AADE-11-NTCE-77

# KPI Drilling Database. Drilling Process Synergy Achieved Through A Systematic & Analytic Approach

Cesar I. Hernandez and Rodolfo Torres, Kayros



## Abstract

A Key Performance Indicators Drilling Database has been gathered since 2008. These tools are quantifiable metrics which reflect the performance of a process in achieving its objectives and standards.

The Drilling Process Synergy is observed as the generation, application and optimization of an engineering strategy to consistently drill more productive and cost effective wells.

Its main purpose is to help clients lower their costs and reduce drilling risks. Also maintain operational integrity and maximize production's potential. Its main phase applies an engineering design based on risk analysis and planning as well as a thorough post well evaluation.

Our methodology studies the drilling performance through:

1. Offset and subject wells analysis.
2. Drilling program based on the offset information analysis.
3. Detailed event analysis.
4. Drilling performance study.
5. Drilling engineering
6. Non-Productive Time (NPT) events and Root-Cause Analysis.
7. Lessons Learned Database
8. Others: Mudlogging reports, daily drilling reports & logs.

Our values are reducing overall cost, defining the impact of technology and providing fit-for-purpose solutions. A systematic and analytic process is required to improve decision making process, to provide a structured set of data for decisions and to reduce uncertainties in the data provided.

Our results are an integrated planning and awareness through the presentation of recommendations, an optimized well construction design, an implementation of operational best practices and the mitigation of drilling events and NPT generators.

## Introduction

Recently Key Performance Indicators have played a major role in supporting drilling engineering. Their main objective is to provide analytical and continuous assessment of performance at multiple levels, provide the detailed analysis behind the benchmarks, and indicate where performance needs to be improved to beat the benchmark. Benchmark is the definitive process for comparing performance. Its main applications include: identifying current performance, identifying areas of improvement, set goals, and implement actions to achieve goals. This process enables delivery of both operational and economical "best in class" performance. Economic performance is the ultimate measure of success for the operator; e.g. drilling cost, bit cost, directional cost, service cost, savings, spread cost, and authorization for expenditure (AFE). On the other hand, operational/drilling performance is used to demonstrate technology application and service leadership; e.g. drilling days, days to top of reservoir, drilling-related NPT, slide/rotating percentage, number of BHA's, etc.

The engineering strategy is supported on the research of client's KPI's, direct incorporation on KPI's which the service company can affect, KPI's review before project startup, awareness on parameters that can affect KPI's, and evaluation.

## KPI Drilling Database

Since 2008 a fit-for-purpose application, Kiodynos V1.0, was designed and developed with the objective of gathering data from drilling operations in order to populate a KPI database. The results have validated the value chain obtained from this application. The conjunction of this tool and experience has revamped operational performance and safeguard expenditures. The Drilling Process Synergy is observed as the generation, application and optimization of an engineering strategy to consistently deliver value in the industry that turns into cost-effective wells, higher operational efficiency, and increased productivity.

Its main purpose is to help clients optimize resources, lower costs and reduce operational risks. Additionally maintain operational integrity and maximize operation's potential. Its main phase applies an engineering design based on risk analysis and planning, detailed and strict execution as well as a thorough post job evaluation.

### *Key Performance Indicators*

Key performance indicators are an analytical metric and continuous assessment of performance at multiple levels within the organization. They can be based on financial and technical measures.

The information gathering process includes analyzing data and results through dissemination into a useable and actionable form as well as understanding the context in which it is applied. Secondly, the process ensures its availability and requires performing a quality assurance and quality control in order to forward them in a timely manner. Thirdly; data, needs and requirements are cascaded to the relevant parties in order to monitor a specific business unit or product line performance. Finally the performance reviewing procedure includes immediate action for decision making process, balance scorecard application for the required discussion, periodical review time allocation, and performance track record. It is important to keep in mind that performance should be focused on KPI's.

### Benchmarking

Benchmarking is a potent tool for learning which companies are best at performing particular activities and then using their techniques or best practices to improve the cost and effectiveness of a company's own internal activities.

It also entails comparing how different companies perform various value chain activities, e.g. how wells are drilled, how technology impacts operational performance, how inventories are managed, how services are perceived, how fast the company can get new products and services to market, how the quality control function is performed, how customer requirements are fulfilled, how experience influence operations, how does risk impact on selected projects, and how objectives are accomplished. The greatest value is achieved through the cross-company comparison for these activities.

