# EDGE AUTOPILOT<sup>TM</sup> TECH-POWERED PERFORMANCE

**DRILLING SOLUTIONS CATALOGUE** 



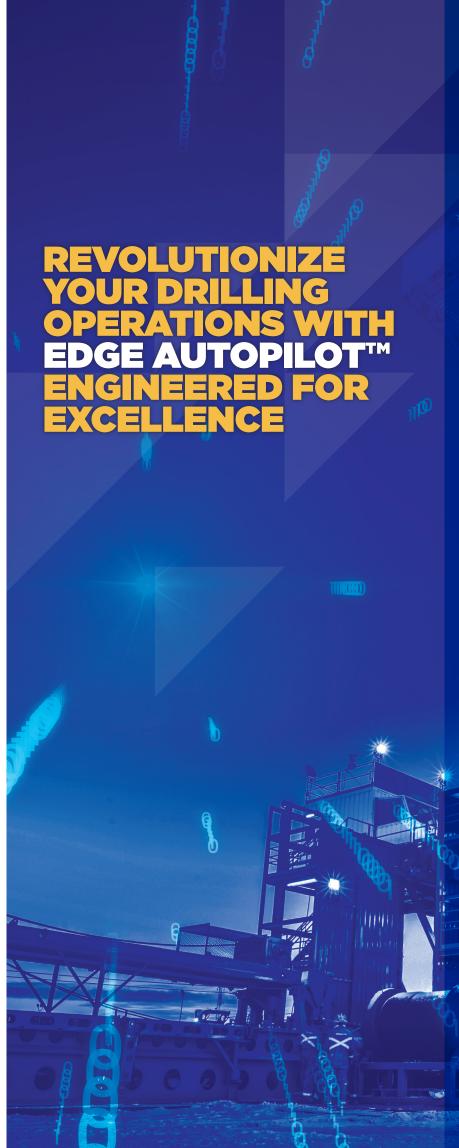






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EDGE AUTOPILOT™
COORDINATES
THE FULL SUITE
OF PROCESS
AUTOMATION TO
UNLOCK THE FULL
POTENTIAL OF OUR
RIG INTELLIGENCE,
ALGORITHMS AND
MACHINE LEARNING.

- 1. Applications automate processes and drive efficient and repeatable execution.
- 2. Analytics + Portal drive data-based decision making for continual improvement.
- Performance
  Management
  team will drive
  optimal repeatable
  performance on
  your rigs, making for
  enhanced well delivery.



# EDGE AUTOPILOTTM APPLICATIONS

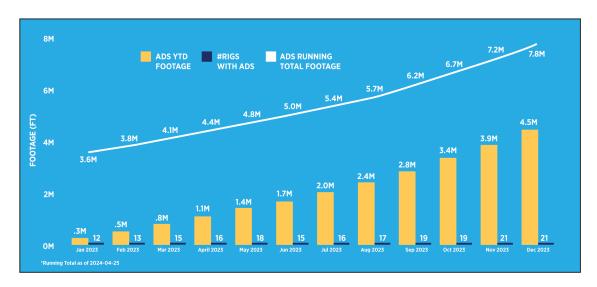
Navigate the future with EDGE AUTOPILOT™. The trailblazing technology that coordinates full process automation. Unlocking each rig's full potential with unmatched performance through intelligence, algorithms, and machine learning.

- 1. AUTOMATED DRILLING SYSTEM (ADS)
- 2. QUILL OSCILLATOR®
- 3. Z-TORQUE / SOFT TORQUE
- 4. AUTODRILLER
- 5. AUTO REAMER ENSIGN ADR
- 6. RIG IQ
- 7. AUTOMATIC TOOLFACE CONTROLLER (ATC)
- 8. AUTO DOWNLINK

# 1 AUTOMATED DRILLING SYSTEM (ADS)

#### **ELEVATING YOUR DRILLING EXPERIENCE**

The Automated Drilling System (ADS) is reshaping the drilling landscape through seamless automation of crucial tasks. This groundbreaking technology ensures a drilling operation characterized by unmatched consistency and a reliable wellbore delivery window. Having successfully drilled over 7.8 million feet using ADS from 2021 to 2023, our cutting-edge solution has demonstrated an impressive 90% year-over-year growth in footage from 2022 to 2023.



Discover the competitive edge of ADS, where industry-leading automation not only enhances efficiency but also ensures unwavering reliability in every drilling venture. Bid farewell to manual inconsistencies and welcome a new era of precision and performance in drilling operations.



Streamline analytic systems, resulting in time and cost savings.

Achieve analytical excellence effortlessly through in-depth automation, saving time and reducing costs. Leverage strategic task planning to maximize operational efficiency by scheduling tasks based on specific parameters.

Ensure compliance and operational control with real-time monitoring and alerts, keeping you informed and preventing deviations from the drilling program. Immerse yourself in the Automated Drilling System (ADS) advantage, where cuttingedge features redefine possibilities in drilling performance.

Revolutionize your drilling operations with industry-leading automation. The Automated Drilling System (ADS) is more than just a set of features; it's a commitment to unparalleled consistency, reliability, and operational efficiency.

#### 1. SEAMLESS OPERATIONAL AUTOMATION:

**Technical Excellence:** Activates and operates seamlessly, encompassing a spectrum of tasks from back to bottom, auto zeros, to mud circulating.

Competitive Emphasis: Experience unmatched consistency and reliability through our industry-leading automation, setting the benchmark for optimal operational efficiency.

#### 2. ANALYTICAL EXCELLENCE WITH ADS:

**In-depth Data Excellence:** Drives state-based automation, ensuring every ADS data point comes with context, eliminating the need for extensive data scrubbing.

Competitive Emphasis: Achieve analytical excellence effortlessly with our ADS, providing contextual data that not only saves valuable time but also significantly reduces costs, setting us apart in the competitive landscape.

#### 3. OPTIMIZED TASK EXECUTION:

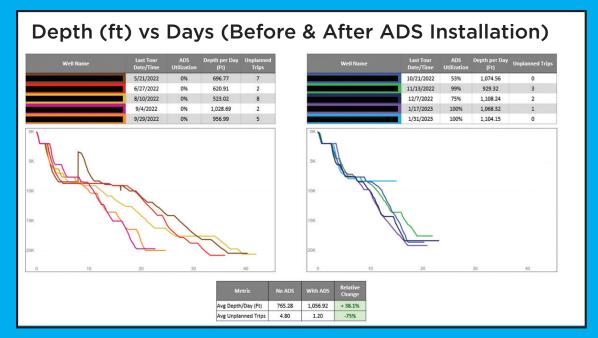
**Strategic Planning Capabilities:** The ADS includes a well planner, allowing scheduling based on bit or hole depth.

**Competitive Emphasis:** Ensure optimal task execution with our well planner, leveraging specific parameters like bit or hole depth, maximizing operational efficiency to surpass industry standards.

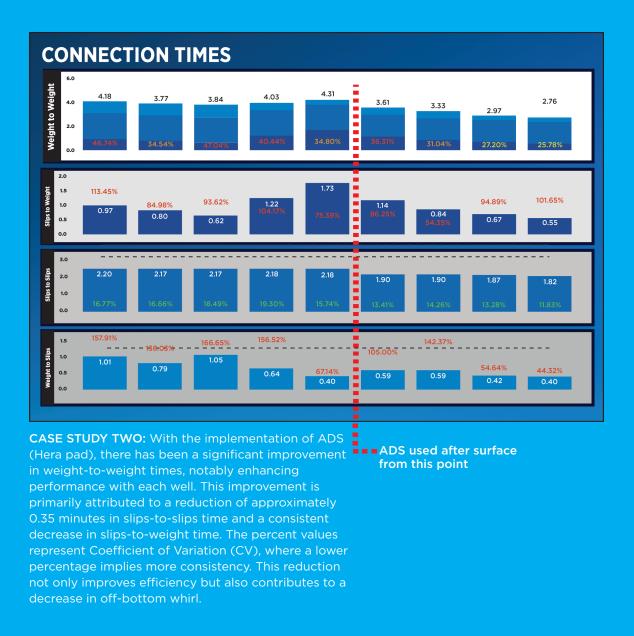
#### 4. PROACTIVE REAL-TIME MONITORING:

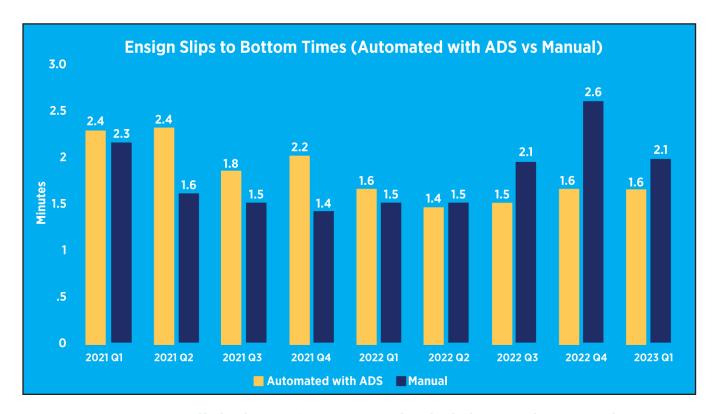
**Alerts for Accuracy:** Notifies users of new tasks, process deviations, or rig deviations in real-time.

**Competitive Emphasis:** Ensure compliance and meet goals with our proactive notifications.



CASE STUDY ONE: Ensign achieved a remarkable 38% improvement in daily footage and cut over 12 operating days per well for a leading energy company. This success was achieved by enhancing drilling connection consistency through the ADS, which led to fewer unplanned trips in ADS wells. The consistent success of this technology was showcased in five wells drilled before and after ADS installation on the same two well pads. The ADS substantially decreased unplanned trips across our ADS well portfolio. The outcomes highlight enhanced operational efficiency, delivering significant time and cost savings. Experience the Ensign advantage, where our innovations redefine drilling performance.





### Experience unparalleled consistency and reliability with our industry-leading automation, optimizing operational efficiency.

CASE STUDY THREE: Since its installation, our Automated Drilling System (ADS) has consistently reduced slips to bottom connection times each quarter for an operator in the Permian Basin, managing multiple Ensign rigs. In contrast, manual slips to bottom connection times remain relatively stagnant. The ADS effectively bridges the performance gap between less experienced and more experienced drillers, ensuring a consistent level of performance that can, over time, surpass even the manual processes of highly experienced drillers. The system not only enhances overall drilling efficiency but also minimizes downtime by reducing unplanned trips through decreased BHA wear.

#### Client Testimonial (Paraphrased)

There's undoubtedly a steep learning curve due to the extensive functionality, but so far, the experience has been entirely positive. The auto driller greatly outperforms the original in maintaining parameter thresholds. I believe it will prove highly advantageous once we become accustomed to it and utilize its full potential. The use of presets ensures it performs precisely as intended, rather than depending on a driller's judgment. The BHA is consistently picked off and returned to bottom exactly as desired. This consistency helps prevent bit balling and high shock, leading to improved performance during runs.

#### **Client Testimonial (Paraphrased)**

The system is complex, yet it leads to increased consistency among drillers. The auto driller appears to be significantly more effective compared to the earlier system. The standardization of going back to bottom and lifting off bottom is likely to enhance bit life and performance. I believe Ensign did an excellent job training the team on the system. Overall, I am very satisfied with the outcomes we've observed and anticipate further improvements as the drillers become more proficient with it.

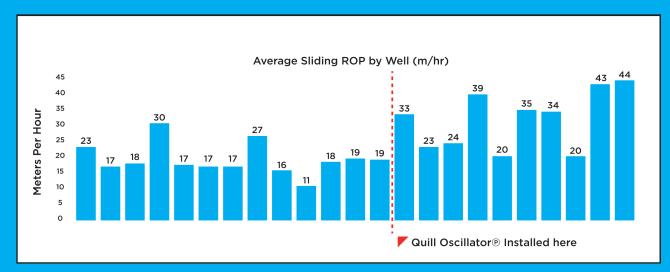
# 2. QUILL OSCILLATOR®

**EXCELLENCE REDEFINED FOR COMPETITIVE DRILLING** 



#### **GREATER SUPPORT FOR DIRECTIONAL DRILLING**

This software facilitates sliding and curve build segments of a well by rocking the drill string, reducing friction and enhancing weight transfer to the drill bit for improved directional steering and increased Rate of Penetration. Continuous improvement cycles involve constant communication between rig personnel and office experts.



**Quill Oscillator®** (**QO**) was installed on this rig in Canada. Immediately after installation on the same well pad with similar well profiles, the rig was able to achieve a higher Sliding Rate of Penetration (ROP). The ROP prior to using the QO was 19.2 m/hr. When QO was utilized, the ROP went to 31.5 m/hr. This is approximatley a 64.5% increase in ROP over the sliding intervals.

Experience a new standard in drilling excellence with the Quill Oscillator®, setting itself apart with patented machine learning algorithms that dynamically compensate for system inertia.

#### 1. PATENTED MACHINE LEARNING FOR PRECISION:

**Technical Advancement:** Utilizing patented machine learning algorithms, our Quill Oscillator® automatically adjusts for system inertia, a competitive edge in the realm of drilling precision.

Competitive Emphasis: Achieve unparalleled precision in quill movements, propelling the rate of penetration, enhancing toolface control, and optimizing hole cleaning. The Quill Oscillator® ensures a flawlessly consistent drill string rotation at a preset speed, eliminating slowdowns that hinder proper weight transfer.

#### 2. EFFORTLESS OPERATION FOR COMPETITIVE DRILLING:

**Versatility Redefined:** The Quill Oscillator® introduces adaptable modes catering to directional drillers – jog, oscillate, and pause, seamlessly applicable in torque, degree, or wraps mode.

Competitive Emphasis: Redefining the user experience, these modes not only reduce adoption rates but also curtail training requirements, offering unparalleled versatility and ease of use for operators. Step into the competitive advantage of excellence with the Quill Oscillator®. Elevate your drilling performance, stay ahead, stay precise.

#### 3. CASE STUDY: RIG PERFORMANCE TRANSFORMATION IN CANADA

The Quill Oscillator® made a significant impact when installed on a rig in Canada. Following installation on the same well pad with similar well profiles, the rig demonstrated remarkable improvements in Sliding Rate of Penetration (ROP). Before utilizing the Quill Oscillator®, the ROP stood at 19.2 m/hr. With the Quill Oscillator® in action, the ROP soared to an impressive 31.5 m/hr, signifying a remarkable 64.5% increase in ROP over sliding intervals. Experience the Quill Oscillator® advantage, where innovation meets outstanding performance.

# 3. Z-TORQUE / SOFT TORQUE

#### **ELEVATE YOUR DRILLING EDGE WITH ENSIGN**



#### **IMPROVES EFFICIENCY WITH A** WIDER DRILLING ENVELOPE

Ensign leads the way in delivering customized stick-slip mitigation solutions, reshaping drilling efficiency. By tackling torsional vibrations, we enhance wellbore delivery time, mitigating risks of premature Measurement While Drilling (MWD) failure, bit failure, and drill pipe fatigue.

#### 1. POWERFUL TOOL: Z-TORQUE/SOFT TORQUE

**Technical Superiority:** Z-Torque/Soft Torque emerges as a powerful tool, strategically designed to effectively mitigate stick slip.

Competitive Emphasis: Experience a remarkable reduction in unplanned trips and equipment failures, driving an overall cost reduction in well operations.

#### 2. OPTIMIZING WEIGHT-ON-BIT:

**Technical Ingenuity:** Z-Torque/Soft Torque pushes the boundaries of weight-on-bit application during drilling, setting new industry benchmarks.

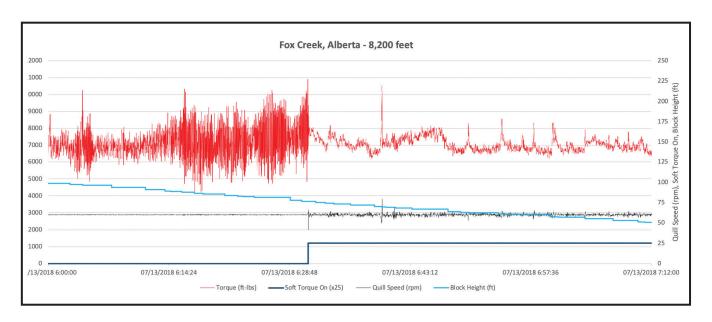
**Competitive Emphasis:** Safely elevate weight-on-bit settings beyond historical levels, delivering a significant boost to the rate of penetration.

#### 3. INTELLIGENT CONTROL WITH ADS INTEGRATION:

**Technical Precision:** Z-Torque introduces intensity parameters, strategically controlling stick slip mitigation with unparalleled precision.

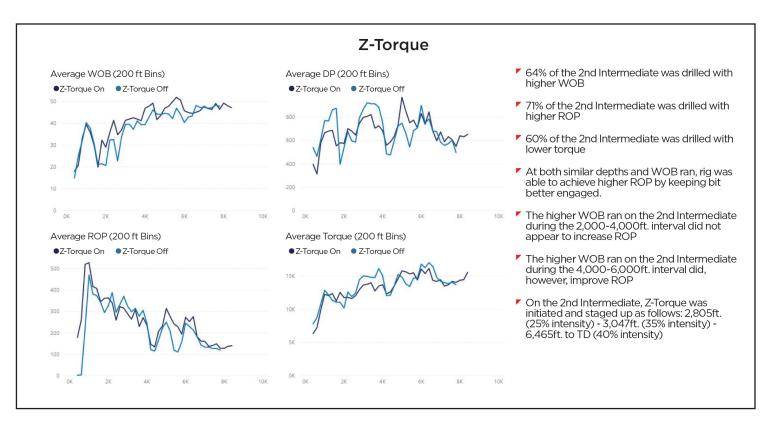
Competitive Emphasis: Integrated seamlessly with Ensign's Automated Drilling System (ADS), this ensures optimal intensity based on depth and drilling interval, preventing over-mitigation and potential issues.

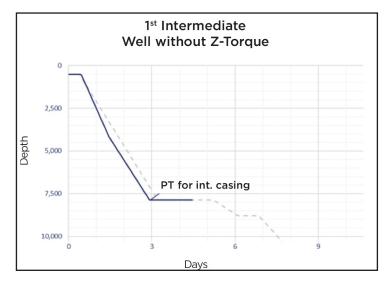
Unlock the operational efficiency, cost reduction, and performance optimization with Ensign's synergy of Stick Slip Mitigation solutions and ADS. Stay ahead, stay precise.

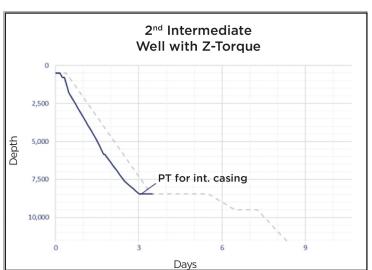


**Z-TORQUE / SOFT TORQUE.** In this case study of a full stand in the intermediate section being drilled on a rig in Canada, Soft Torque was switched on halfway through the stand and immediately decreased torque oscillations by over 80% and stopped stick-slip.

Stick slip occurs during on-bottom rotary drilling, posing challenges for Revolutions Per Minute (RPM) stability and on-bottom time. This phenomenon can abruptly halt the bit and bottom hole assembly (BHA), leading to rapid accelerations up to five times the surface RPM. Our Stick-Slip Mitigation software effectively addresses these challenges, widening the drilling envelope to deliver better RPM stability and increased ROP.







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### 4. AUTODRILLER

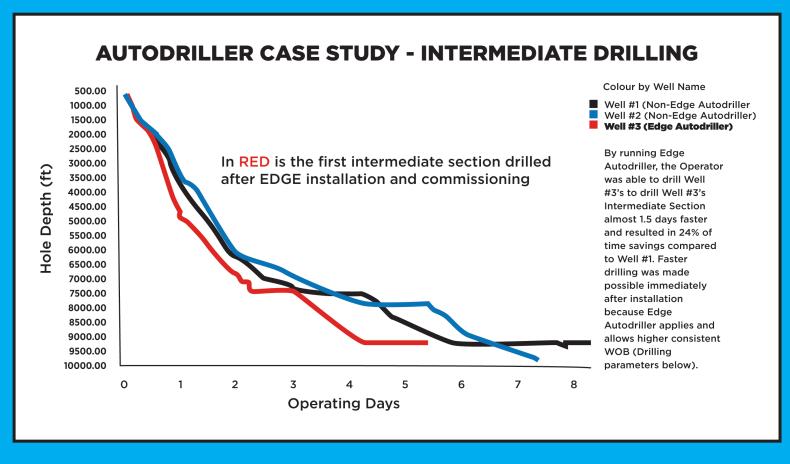
### **Mastery in On-Bottom Drilling**



### ACCELLERATE WELLBORE DELIVERY TIMES

Elevate your drilling precision with Ensign's proprietary AutoDriller, a pivotal force in controlling and stabilizing onbottom drilling parameters.

AutoDriller uses advanced algorithms to optimize the desired control mode, ensuring the correct WOB, Drill Pipe, Torque or ROP are held for the duration of the stand. The system continuously calculates and then switches to the optimum control mode to ensure smooth and consistent drilling. Drillers have sophisticated AutoDriller tuning capabilities at their fingertips.



#### 1. LARGEST AUTOMATION FACTOR:

**Technical Mastery:** The AutoDriller stands as the largest automation factor for onbottom drilling, employing diverse tuning profiles based on depth, formation, and BHA design.

**Competitive Emphasis:** This not only allows more aggressive weight-on-bit and differential pressure set points but also significantly increases the rate of penetration while effectively limiting dysfunction.

#### 2. INSIGHTFUL ANALYTIC CAPABILITIES:

**Enhanced Decision Making:** The AutoDriller provides greater insight into the drilling process by using onsite analytic systems. Real-time data is processed and disseminated to users, offsite personnel, and AI, empowering decision-making with new channels of data.

**Competitive Emphasis:** Elevate your decision-making process with up-to-date information, setting a new standard in drilling analytics.

#### 3. SEAMLESS INTEGRATION WITH EDGE AUTOPILOT™ APPLICATIONS:

**Enhanced Performance:** The AutoDriller seamlessly integrates with any EDGE AUTOPILOT™ App, with standard integrations available for common Mechanical Specific Energy (MSE) optimizing software packages.

**Competitive Emphasis:** Paired with MSE optimizing software, the AutoDriller further enhances performance, ensuring optimal functionality and compatibility.

#### 4. ADVANCED DYSFUNCTION LIMITATION ALGORITHMS:

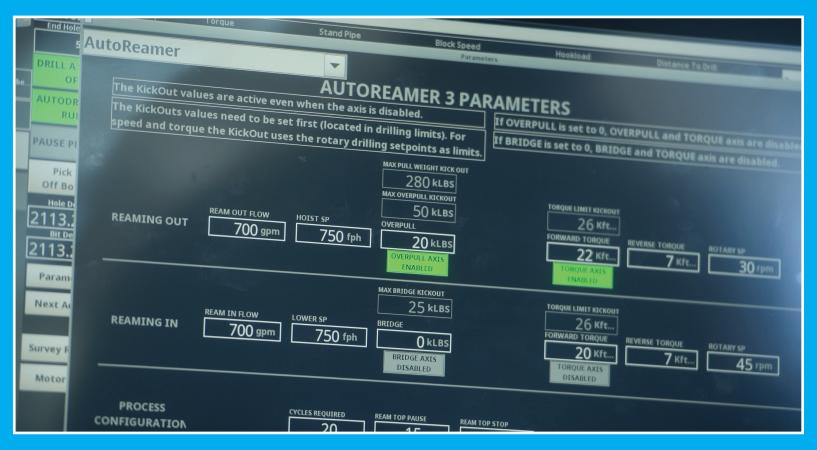
**Extended Bit Life:** The AutoDriller incorporates algorithms that limit dysfunction during bit engagement and prevent whirl by gradually ramping the ROP settings.

**Competitive Emphasis:** Improve bit life significantly by minimizing dysfunction during drilling transitions, setting new benchmarks in operational stability.

#### 5. AUTOMATED INTEGRATION WITH ADS:

**Optimized Drill Plan:** When paired with Ensign's Automated Drilling System (ADS), the AutoDriller takes automation to the next level. Tuning profiles, drilling set points, and control modes change automatically based on depth, BHA, or drilling section.

**Competitive Emphasis:** Boost rig performance by ensuring automatic parameter selection aligns with the optimized drill plan, setting Ensign apart in automated drilling solutions.



#### **ENSURES CONSISTENT OPERATIONS DURING REAMING**

### 5. AUTO REAMER

### **Elevating Operational Control**

Experience a transformative approach to drilling efficiency with our cutting-edge app that seamlessly automates the entire reaming sequence.

This innovative solution not only ensures precision and consistency in execution but also empowers drillers by freeing them from routine tasks.

As a customer-centric tool, our app goes beyond standard automation—it incorporates reaming instructions specifically tailored to your unique needs.

Liberate your drilling operations with Ensign's Automated Reaming App, where automation meets customization for unparalleled and efficient drilling performance.

#### 1. COMPLETE REAMING AUTOMATION:

**Effortless Management:** Automates the entire reaming process, allowing users to input different parameters and limits effortlessly.

**Competitive Emphasis:** Empowers the driller to efficiently manage the crew and focus on the overarching drilling process, enhancing overall operational control.

#### 2. UTILIZATION OF CONTROL LOOPS:

**Technical Precision:** Applies control loops, mirroring the same advanced technology used by the AutoDriller.

Competitive Emphasis: Enables the driller to navigate a tight hole with enhanced precision, minimizing the risk of stuck pipe and ensuring a seamless drilling experience.

#### 3. ADAPTIVE HOISTING AND LOWERING:

**Condition-Based Adjustments:** Adjusts the speed of hoisting and lowering the drill pipe based on wellbore conditions.

**Competitive Emphasis:** Ensures consistent operation during reaming, promoting wellbore integrity and significantly reducing common wellbore risks.

### 6. RIG IQ



SYSTEMS FOR COMMON DYSFUNCTIONS WITH REAL-TIME PERFORMANCE

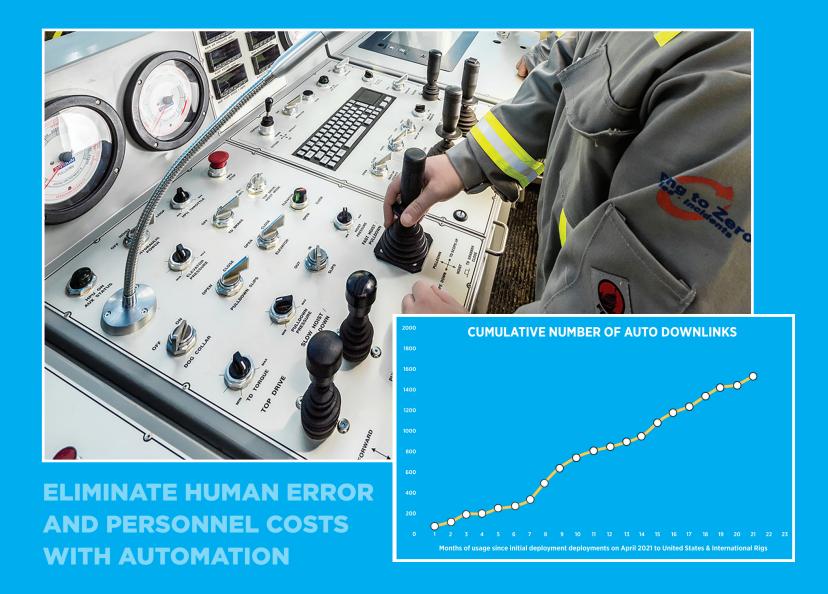
Rig IQ effectively reduces costs and resource demands for "Cloud" or back-office requirements. Unlock the full potential of rig data and derived analytics to mitigate dysfunction and enhance the Rate of Penetration (ROP). Leverage the capabilities of EDGE AUTOPILOT™ applications to gain valuable insights into well construction.

# 7. AUTOMATIC TOOLFACE CONTROLLER (ATC)



AUTOMATES THE DIRECTIONAL FUNCTION FROM DRILLER'S CABIN

The system maintains the downhole toolface by adjusting the quill position during sliding, crucial for accurate directional drilling. It automates the directional function from the driller's cabin, enhancing precision and efficiency. This allows for more effective management of drilling direction, improving speed and accuracy in complex environments.



## 8. AUTO DOWNLINK

### Enhance Operational Control, Delivering Unparalleled Drilling Performance

Automate downlinking functionality with Auto Downlink, minimizing human error and ensuring unparalleled accuracy.

Steer your well remotely to reduce on-site personnel costs and enhance operational efficiency.

Auto Downlink, our performance drilling app, redefines well steering proficiency by seamlessly integrating with Ensign's innovative solutions.

#### 1. VERSATILE PERFORMANCE APPLICATION:

**Technical Proficiency:** AP Auto Downlink offers the features and automation needed for both sophisticated and routine downlinks.

**Competitive Emphasis:** Enables rotary or flow, both on bottom and off bottom, catering to a wide range of drilling scenarios.

#### 2. GLOBAL COMMAND EXECUTION:

**Remote Well Steering:** Coupled with EDGE AUTOPILOT™ Portal, downlink commands can be sent and executed from anywhere in the world.

**Competitive Emphasis:** Empowers remote well steering, limiting the need for personnel on-site and reducing associated costs.

#### 3. INTEGRATED WITH ADS FOR SCHEDULING:

Improved Accuracy and Repeatability: When run with Ensign's Automated Drilling System (ADS), downlinks can be scheduled and automatically executed or initiated by the driller based on depth after notification.

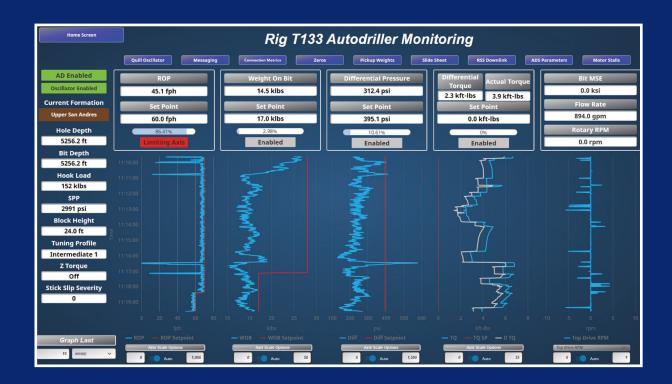
Competitive Emphasis: Elevates the accuracy and repeatability of downlinks in both rotary and flow scenarios, ensuring proper execution without excessive oversight.

#### A SUMMARY EXAMPLE OF DOWNLINK COMMANDS BEING SENT TO THE RIG FOR FUTURE EXECUTION

t-stamp		read by driller	
04/13/2021 14:40:01	At 13,621 feet use downlink command "Toolface Commands"	"TF O-SR 25"	UNREAD
04/13/2021 14:39:02	At 12,893 feet use downlink command "Toolface Commands"	"TF 270-SR 50"	READ
04/13/2021 14:38:27	At 11,563 feet use downlink command "Toolface Commands"	"TF O-SR 25"	READ
04/13/2021 14:37:57	At 10,256 feet use downlink command "Toolface Commands"	"TF 180-SR 25"	READ
04/13/2021 14:37:12	At 10,112 feet use downlink command "Toolface Commands"	"TF 45-SR 25"	READ
04/13/2021 14:36:44	At 9,843 feet use downlink command "Toolface Commands"	"TF O-SR 50"	READ
04/13/2021 14:36:21	At 9,523 feet use downlink command "Toolface Commands"	"TF O-SR 25"	READ

#### Client Testimonial (Paraphrased)

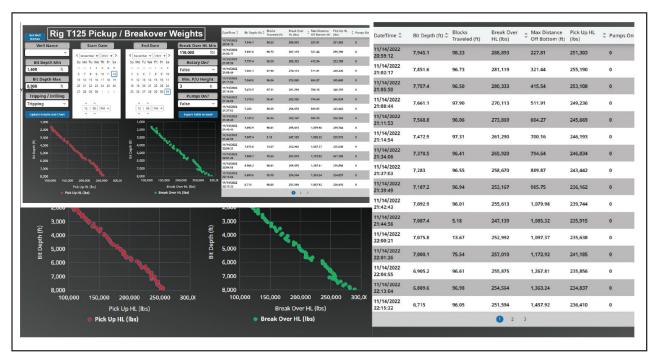
Everything is going well so far. The experience has been great, and I'm particularly interested in the back to bottom automation. This could allow us to reduce the number of directional staff for the production section on the next pad, which would be a significant advantage.

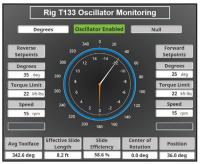


# ENSIGN'S ENHANCED CUSTOMER PORTAL

#### **ELEVATING RIG PERFORMANCE**

Transform your drilling operations with Ensign's Enhanced Customer Portal, delivering an immersive experience akin to being in the driller's cabin. The EDGE AUTOPILOT™ Portal, a secure web-based platform, ensures on-demand access to well data precisely when and where our customers need it for swift, informed decision-making. Harness the power of data through the EDGE AUTOPILOT™ Analytics Dashboard to enhance rig performance seamlessly. With the EDGE AUTOPILOT™ Portal, you can monitor KPI's, access real-time rig data, and streamline communication between the rig and the office, elevating your experience to a new level.







#### 1. REAL-TIME PERFORMANCE INSIGHTS:

**Effortless Access:** The Edge Portal effortlessly monitors rig performance, offering easy access to setpoints, Key Performance Indicators (KPIs), and configurable targets.

**Competitive Emphasis:** Seamlessly access real-time or historical sensor, machine, or contextual data through the EDGE Drilling Dashboard, providing a comprehensive understanding of rig performance and empowering optimized decision-making.

#### 2. AUTOMATED REPORTING AND PERFORMANCE BENCHMARKING:

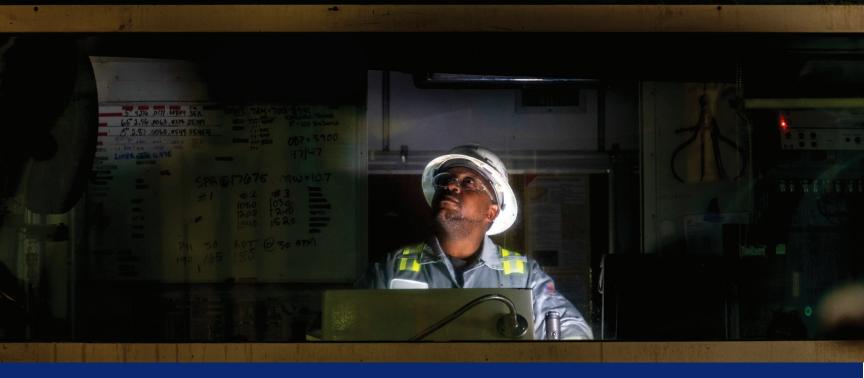
**Report Generation:** Generate automated reports within context for a closer look at performance and simplified benchmarking.

**Competitive Emphasis:** Effortlessly compare performance metrics, pinpointing areas for improvement and empowering strategic decision-making.

#### 3. EFFICIENT COMMUNICATION AND INTEGRATED WELL PLANNING:

**Well Plan Upload:** The Edge Portal allows direct uploading of a well plan to the Automated Drilling System, streamlining communication between the rig and the office.

**Competitive Emphasis:** Overcome communication hurdles, achieve enhanced consistency, and optimize efficiency by delivering connection parameters, scheduled tasks, and direct messages directly to the on-site driller.

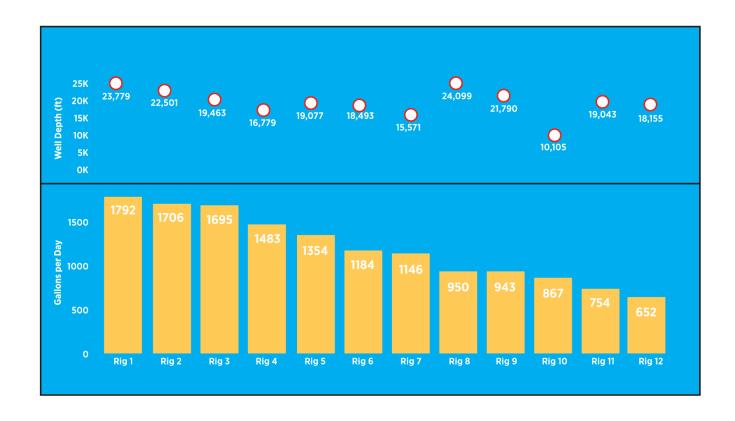


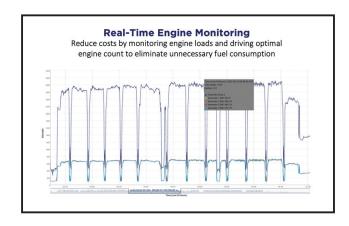
# PROACTIVE ENGINE MANAGEMENT

#### **OPTIMIZING OPERATIONS**

Ensign's Proactive Engine Management initiative represents a strategic step forward while optimizing operational costs. By leveraging advanced data analytics, we synchronize engine management schedules with rig activity, gaining valuable insights.

Our commitment to Proactive Engine Management enhances operational efficiency, leading to a more cost-effective future.





#### Real-Time Engine Monitoring

Reduce costs by monitoring engine loads and driving optimal engine count to eliminate unnecessary fuel consumption.

#### **KEY FEATURES:**

- 1. Optimal Load Compliance: Achieve optional load compliance and reduce costs.
- 2. Power Management Schedule: Implement a proactive power management schedule, utilizing historical data to determine the optimal active engine count per section and well activity.
- **3. Proactive Management Advisory:** Benefit from a proactive management advisory. Display current and active engine count directly to the driller on the Human-Machine Interface (HMI), reducing active engine hours and promoting higher efficiency in engine loads.



# THIRD-PARTY APPLICATIONS

#### REVOLUTIONIZE RIG AUTONOMY WITH EDGE AUTOPILOT™

Explore the future of rig autonomy with confidence—EDGE AUTOPILOT™ sets a new standard for versatility, customization, and unrivaled service. Our continually expanding network of rigs, equipped with the latest EDGE AUTOPILOT™ ADS technology, ensures safe and efficient drilling with a proven track record of success.



Enhance your drilling operations with innovative Ensign and third-party-developed technologies.

### DISCOVER THE UNMATCHED POWER OF EDGE AUTOPILOT™ AND UNLOCK YOUR COMPETITIVE ADVANTAGE WITH THESE KEY FEATURES:

- UNIVERSAL VERSATILITY: Experience the freedom to install EDGE AUTOPILOT™ on ANY rig. Unlike other systems designed for specific rigs, EDGE AUTOPILOT™ is a universal technology, setting a new standard for versatility.
- 2. TAILORED TECHNOLOGY AND ANALYTICS: Elevate your drilling operations with EDGE AUTOPILOT'S fully customized suite of cutting-edge technology and analytics. We don't just meet your needs; we redefine them.
- 3. EXCEPTIONAL SERVICE, EVERY STEP OF THE WAY: Gain peace of mind with our dedicated Drilling Solutions team, ensuring that you receive exceptional service and support throughout your journey with EDGE AUTOPILOT™.
- 4. PERFORMANCE EXCELLENCE: Elevate your drilling performance with our outstanding Performance Drillers team. We are committed to ensuring your success by providing continuous follow-up and support.

#### **Training**

At Ensign, we're proud that our people meet rigorous skill and safety standards, providing our customers with a consistent level of service on all their projects. We know that when our crews mobilize, our people are not only capable and experienced but also ready to excel. Ensign believes that quality training for our people translates to quality service for our customers.

This approach to customer service is routed in Ensign's enterprise-wide Global Skills Standard

(GSS). GSS is an approach to training that uses a standardized curriculum to ensure and guarantee Ensign's people (specifically rig crew) around the world, meet our global criteria for skills and competency, enabling us to provide a consistently high level of service in all our operations.

Our customers deserve the assurance that Ensign meets benchmark standards of performance, regardless of the size or location of an operation.

#### **Health, Safety and Environment (HSE)**

At Ensign, we're striving for a perfect Health, Safety and Environment (HSE) record.

In our industry, there's no compromise on health and safety. Ensign is never complacent about safety performance. We believe all incidents are preventable. That's why we train our employees in a high-performance safety culture and are continuously Driving to Zero®.

Zero safety incidents. Zero injuries. Zero absences due to injury.

Training starts on the first day of employment and is continuously reinforced through rigorous job safety analysis practices, personal injury prevention training, safety coaching, pre-job safety meetings, and work observation and intervention programs.



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