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DRILLING OPTIMIZATION AND AUTOMATIC RIG IN OMV PETROM: INTEGRATING ADVANCED DIGITAL TECHNOLOGIES IN DRILLING OPERATIONS

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Abstract: *As the energy sector confronts the dual imperatives of decarbonization and digitalization, OMV Petrom has initiated a comprehensive transformation of its upstream operations through the DigitUP program. This paper explores the company's strategic integration of advanced digital technologies into its drilling workflows, emphasizing the deployment of automated drilling systems, real-time monitoring platforms and data-driven optimization tools. Central to this transformation are the cloud-based drilling reporting system, coherent well planning solution, real-time drilling data monitoring platform, drilling performance management system and the AR 150 automatic rig, all of which contribute to a closed-loop digital workflow encompassing planning, execution and post-well analysis.*
The study presents operational and performance data illustrating significant improvements in drilling efficiency, including increased rate of penetration (ROP), reduced well delivery time and minimized non-productive time (NPT). Key performance indicators (KPIs) are utilized to track operational behavior and guide continuous improvement, while predictive analytics and machine learning algorithms enable dynamic parameter adjustment and failure prevention. Additionally, using electrical rigs and automation of tasks support OMV Petrom's sustainability and safety objectives.
The findings demonstrate that OMV Petrom has established a scalable, digitally integrated model for high-performance drilling. This approach not only enhances organizational agility and technical excellence but also aligns with broader environmental and economic goals. The paper concludes that the DigitUP initiative positions OMV Petrom as a leading example of how legacy oil and gas operators can successfully transition toward a future-ready, data-driven operational paradigm.
Keywords: *drilling optimization, rate of penetration (ROP), drilling performance, drilling automatization, automatic rig, cost savings, decarbonization, drilling parameters, safety enhancement. digitalization, software, drilling bit, non-productive time (NPT), invisible lost time (ILT), key performance indicator (KPI), mechanical specific energy (MSE), digital workflow, predictive maintenance, drilling automation, upstream innovation, data-driven operations, sustainable drilling, energy sector transformation, greenhouse gas (GHG).*

1. Introduction

As the global energy sector undergoes a profound transformation driven by decarbonization imperatives, technological innovation and heightened market volatility, oil and gas companies are increasingly turning to digitalization as a strategic enabler of long-term competitiveness and operational resilience. In this rapidly evolving landscape, OMV Petrom — the largest integrated energy company in Southeastern Europe — has embraced a bold and comprehensive approach to digital transformation through its flagship initiative, DigitUP [1].

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DigitUP represents more than a technological upgrade; it is a fundamental reimagining of how OMV Petrom designs, executes and optimizes its upstream operations. By integrating advanced digital platforms, real-time data analytics, automated systems and artificial intelligence into its core workflows, the company aims to transition from legacy operational models to a data-driven, performance-oriented enterprise. This transformation is particularly evident in OMV Petrom's drilling operations, where the deployment of automated rigs, intelligent monitoring systems and integrated planning platforms is reshaping the way wells are delivered — faster, safer and more efficiently [2].

This paper provides a comprehensive analysis of OMV Petrom's digital transformation in the drilling domain, focusing on the practical implementation of technologies such as the *cloud-based drilling reporting system*, *coherent well planning solution*, *real-time drilling data monitoring platform*, *drilling performance management system* and the AR 150 automatic rig. It also highlights how the strategic use of key performance indicators (KPIs) enables real-time performance tracking and continuous improvement. From reducing well delivery times and non-productive time (NPT), to optimizing connection practices and bit selection, OMV Petrom's data-centric approach is setting new benchmarks in operational excellence [1].

By exploring the synergy between engineering rigor and digital innovation, this paper demonstrates how OMV Petrom is not only enhancing its current operational capabilities but also laying the foundation for a scalable, future-ready drilling model — one that is aligned with both economic goals and environmental sustainability targets.

2. Digital Transformation Initiatives at OMV Petrom

OMV Petrom's commitment to digital transformation is epitomized by the launch of its comprehensive DigitUP program, a cornerstone initiative aimed at redefining the company's operational model and establishing its position as a digital leader within the global energy sector. The DigitUP program reflects a strategic vision to harness emerging technologies and digital capabilities to streamline operations, reduce costs and adapt to the dynamic demands of the energy market [3].

In alignment with its digital transformation roadmap, OMV Petrom has undertaken substantial efforts to digitally modernize its drilling operations, focusing not only on automation and real-time data usage, but also on the standardization and integration of planning and reporting tools across the organization. Figure 1 provides a concise overview of the digitalization flow in the drilling process in OMV Petrom from 2015 to the present.

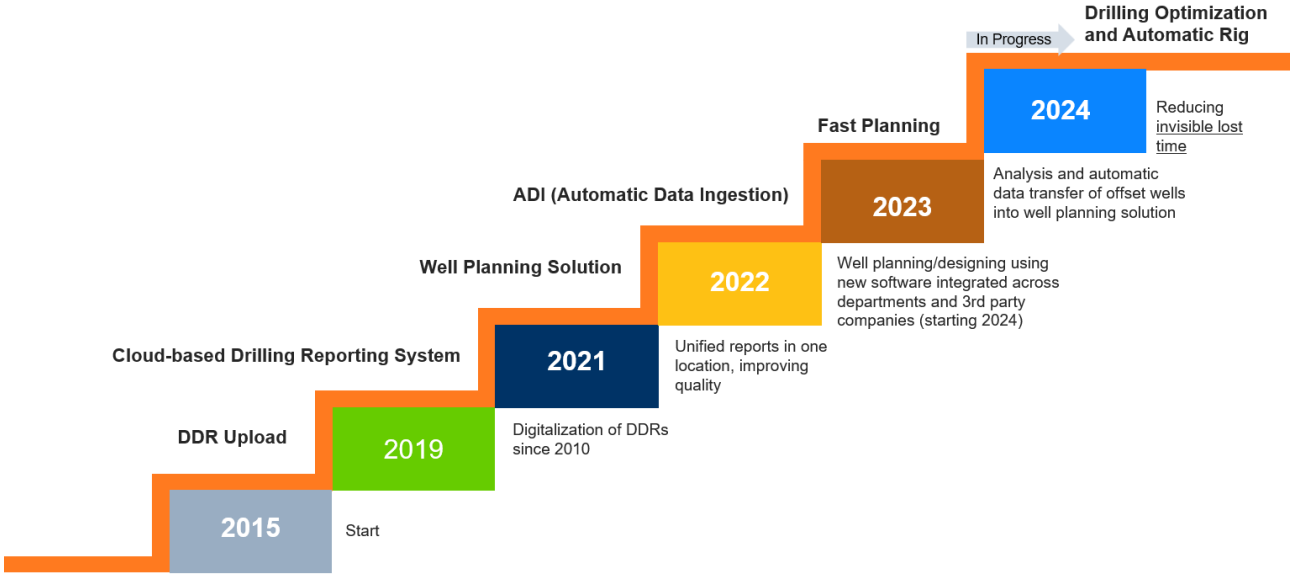


Fig. 1. Drilling digitization in OMV Petrom

A key component of this modernization is the digitalization of daily drilling reports (DDRs) through the implementation of the *cloud-based drilling reporting system*. This platform enables automated data ingestion (ADI), eliminating the need for manual entry and ensuring consistency, accuracy and faster decision-making. By centralizing DDRs within *cloud-based drilling reporting system* and aligning them with corporate data standards, OMV Petrom has streamlined communication between field teams, engineering offices and third-party contractors, greatly enhancing transparency and operational oversight.

Moreover, OMV Petrom has adopted *coherent well planning solution*, a state-of-the-art well construction planning platform developed by SLB (formerly Schlumberger), which allows for the collaborative design and execution planning of wells in a digitally unified environment. *Coherent well planning solution* consolidates offset well data, geomechanical models, casing designs and BHA configurations into a single digital workflow that can be accessed and updated by multidisciplinary teams. The platform not only accelerates planning cycles but also reduces the likelihood of design inconsistencies and fosters better integration across subsurface, drilling and logistics disciplines.

One of the standout innovations enabled by this digital ecosystem is the use of the automatic drilling rig, introduced in 2024. This fully automated rig integrates is capable to receive pre-programmed drilling instructions based on offset well data and engineering simulations. The rig is also capable of automatically adjusting key drilling parameters, such as Weight on Bit (WOB), Rotary Speed (RPM) and Mud Flow Rate, based on downhole feedback in real time. When combined with historical performance data and digital lookbacks, this system optimizes connection times, minimizes invisible lost time (ILT) and ensures adherence to performance-based key performance indicators (KPIs).

In support of real-time performance monitoring, OMV Petrom utilizes the *real-time drilling data monitoring platform* — an advanced digital platform that captures, visualizes and analyzes rig activity and drilling data in real time. *Real-time drilling data monitoring platform* enables the central operations team to remotely track critical drilling events, detect anomalies and assist field crews in applying performance corrections instantaneously. This contributes to safer, more predictable operations and aligns with OMV Petrom's broader strategy of digital supervision and centralized control [4].

For post-drilling analysis and forward-looking optimization, the company employs the *drilling performance management system* — a digital application designed to aggregate operational data, benchmark performance across multiple wells and suggest optimization strategies based on historical and real-time inputs. *drilling performance management system* supports the identification of "invisible lost time" sources, inconsistencies in rig crew performance and inefficiencies in tripping or connection practices, thereby driving continuous improvement across the drilling portfolio. Figure 2 presents an overview of drilling optimization opportunities, highlighting the impact caused by invisible lost time (ILT).

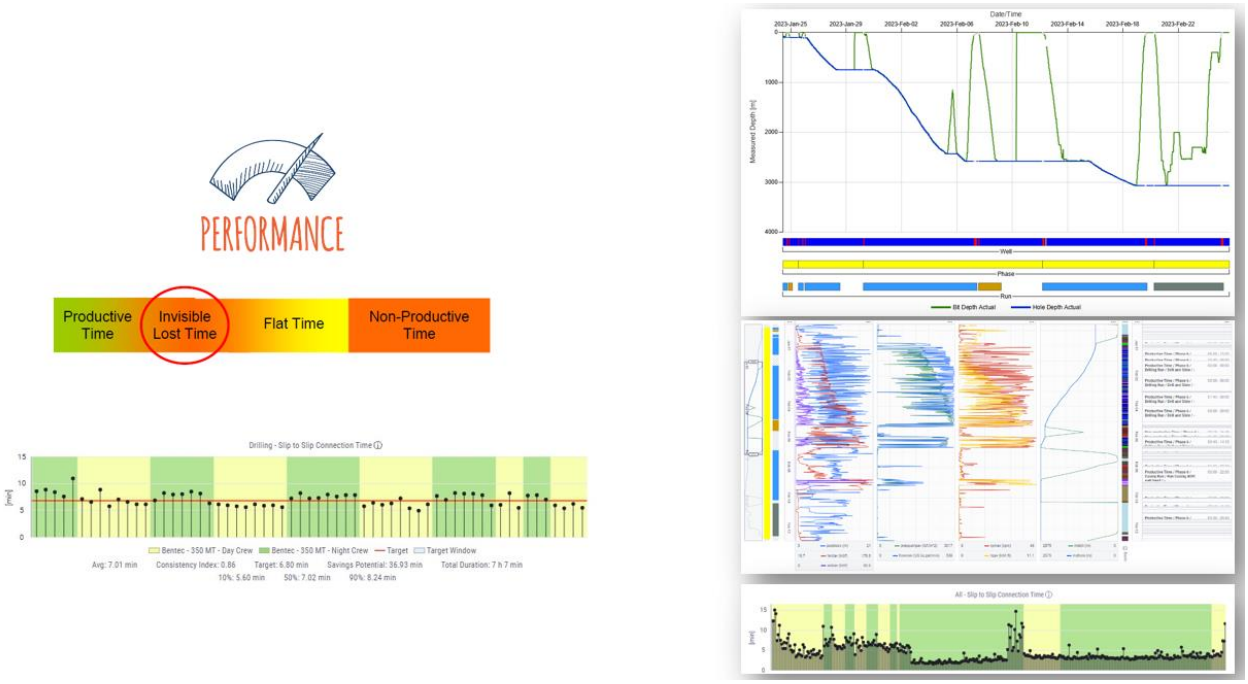


Fig.2. Optimization opportunities [4]

Additionally, the synchronization of planning and execution data between *coherent well planning solution* and *cloud-based drilling reporting system* creates a closed-loop digital workflow — from well design to real-time execution monitoring and post-well performance evaluation. This integration supports the continuous refinement of drilling practices and reinforces the application of lessons learned in future campaigns.

Altogether, these technological advances represent a shift from fragmented, manual planning systems to a digitally integrated drilling environment, where data flows seamlessly between platforms, decisions are informed by real-time analytics and operational consistency is ensured across the enterprise.

Together, these DigitUP components, including *coherent well planning solution*, *cloud-based drilling reporting system*, *real-time drilling data monitoring platform*, *drilling performance management system* and the automated rig, are designed not only to enhance operational efficiency and scalability, but also to improve organizational agility — enabling OMV Petrom to respond rapidly to technological advances, market volatility and sustainability requirements. Through this program, OMV Petrom exemplifies how a legacy oil and gas company can evolve into a data-driven, technology-enabled energy enterprise.

3. Deployment of Automated Drilling Rigs

In 2024, OMV Petrom launched a groundbreaking drilling campaign featuring the deployment of a next-generation automated drilling rig, developed by Huisman, a globally recognized manufacturer of advanced engineering systems for the energy sector. This strategic implementation, emerging from the broader DigitUP digitalization program, marks a pivotal step in the company's ambition to modernize its upstream operations through automation, electrification and real-time data integration. Figure 3 shows the HM 150 automated rig installed at the wellsite [5, 6].

Fig. 3. Automatic Rig HM 150 [6]

The drilling operations commenced in July 2024 with the AR 150 rig and by the end of the initial phase, seven wells had been successfully drilled in Romania, including both appraisal and development wells. The rig incorporates a series of sophisticated features that collectively represent a paradigm shift in onshore drilling operations.

At the core of the rig's architecture lies a high degree of automation, enabled by a SCADA system that offers centralized real-time control and monitoring. The automated driller system dynamically adjusts key parameters such as weight on bit (WOB), torque and rotation speed based on live downhole conditions. These capabilities reduce physical workload, minimize human error and enhance consistency and safety. The automated system also enables hands-free operations like tripping, casing running and casing fill-up, with all critical operations controllable from the driller's cabin [7].

The rig is powered by a fully electric central system, replacing traditional diesel generators. Combined with the rig's crane-less modular trailer design and real-time optimization, this leads to significant reductions in fuel consumption and reduction in CO_2 emissions, aligning with OMV Petrom's long-term decarbonization goals.

The AR 150 rig is trailer-mounted and highly mobile, designed for fast pad-to-pad moves without the need for cranes. Its modularity reduces rig-up and rig-down times, increasing utilization and decreasing total well delivery time. Upgrades such as the TopDrive Trolley and Automatic Mudbucket have improved safety and reduced manual operations during transitions.

Equipped with a dense sensor network and a robust fiber-optic communication infrastructure, the rig enables high-frequency acquisition of downhole and surface parameters. This data is processed in real-time and integrated into OMV Petrom's cloud-based digital ecosystem via an OPC-UA server, facilitating predictive maintenance, drilling performance optimization and dynamic trajectory control.

The system is designed to enable a higher level of automation, with the potential to leverage artificial intelligence and machine learning technologies. Algorithms process real-time and historical data to optimize ROP, avoid stick-slip, minimize vibration and adapt drilling parameters dynamically. Drilling mode selection is also automated, with the system transitioning between rotary, sliding and geosteering modes based on borehole tortuosity and formation feedback [7].

Field data revealed a 30% increase in net ROP on average, compared to conventional rigs. Time vs. depth comparisons clearly show superior efficiency of the automatic rig. A potential saving of approximately 5 days was identified for the 5 wells analyzed for a total of 10,356 meters drilled, translating into significant cost savings. Figures 4 and 5 illustrate the comparative rate of penetration (ROP) between the automated rig and the conventional one, while Figures 6 and 7 present a comparative analysis of wells drilled with the two types of rigs, highlighting the lithology and well profiles. The complete ROP benchmark is presented in Figure 11 [6].

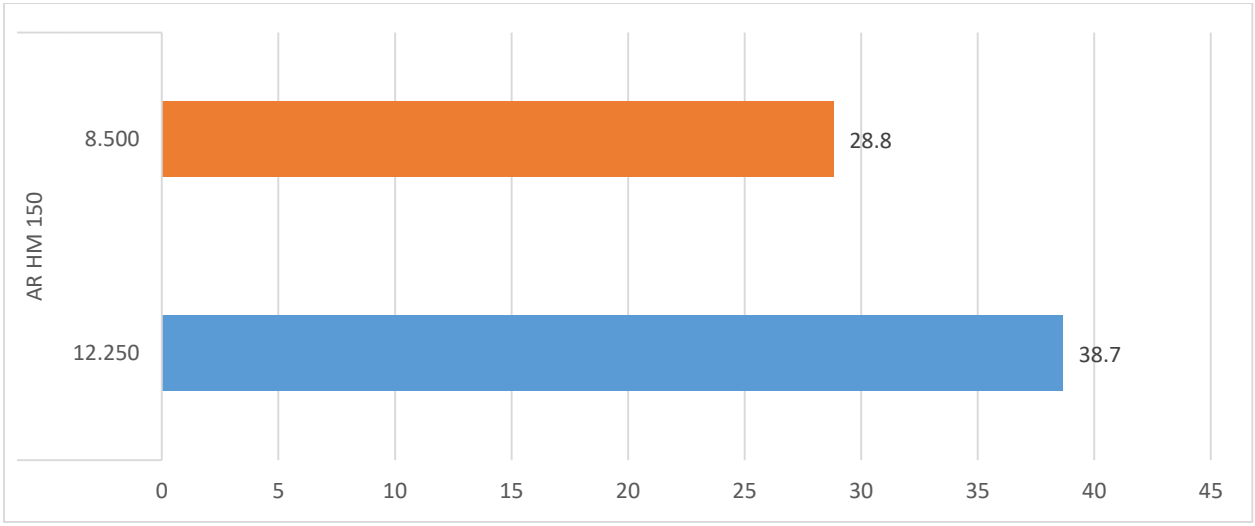


Fig. 4. Average - Net ROP per Stand, Avg (m/h) – Automatic Rig [6]

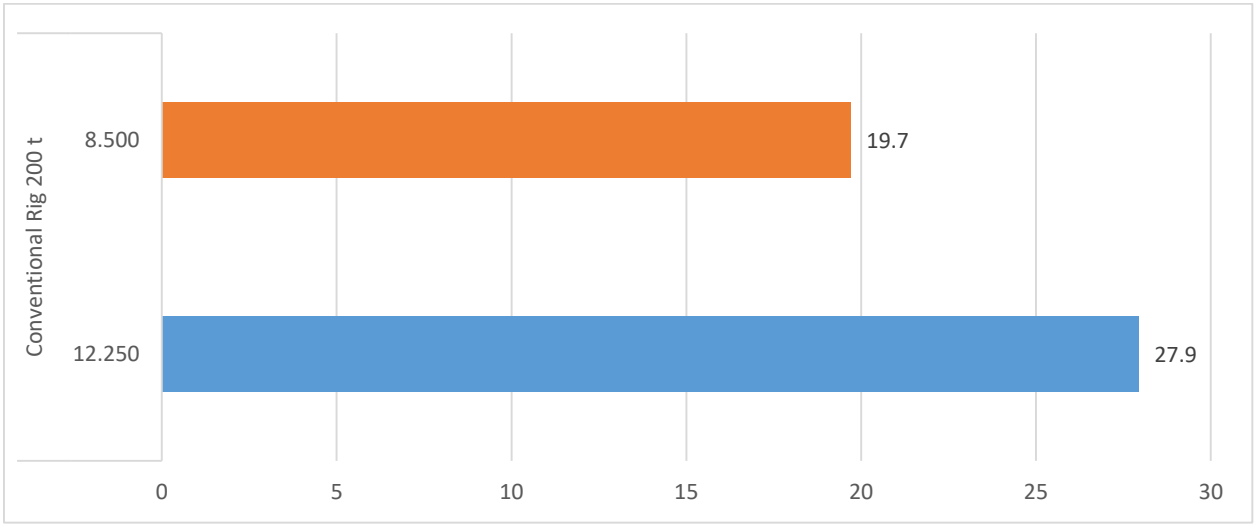


Fig. 5. Average - Net ROP per Stand, Avg (m/h) – Conventional Rig [6]

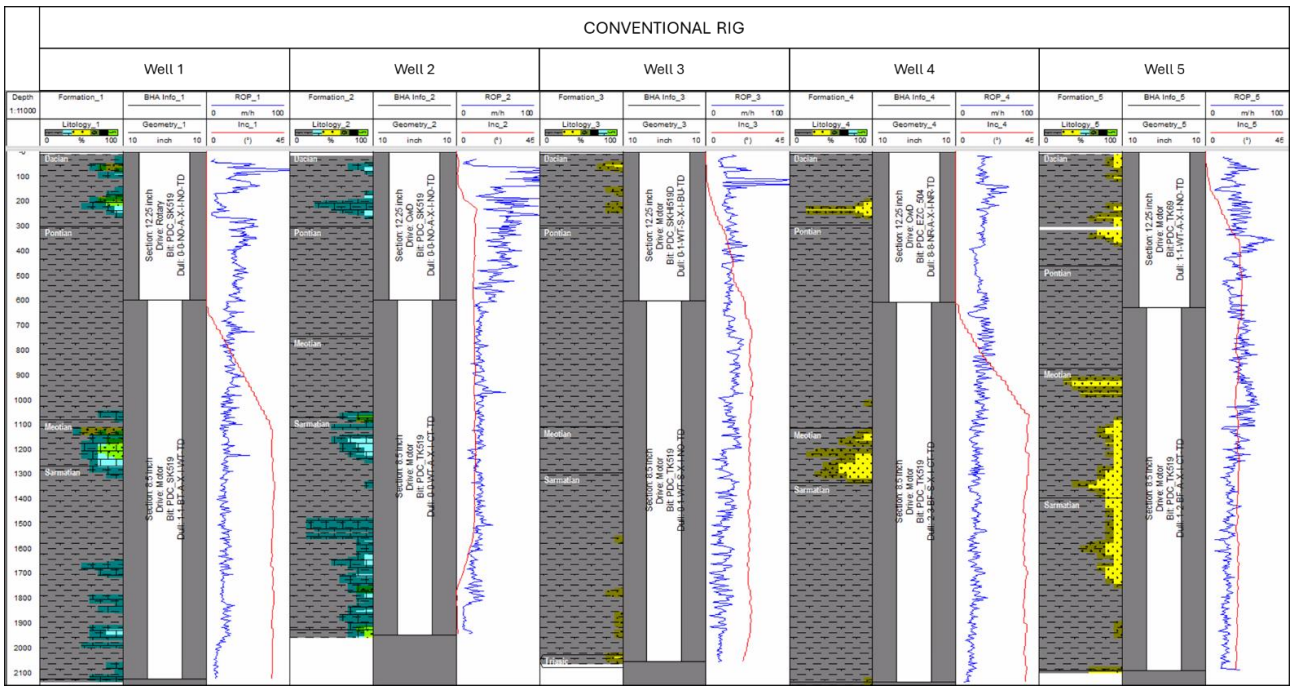


Fig. 6. Performance analysis – Conventional Rig [6]

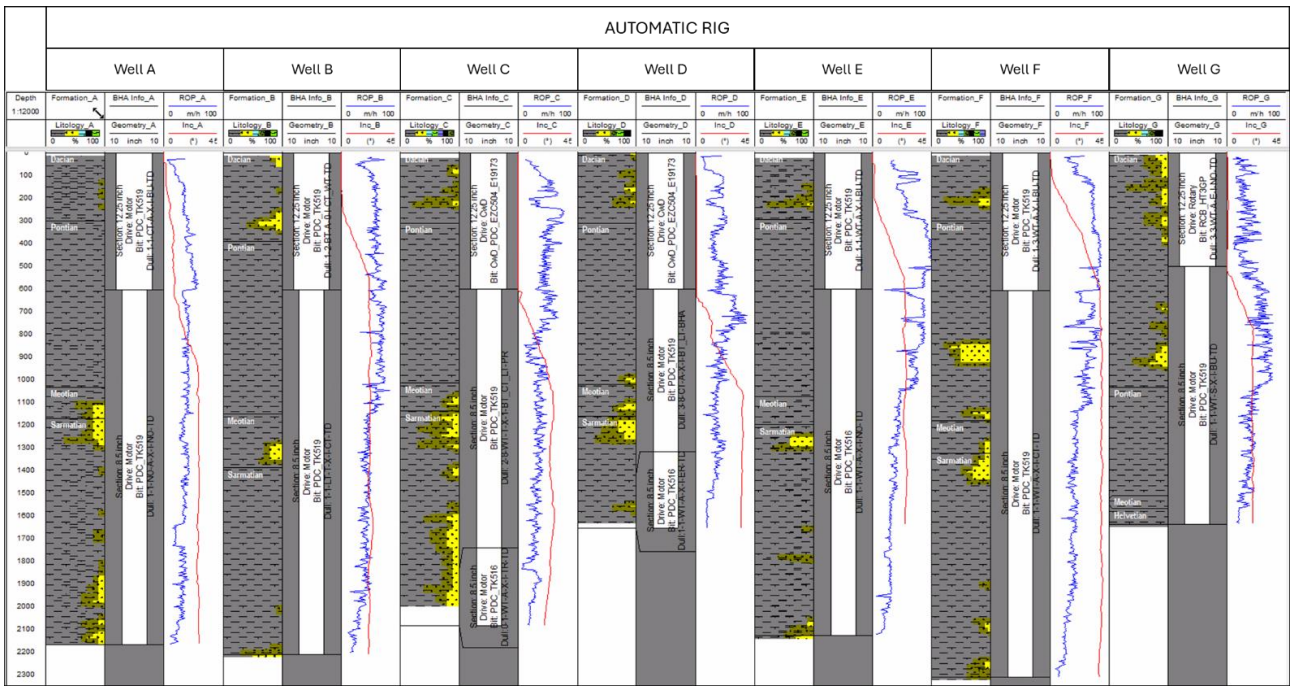


Fig. 7. Performance analysis – Automatic Rig [6]

After the first three wells, several upgrades were implemented—such as enhanced alignment of the TopDrive and gripper modifications for safer BHA handling. The second phase of enhancements, including a redesigned Poorboy Degasser and Top Drive Parallel Arm extension, further boosted casing operation precision and safety. Advanced composite materials were introduced for gripper dies to extend their service life and reduce slippage.

The deployment of the AR 150 automatic rig represents a major milestone for OMV Petrom and the broader European drilling industry. It demonstrates how automation, digitization and intelligent systems can be combined to deliver safer, more efficient and sustainable drilling solutions. As operational teams continue to refine workflows and embrace advanced technologies, OMV Petrom is poised to lead in shaping the future of drilling.

4. Key Performance Indicators in Drilling Optimization

To systematically evaluate the performance and efficiency of its drilling operations, OMV Petrom relies on a robust framework of Key Performance Indicators (KPIs). These metrics provide quantitative insights into operational behavior, facilitate benchmarking and support the identification of inefficiencies that can be addressed through targeted interventions. Among the most critical KPIs utilized by the company are:

Rate of Penetration (ROP). Defined as the speed at which the drill bit advances through the formation (typically measured in meters per hour), ROP serves as a direct indicator of drilling efficiency. By closely tracking ROP trends across different lithologies and well profiles, OMV Petrom optimizes parameters such as weight on bit, rotary speed and mud properties to maximize bit performance while avoiding detrimental effects like bit balling or borehole instability [8, 9].

Flat Time. Flat time refers to the cumulative duration of planned or unplanned operations during which no actual drilling or well construction progress is made — including tasks such as casing, logging, or tripping. While some flat time is unavoidable, minimizing excessive duration is essential for reducing overall well costs. Through digital planning tools and lean operational workflows, OMV Petrom works to reduce unnecessary downtime associated with flat time [8, 9].

Non-Productive Time (NPT). NPT encompasses all unscheduled events or technical issues that lead to operational delays — such as equipment failures, stuck pipe incidents, loss of circulation, or weather-related stoppages. OMV Petrom employs root-cause analysis and predictive maintenance algorithms to mitigate these occurrences, using real-time monitoring and historical failure data to preemptively address vulnerabilities [8, 9].