The objectives of benchmarking are to identify the best practices in performing an activity, to learn how other companies have actually achieved lower costs or better results in performing benchmarked activities, and to take action to improve a company's competitiveness whenever benchmarking reveals that its costs and results of performing an activity are not on a par with what other companies, either competitors or non-competitors, have achieved.

The benchmarking process involves identifying "best in class" performing companies and learning from them in order to systematically improve with the aim of becoming one eventually.

### Performance

Any kind of leadership starts with direction and with performance. Performance can be defined as the test of following the right path and direction. In order for a company, institution or individual to demonstrate its leadership, it must provide a track record database for performance support. The oil and gas industry requires high performance in both comparative and competitive basis measured by benchmark series. It is fundamental to select, establish and define the KPI's selected for the record. Both performance and leadership will be measured by the results achieved and validated with the KPI's compliance.

Drilling performance is relative to the well, asset, project, operator, or client being addressed. It is also dependent on competitors and employed technology. In order to validate improvement and its significance, a comparison between the published objectives should be performed. Improvement measures should be guarded during the design phase in order to be implemented in the execution. Moreover demonstration of a superior performance will increase profitability and value perception.

### Technical Specifications

As outlined in "Chart 1. KPI Drilling Database Process" it is fundamental to identify the main contributors for the analytical approach.

The main objectives of the subject well, offset well and drilling program analysis process are: to identify all problem areas to be addressed during the planning phase; to identify all events that might influence well design, equipment selection and schedule; to measure performance for benchmarking; to identify constraints and areas of opportunity; and to validate assumptions.

The main objectives of the drilling engineering and NPT analysis process are: to identify all good practices that should be continued; to incorporate lessons learned; and to provide the necessary information to conduct a risk analysis

During the drilling performance and optimization analysis process relevant and selected data should be reviewed. These includes: daily operations reports (DOR); drilling fluids, cementing, casing reports; composite log or mud loggers log; drilling data log; open hole logs (e.g. caliper, gamma-ray, resistivity, neutron-density, sonic, etc.); cased hole logs (e.g. CBL, multi-finger calipers, etc.); structure map showing location of offset wells (surface and subsurface) and location of proposed wells; field map showing location of existing roads and existing pads; end of well reports (EOWR); seismic sections; bit records; pore and fracture pressure profiles; and temperature profiles.

The synergy achieved through a multi-variable analysis, a critical mass of participating operators and a standard set of data definitions creates real value for drilling and completions benchmarking study. Information relevance and compliance to a significant sample should be verified to guarantee the data gathering process.

The technical data provided for each well such as casing sizes, mud type and weight, coring and logging measures, age of lowest reservoir accessed, etc., should be highly reliable. Additionally the data relating to operational times should be capable of verification through examination of time-depth charts. Data related to NPT is more indicative due to the different ways in which operators define and calculate these values. The key for information differentiation is based on the strategy that the results need to be intelligently interpreted with an understanding of the reality behind the information. Comparative performance is just a starting point and then using informed judgment to discern the meaning behind the data.

Finally, performance should be monitored following assessed metrics such as: drilling time estimate, drilling cost

estimate; factors affecting drilling rate, bit weight, rotary speed, bottom-hole cleaning, mud properties, solids content, hydrostatics and drilling cost analysis. Recommendations will include operational procedures that will safely drill and complete the well at the lowest cost possible as well as promote references concerning routine rig operations.

## Conclusions

Based on the design and development of our fit-for-purpose application Kiodynos V1.0, which objectives include gathering data from drilling operations in order to populate a KPI database, we have been able to accomplish one of the greatest challenges for benchmarking applications. Gaining access to information over all drilling operations has empowered our consulting organization to gather benchmarking data, distribute information about best practices, and provide comparative cost data.

As mentioned before experience combined with data interpretation will turn out into in-depth analysis. Results may include best well selection, activity distribution, total operational time, effective operational time, non-productive time, and its associated cause. The integration of NPT generators support decision making process and allow implementation of preventive and mitigation measures. Detailed analysis in drilling phases promotes specific actions and value-generation procedures that will enhance performance and productivity.

It is essential that well complexity is kept in mind though it will normalize the comparison process.

The systematic and analytic approach bears the value for solution proposals. The process synergy selects the most significant events and practices that, if addressed through a different approach, could derive in greater performance.

Operational recommendations are generated based on the lessons learned from previous analysis, offset data, performance track records and KPI drilling database.

### *Values*

Our values are reducing overall cost, defining the impact of technology and providing fit-for-purpose solutions. A systematic and analytic process is required to improve decision making process, to provide a structured set of data for decisions and to reduce uncertainties in the data provided.

The results excerpted from the application can assess and guide for future planned AFE. Data can be compared using a different classification system and be reviewed and updated in real-time. Efficiency plays a major role in operational performance. Even though NPT totalizes on a worldwide basis 20% to 22% of the total time and accounts for more than $8 billion USD in losses (reported in year 2000), its main generator (70%) is caused by wellbore instability. It is critical to know that problems aggravate with more sophisticated wellbore geometries (ERD, MLT, deep water, HPHT, tectonically active areas). Solution efforts should be focused on wellbore instability issues, drilling fluid quality, drilling practices as well as on trendless problems like pressure control equipment (BOP) and tubular running services (casing and tubing).

### *Benefits*

Specific benefits obtained from benchmarking include providing an insight into the base line cost exposure when no direct experience exists. Furthermore it serves as a tool for comparison of performance metrics between wells, between assets, between projects, between operators, and between clients. Benchmarking allows data analysis for performance target setting. With this analysis, we can identify the “best in class” performance and the indicators associated with it. Operational performance can be evaluated while companies compare their activities within the benchmarking data. It is fundamental to keep the analysis unbiased.

Moreover a detailed analysis and a systematic benchmarking data will provide specific support to “Technical Limit Drilling” implementations. TLD is being used by some operators worldwide to achieve spectacular performance improvements. The technical limit is what could be achieved in a flawless operation using the best possible people, planning and technology. Actual time accounts for the technical limit time plus the waste time (between 20 and 40%) plus the total NPT (between 10 to 15%). It is essential to use KPI’s to determine technical limit.

Additionally offset data becomes a requirement as comparison point and benchmark against new data. Value generation is specified by the metrics set for the job, the selection of appropriate and relevant KPI’s, the perfect understanding of KPI’s metrics and gathering, the parameters and variables normalization, and the improvement and results achieved through the process.

The Drilling Process Synergy, through a theoretical and knowledge-based system, will aim permanently for perfection.

## Acknowledgments

Kayros Investments S.A. de C.V.

## Nomenclature

*AFE* = *Authorization For Expenditure*
*BHA* = *Bottom-Hole Assembly*
*DOR* = *Daily Operational Report*
*EOWR* = *End of Well Report*
*IADC* = *International Association of Drilling Contractors*
*KPI* = *Key Performance Indicators*
*KIODYNOS* = *Trademark*
*NPT* = *Non-Productive Time*
*RCA* = *Root-Cause Analysis*
*TLD* = *Technical Limit Drilling*
*QA* = *Quality Assurance*
*QC* = *Quality Control*

## References

1. SPE 92194. "Maximizing Drill Rates With Real-Time Surveillance of Mechanical Specific Energy,” Fred E. Dupriest, SPE, ExxonMobil, et al.
2. SPE 92576. “Unique ROP Predictor Using Bit Specific

Coefficient of Sliding Friction and Mechanical Efficiency as a Function of Confined Compressive Strength Impacts Drilling Performance," Hector Caicedo, William Calhun & Russ Ewy.
3. Mims, M., Krepp, T. (2003). Drilling Design And Implementation For Extended Reach Drilling And Complex Wells (3rd. Ed). Houston, USA: K&M Technology Group, LLC.
4. Gabolde, G., Nguyen, J. (2006). Drilling Data Handbook (8th. Ed.). Paris, France: IFP Publications.
5. Thompson, A., Strickland, A. & Gamble, J. (2010). Crafting And Executing Strategy: The Quest For Competitive Advantage (17th. Ed.). New York, USA: McGraw-Hill Irwin.
6. "Aspectos Relevantes de la Exploración y Producción de Hidrocarburos". Ing.Carlos A. Morales Gil. Pemex Exploración y Producción. December 1st, 2009.
7. "Programa de Perforación y Terminación del Pozo Sen 201." