDR Plus to reside as the legal report of drilling operations.

Initial reluctance to agree a standard gave way to compliance as multiple companies realized that true performance evaluation to standard KPI’s and comparisons lead to overall improved performance. The oil and gas drilling industry recognized that overall performance improvement was of mutual benefit to maintain competitiveness of oil and gas against renewable options.

After drilling states had been agreed, the industry set about defining primary levels for equipment states (starting, running, etc.) and borehole states (hole cleaning, sloughing, influx, etc.).

IV Multiplicity of Drilling State Definitions Proliferate

Industry players have all invested in their own versions of state engines. While drilling or tripping are commonly recognizable states their transitions are inconsistent – when does drilling become tripping, when does an NPT event start and end? This smorgasbord of options seriously inhibits performance evaluation across industry and even across companies as different service providers and operators insist on their own solution.

Current States of Drilling Data and Information

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Introduction

Current state is intended to describe the state of the drilling industry in terms of data and information.

Listing Of Organizations Covering This Topic.

Many initiatives are underway or soon to start that address challenges relevant to digitalization and information of drilling wells. Knowing the roles of these various (volunteer) organizations has high value for following relevant developments.
A list of industry organizations working on or with drilling data and information are listed below (May 2023).

- IADC ART – (Advance Rig Technology committee) provide information and guidelines to improve safety and reliability of the interfaces between human and machine, and between multiple control systems.
    - DCS (Data, controls and sensors) & Maintenance Committees Sensor Stewardship Guideline. Objective was to develop sensor stewardship guidelines that enable drilling contractors and service providers to deliver high integrity and reliable data. Status - issued to industry.
    - DCS DDR Plus™ is a print and electronic data collection system aimed at securing accurate and relevant drilling data that industry can use to assess performance

against drilling Key Performance Indicators. Distributors include IDS (now SLB), NOV, M/D Totco, Infostat, Oilfield Instrumentation, Pason Systems, Apriside, Kwantis. Licensees include SeaDrill, Shelf Drilling, Tribollgas, Valaris, Transocean. There is a need to investigate there actual usage of DDR Plus.

- SPE DSATS – (Drilling Systems Automation Technical Section) accelerate the development and implementation of systems automation in the well drilling industry by supporting initiatives which communicate the technology, recommend best practices, standardize nomenclature and help define the value of drilling systems automation.
    - Drillbotics - an international competition for universities to design and build a small drilling rig that uses sensors and control algorithms to autonomously drill a rock sample provided by SPE's Drilling Systems Automation Technical Section (DSATS). Affiliated with SPE DSATS.
    - D-WIS – (Drilling and Wells Interoperability Standards) establish recommended practices and standards that enable interoperability between all components, equipment and systems used in oil and gas well construction – regardless of the type or provider. Affiliated with SPE DSATS and OSDU.
    - OSDC – (Open Source Drilling Community) a coalition of industry and academic leaders to support an open-source effort for drilling, to encourage the reuse of ever-improving models and code. Chartered by SPE DSATS.
    - DDQUD – (Drilling Data Quality and Uncertainty Description) to increase the awareness and understanding in the drilling community on how to describe drilling data quality and uncertainty. Chartered by DSATS, DUPTS and WPTS.

- SPE WPTS – (Wellbore Position Technical Section) to produce and maintain standards for the industry relating to wellbore survey accuracy.
    - ISCWSA – (Industry Steering Committee on Wellbore Survey Accuracy) produces, maintains, and publishes standards for the industry, promoting a collaborative understanding of issues associated with wellbore surveying. Affiliated with SPE WPTS.

- SPE DUPTS – (Drilling Uncertainty Prediction Technical Section) to provide international multidisciplinary forum for technical discussion and a consensus-based arena related to drilling uncertainty & prediction, which focuses mainly on artificial intelligence, machine learning and data science solutions supporting drilling planning and execution challenges.

- OGDQ – (Operators Group for Data Quality) further the state of the art of operational data and data systems which are material to the construction and servicing of oil and gas wellbores.
    - OGDQ with IADC ART. Field Verification of Rig Instrumentation for Oil and Gas Well Drilling Operations (API 8). Objective to provide recommended practices for the development of field verification procedures for critical drilling rig devices

used in drilling operations. Status - in process and out for voting on Rotary Torque, Make Up Torque, Hook Load, Rotational Speed, Block Position, Pressure, Pump Rate Output.

- Open Group OSDU Forum – (Open Subsurface Data Universe) delivers an Open Source, standards-based, technology-agnostic data platform for the energy industry that stimulates innovation, industrializes data management, and reduces time to market for new solutions.
    - Energistics - global consortium that facilitates the development of data exchange standards for the upstream oil and gas industry. Now incorporated in OSDU in the Open Group.
    - Wells Data Foundation. Integrate Operational and Engineering data to optimize well planning, design, development, and execution.
    - Well Planning DDMS. Well planning Data Domain Management Service (DDMS) is the development of services for handling well construction related domain data in OSDU.
    - Wellbore DDMS. Wellbore Data Domain Management Services (DDMS) is one of the several backend services that comprise Exploration and Production (E and P) software ecosystem. It is a single, containerized service written in Python that provides an API for wellbore related data.

- PPDM - (Professional Petroleum Data Management association) global, not-for-profit society within the petroleum industry that provides leadership for the professionalization of petroleum data management through the development and dissemination of best practices and standards, education programs, certification programs and professional development opportunities.

IOGP – (International Oil and Gas Producers) is a membership driven organization who aim to be the global voice of the industry pioneering excellence in safe, efficient, sustainable energy supply and an enabling partner for a low carbon future. As an independent, non-standards developing organization of global operators, IOGP can serve as a voice of the industry to influence international, global, regional and industry standards development and seek to agree to the preferred international standards. The DISC (digital and information standards subcommittee) seeks to identify and drive adoption of information standards to improve the integration between supply chain partners and support the introduction of digitalization technologies. IOGP works with ISO, OSDU, and other standards development organizations.

Associated Initiatives

- DSA Roadmap – (Drilling Systems Automation Roadmap) a cross-industry effort launched in June 2013 to provide insights to industry participants and non-industry participants regarding the adoption of advancements in drilling systems automation for both onshore and offshore oil and gas wells.
- DSABOK – (Drilling Systems Automation Body of Knowledge) disseminate Drilling Systems Automation (DSA) knowledge directly or through linkages to various industry recognized websites.

Examples of Interoperability Use Cases

One of the reasons so many different organizations are working different paths toward standardization is the work siloes present in well construction organizations. Different stakeholders within operators, for example, focus on well design, planning, and execution and it isn't unusual for each of these functions to have independent relationships with different service providers and systems. To illustrate the value of interoperability some different use cases are provided.

Drilling States and State Engines

Drilling states (sometimes called rig states) are the operational drilling activity underway at any point in time. Examples include drilling, reaming, tripping, etc. Drilling state engines are algorithms that process sensor data to determine the state of operations at any point in time. These state engines usually use rig site data streams that typically resolve to one second data. The state engines produce a far more granular report of activities than the IADC daily drilling report. These granular reports are used for monitoring connection times, crew capabilities, etc. to determine and improve performance.

Drilling state engines have been available for many years. Patents describing Drilling state engines date back to 2009 (SLB) and ??? (Noble / TDE). The TDE patent was found invalid by a US court in 2015. The state engines determine the activity state through combinations of sensor readings as shown in the table below from B du Castel SLB.

Comment	Input ▲	block	bottom	pump	rotate	slips	absent	classified	datagap
Rotary Drill	0	slow	onbottom	on	on	notslips	no	yes	no
Slide Drill	1	slow	onbottom	on	off	notslips	no	yes	no
InSlips	2	...	offbottom	...	...	inslips	no	yes	no
Ream	3	down	offbottom	on	on	notslips	no	yes	no
Run In, Pump	4	down	offbottom	on	off	notslips	no	yes	no
Run in, Rotate	5	down	offbottom	off	on	notslips	no	yes	no
Run In	6	down	offbottom	off	off	notslips	no	yes	no
Back Ream	7	up	offbottom	on	on	notslips	no	yes	no
Pull Up, Pump	8	up	offbottom	on	off	notslips	no	yes	no
Pull Up, Rotate	9	up	offbottom	off	on	notslips	no	yes	no
Pull Up	10	up	offbottom	off	off	notslips	no	yes	no
Rotate, Pump	11	stop	offbottom	on	on	notslips	no	yes	no
Pump	12	stop	offbottom	on	off	notslips	no	yes	no
Rotate	13	stop	offbottom	off	on	notslips	no	yes	no
Stationary	14	stop	offbottom	off	off	notslips	no	yes	no
Unclassified	15	...	...	...	...	...	no	no	no
Absent	16	...	...	...	...	...	yes	yes	no
Data Gap	17	...	...	...	...	...	no	yes	yes

Typically the activities can only be determined from traditional rig sensors rendering activities that do not incorporate sensors (e.g. nippling up) invisible unless a human is assigned the task. Recently cameras are being employed and trained to identify drilling states and even borehole states (shale shaker monitoring).