Well Delivery Time. This composite KPI reflects the total time required to drill, complete and deliver a well for production or further operations. As a comprehensive measure, it encapsulates the efficiency of planning, execution and logistical coordination. Shortening the well delivery time directly correlates with reduced operational expenditure and improved return on investment [8, 9].

Figure 8 illustrates the identification of optimization opportunities through the analysis of each main drilling operation.

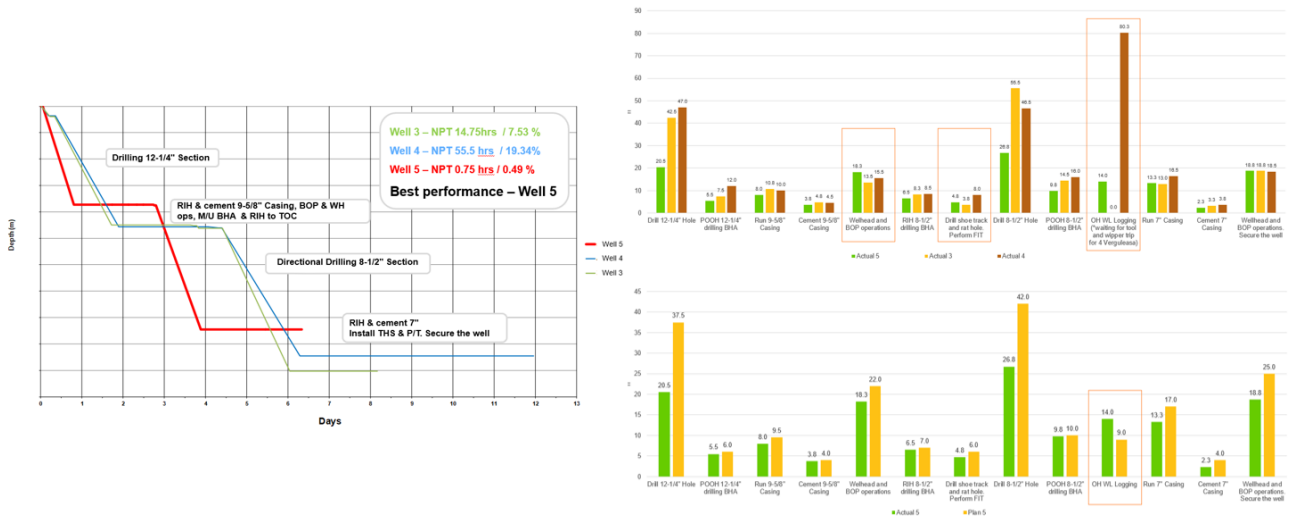


Fig.8. Identifying optimization opportunities

By continuously monitoring and analyzing these KPIs across its well portfolio, OMV Petrom can establish performance baselines, detect anomalies in real time and implement data-informed optimization strategies. These include the use of digital dashboards for real-time visualization and adaptive operational protocols tailored to specific geological and technical conditions.

The iterative analysis of these performance indicators not only enhances day-to-day drilling effectiveness but also informs strategic decisions related to technology deployment, workforce training and well design standardization — reinforcing OMV Petrom's broader commitment to continuous improvement and operational excellence.

5. Optimization Opportunities and Engineering Workflows

OMV Petrom's commitment to continuous operational improvement is reflected in its strategic identification and pursuit of specific drilling optimization opportunities. Drawing on extensive operational data, lessons learned from previous campaigns and KPI-driven performance targets.

OMV Petrom leverages ROP as a performance metric across various well profiles and lithologies, using it to guide the continuous adjustment of drilling parameters such as Weight on Bit (WOB), rotary speed (RPM), mud flow rate and fluid properties. These adjustments are made to achieve optimal bit performance, maintain borehole integrity and avoid detrimental effects such as bit balling, excessive vibrations, or cuttings evacuation. Figure 9 illustrates performance enhancement opportunities by adjusting optimal mechanical and hydraulic parameters for drilling through hard stringers.

Fig.9. Drilling through hard stringers

In operational practice, OMV Petrom integrates both field experience and engineering models to estimate and optimize ROP. One of the foundational concepts used is Mechanical Specific Energy (MSE) — a measure of the energy required to remove a unit volume of rock. Lowering the MSE through appropriate adjustments of WOB and RPM typically results in higher ROP. Real-time MSE calculations are supported by the *real-time drilling data monitoring platform*, which processes surface and downhole sensor data to detect deviations from the expected drilling performance envelope. Figure 10 highlights the dependency of drilling parameters on rock hardness, resulting in an increase in mechanical specific energy (MSE) and a decrease in the rate of penetration (ROP) [10].

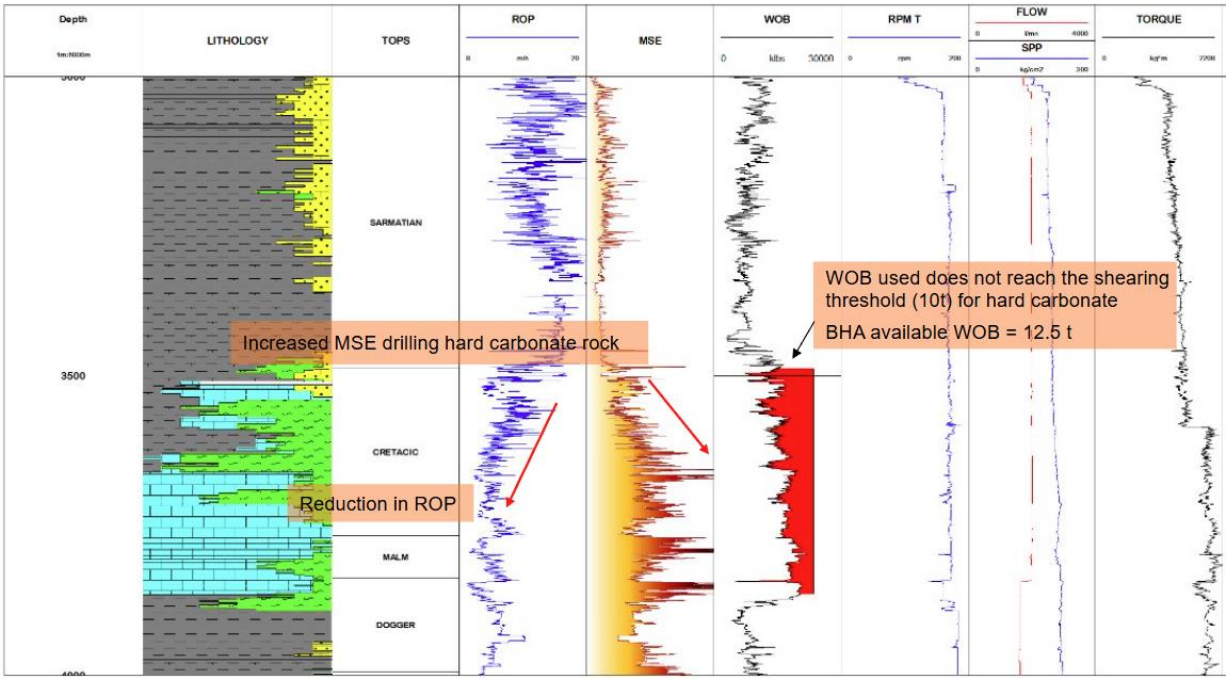


Fig.10. Rock strength vs. mechanical parameters

Additionally, OMV Petrom uses data-driven platforms like *drilling performance management system* to analyze historical ROP values in relation to applied drilling parameters and formation characteristics. These analyses allow for the identification of performance trends and the definition of parameter envelopes that have yielded the best results in similar geological settings. Figure 11 presents rate of penetration (ROP) benchmark between offset wells, based on sections and geological formations.

Hole Size	Rig	Well	Bit Model	Dull Grade	Drive System	12-1/4" Section	Dacian	Pontian
12.250"	Conventional Rig 200 t	1	PDC_SK519	0-0-NO-A-X-I-NO-TD	Rotary	30.0	30.0	30.0
		2	PDC-SK519	0-0-NO-A-X-I-NO-TD	CwD	35.2	30.5	38.1
		3	PDC_SKHI519D	0-1-WT-S-X-I-BU-TD	Motor	22.6	21.2	24.0
		4	PDC_EZC_504	8-8-NR-A-X-I-NR-TD	CwD	24.3	28.1	21.7
		5	PDC_TK69	1-1-WT-A-X-I-NO-TD	Motor	27.6	28.3	25.7
	AR HM 150	A	PDC_TK519	1-1-CT-A-X-I-BU-TD	Motor	30.7	23.1	43.7
		B	PDC_TK519	1-2-BT-A-0-I-CT_WT-TD	Motor	50.5	46.2	60.0
		C	PDC_EZC505_E19173	-	CwD	30.4	34.3	43.3
		D	PDC_EZC504_E19173	-	CwD	25.0	25.3	24.9
		E	PDC_TK519	1-1-WT-A-X-I-BU-TD	Motor	56.9	44.7	74.7
		F	PDC_TK519	1-3-WT-A-X-I-BU-TD	Motor	56.6	49.9	64.5
		G	RCB_HT3GP	3-3-WT-A-E-I-NO-TD	Rotary	20.4	20.4	-

Hole Size	Rig	Well	Bit Model	Dull Grade	Drive System	8-1/2" Section	Dacian	Pontian	Meotian	Helvetian	Sarmatian
8.500"	Conventional Rig 200 t	1	PDC_SK519	1-1-BT-A-X-I-WT-TD	Motor	17.7	-	23.7	19.3	-	16.1
		2	PDC_TK519	0-0-WT-A-X-I-CT-TD	Motor	19.3	-	24.5	23.7	-	16.8
		3	PDC_TK519	0-1-WT-S-X-I-NO-TD	Motor	17.4	-	23.3	23.3	-	14.7
		4	PDC_TK519	2-3-BF-S-X-I-CT-TD	Motor	19.5	-	23.7	21.3	-	17.4
		5	PDC_TK519	1-2-BF-A-X-I-CT-TD	Motor	24.6	-	32.8	26.8	-	20.1
	AR HM 150	A	PDC_TK519	1-1-NO-A-X-I-NO-TD	Motor	27.7	-	36.6	35.3	-	24.4
		B	PDC_TK519	1-1-LT-T-X-I-CT-TD	Motor	33.3	-	55.5	30.0	-	28.2
		C	PDC_TK519	2-8-WT-T-X-1-BT_CT_LT-PR	Motor	23.9	-	29.7	28.4	-	21.6
			PDC_TK516	0-1-WT-A-X-I-TR-TD	Motor						
		D	PDC_TK519	3-8-CT-A-X-I-BT_LT-BHA	Motor	26.7	-	36.4	23.9	-	23.0
			PDC_TK516	1-1-WT-A-X-I-ER-TD	Motor						
		E	PDC_TK516	1-1-WT-A-X-I-NO-TD	Motor	28.3	-	51.7	27.6	-	23.2
		F	PDC_TK519	1-1-WT-A-X-I-CT-TD	Motor	30.2	-	44.3	27.8	-	26.3
		G	PDC_TK519	1-1-WT-S-X-I-BU-TD	Motor	31.5	42.2	28.4	18.4	17.2	-

Fig.11. ROP Benchmark – Automatic Rig vs. Conventional Rig

The correlation between ROP and drilling parameters is further embedded in pre-spud road map (figure 12), where simulations and offset well data are used to recommend parameter sets for each planned formation. This ensures a high degree of predictability and consistency in well delivery.

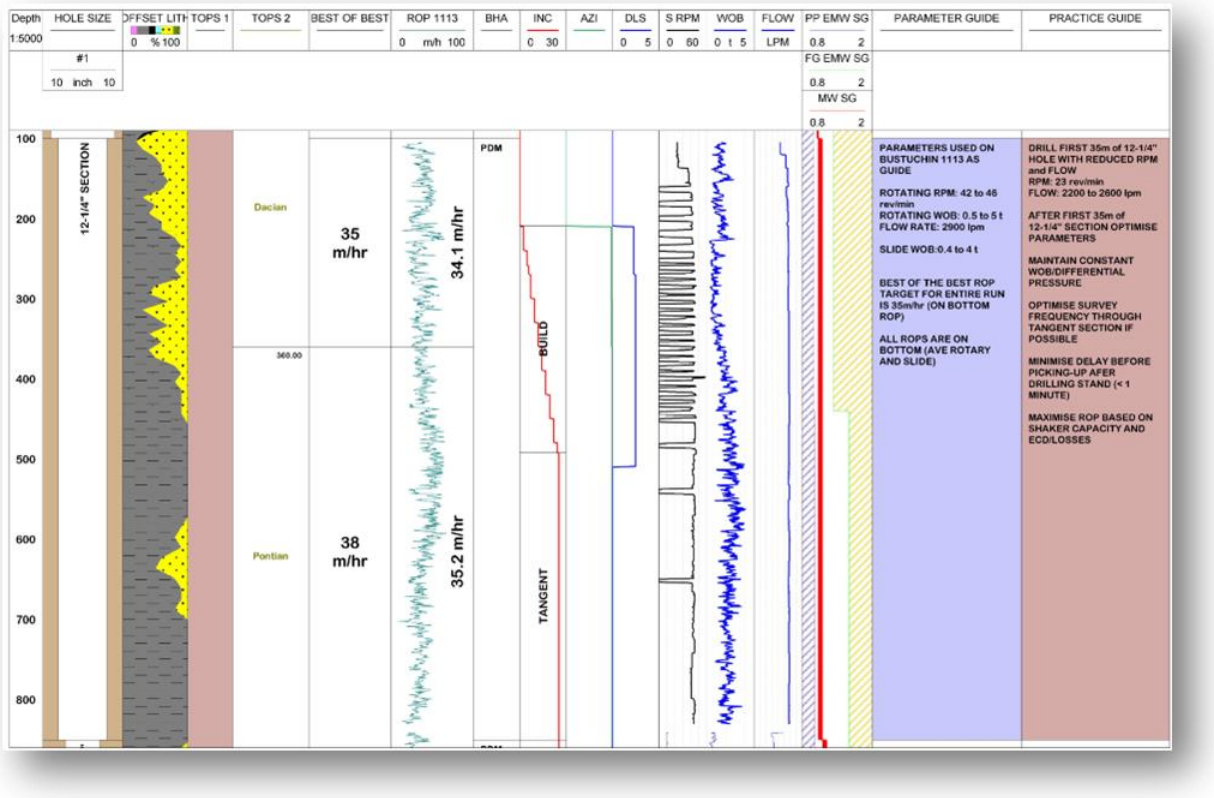
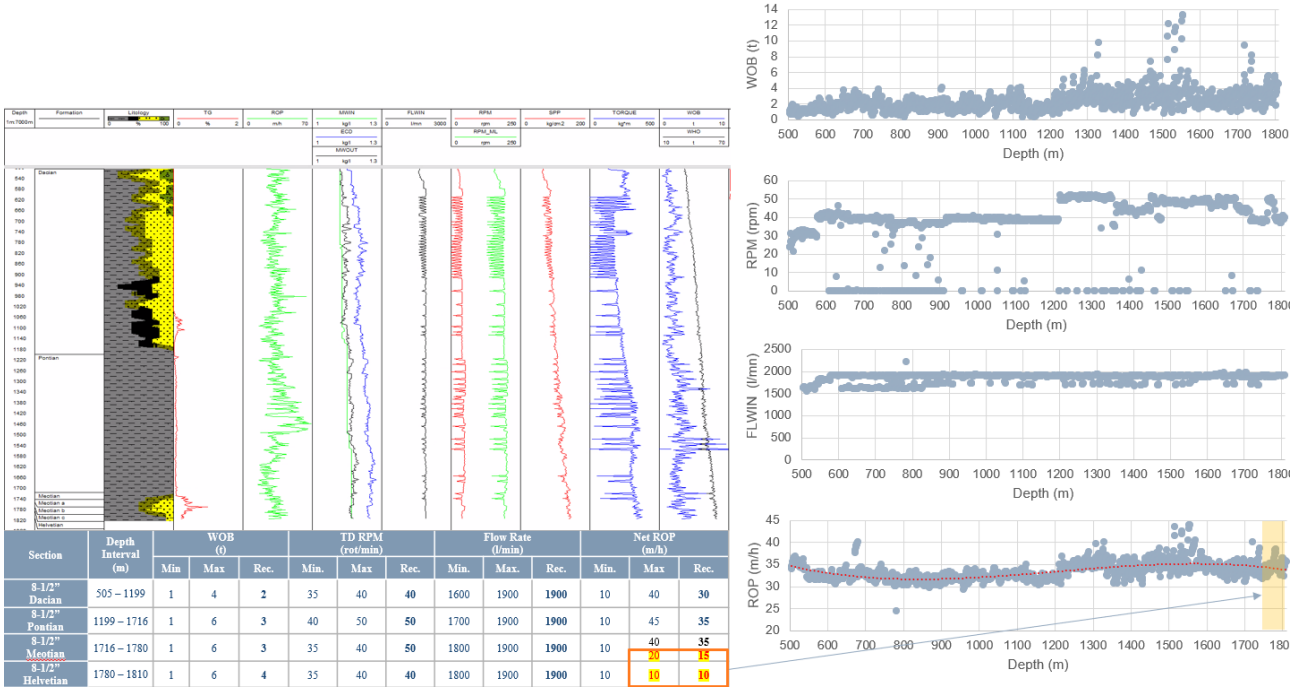


Fig.12. Pre-spud Road map

By combining real-time monitoring, historical benchmarking and predictive planning, OMV Petrom can calculate and continuously refine ROP in direct relation to optimized drilling inputs — supporting faster, safer and more cost-effective operations (figure 13).



Section	Depth Interval (m)	WOB (t)			TD RPM (rot/min)			Flow Rate (l/min)			Net ROP (m/h)		
		Min	Max	Rec.	Min.	Max	Rec.	Min.	Max.	Rec.	Min.	Max	Rec.
8-1/2" Dacian	505 – 1199	1	4	2	35	40	40	1600	1900	1900	10	40	30
8-1/2" Pontian	1199 – 1716	1	6	3	40	50	50	1700	1900	1900	10	45	35
8-1/2" Meotian	1716 – 1780	1	6	3	35	40	50	1800	1900	1900	10	40	35
8-1/2" Helvetian	1780 – 1810	1	6	4	35	40	40	1800	1900	1900	10	10	10

Fig.13. ROP calculation based on mechanical and hydraulic parameters

Connection practices—particularly during the making and breaking of drill pipe connections—represent a significant portion of flat time during drilling operations. Variability in connection procedures across crews and rigs can lead to inconsistencies, inefficiencies and even safety risks. OMV Petrom has initiated the standardization of connection protocols across its fleet, establishing best practices based on timing benchmarks, automation capabilities and ergonomic improvements. Standardized procedures contribute to improved rig crew performance, enhanced training effectiveness and more predictable operational outcomes. Figure 14 shows the operations performed during drill pipe connections throughout the drilling process.

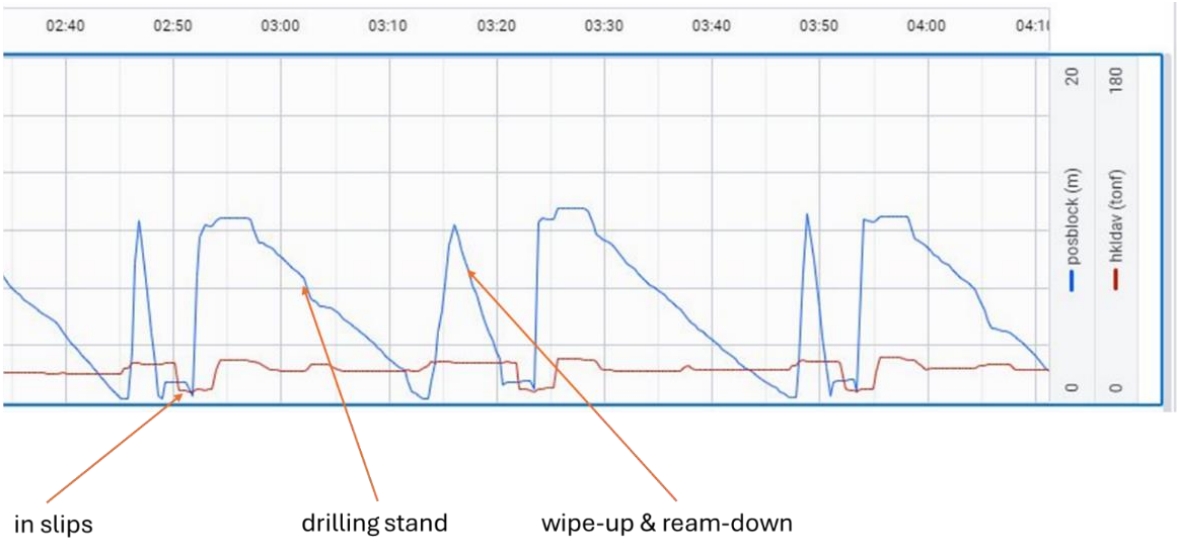


Fig.14. Optimization opportunities for connection practices

Drill bit performance is a major determinant of ROP and cost-per-meter drilled. OMV Petrom employs a data-driven approach to bit selection, considering formation characteristics, historical bit runs, vibration data and failure modes. Bit performance is further enhanced through parameter optimization, adjusting mechanical and hydraulic parameters in real time to match the evolving conditions of each formation layer and rock type/hardness. This approach maximizes bit life, minimizes trips and contributes to a reduction in total well delivery time. Figure 15 illustrates various types of cutters used in drill bits, each suited for specific rock types.

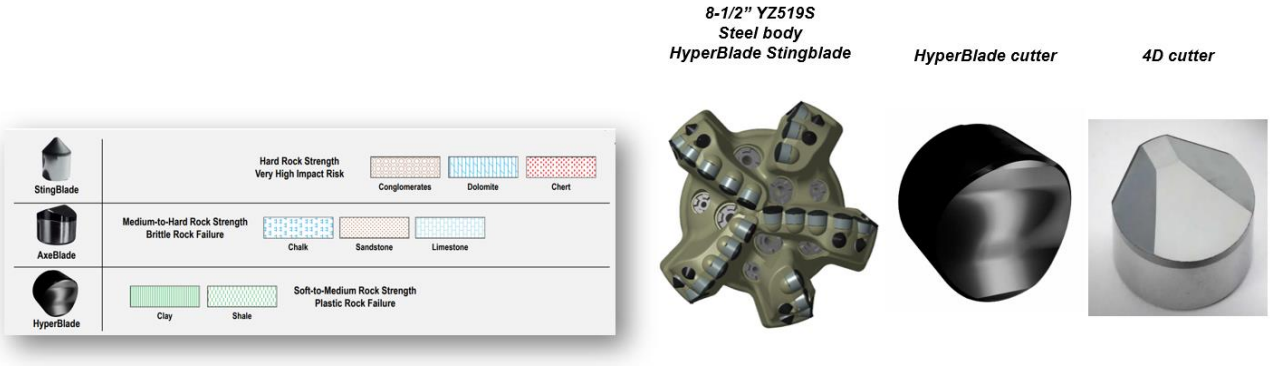


Fig.15. Bit selection [11]

The company leverages advanced digital infrastructure to support real-time monitoring and advanced supervision of drilling operations. High-frequency data from rig sensors is transmitted to centralized monitoring centers, where engineers and drilling specialists track KPI deviations, detect inefficiencies and intervene proactively when thresholds are breached. Real-time analytics and visualization dashboards facilitate rapid decision-making and adaptive control, enabling a shift from reactive to predictive operations.

These optimization opportunities are embedded into engineering workflows through iterative feedback loops and continuous improvement frameworks. Insights derived from field operations are translated into standard operating procedures (SOPs), design-of-experiment (DOE) trials and simulation-based pre-well planning. Moreover, lessons learned from successful implementations are institutionalized across teams and projects, fostering organizational learning and knowledge retention.

By addressing these key levers, OMV Petrom enhances its ability to deliver high-performance wells consistently, while simultaneously reducing risk exposure and operational costs. This structured approach to optimization supports the company's broader digitalization goals and contributes to its reputation as a technically sophisticated and innovation-driven operator in the Southeastern European energy market.

6. Results and impact

The integration of advanced digital and engineering technologies into OMV Petrom's drilling operations has yielded measurable and multidimensional improvements, significantly enhancing the company's ability to execute wells more efficiently, safely and sustainably. These benefits are the result of targeted investments in automation, real-time data systems and operational standardization, all of which have contributed to redefining performance baselines across the drilling portfolio. The most salient outcomes can be summarized as follows:

Efficiency Gains

One of the most immediate and impactful outcomes of technology integration has been the reduction in well delivery time, driven by automation of routine tasks, optimization of connection practices and real-time parameter adjustments. Digital well planning tools and performance dashboards have enabled engineers to identify performance bottlenecks, refine operational sequences and reduce invisible lost time (ILT). These process improvements have ensured that wells are delivered on time and within budget, even in technically complex fields, ultimately contributing to improved capital efficiency and asset utilization. Reports from OMV Petrom's operations indicate that certain optimization measures, such as improved ROP benchmarking and consistent BHA design, have led to considerable time savings [6].

Safety Enhancements

Through the adoption of automated drilling systems, OMV Petrom has reduced the exposure of field personnel to high-risk manual activities. Automation of pipe handling, slips-to-weight transitions and downlinking operations has minimized human interaction with rotating or pressurized systems, resulting in a notable decrease in safety incidents and near misses. Furthermore, the predictive maintenance capabilities offered by real-time data acquisition allow for early detection of anomalies and timely interventions, thereby reducing the likelihood of equipment failures and unplanned shutdowns [6].

Environmental Benefits

The use of electrical drilling rigs and fuel consumption reductions achieved through process optimization play a key role in advancing OMV Petrom comprehensive decarbonization and sustainability strategy. The deployment of electric rigs has notably reduced greenhouse gas (GHG) emissions compared to conventional diesel-powered units, while optimized drilling performance has curtailed unnecessary waste generation. Collectively, these advances support the company's commitment to lowering its operational carbon footprint and aligning with EU and international climate targets [6].

In summary, the integration of advanced technologies has empowered OMV Petrom not only to meet industry benchmarks but to set new standards for operational excellence in the region. By linking engineering discipline with digital innovation, the company has built a scalable model of high-performance drilling that is both economically viable and environmentally responsible [12].

7. Conclusions

OMV Petrom's comprehensive digital transformation, exemplified by the DigitUP program, marks a significant milestone in the evolution of upstream operations within the Southeastern European energy sector. By systematically integrating advanced technologies—such as automated rigs, real-time monitoring systems, AI-driven planning tools and centralized performance dashboards—the company has successfully transitioned from fragmented, manual processes to a fully connected, data-centric drilling environment.

The deployment of the AR 150 automated rig, along with the use of platforms like *coherent well planning solution*, *cloud-based drilling reporting system*, *real-time drilling data monitoring platform* and *drilling performance management system*, has enabled OMV Petrom to establish a closed-loop digital workflow that spans the full well lifecycle—from design and execution to post-drilling analysis. This digital ecosystem not only improves operational transparency and collaboration but also enhances decision-making speed and precision through real-time data acquisition and predictive analytics.

Quantitative results confirm the effectiveness of these initiatives: significant reductions in well delivery times, increased rate of penetration (ROP), minimized flat and non-productive time (NPT) and measurable improvements in safety and environmental performance. These outcomes are supported by the company's strategic use of key performance indicators (KPIs), which allow for continuous tracking, benchmarking and optimization of drilling activities. Moreover, the standardization of connection practices and data-informed bit selection strategies have further reinforced OMV Petrom's position as a technically advanced and efficiency-driven operator.

Equally important is the alignment of these technological advancements with OMV Petrom's sustainability agenda. Electrical rig systems, automation of high-risk manual tasks and optimized resource consumption demonstrate the company's commitment to reducing its carbon footprint and contributing to EU-wide decarbonization targets.

In conclusion, OMV Petrom's transformation initiative showcases how legacy oil and gas operators can leverage digital innovation to remain agile and competitive in a changing energy landscape. Through a combination of engineering rigor, advanced analytics and a forward-looking digital infrastructure, the company has developed a scalable and replicable model of drilling excellence—one that is capable of meeting both current operational demands and future sustainability challenges.

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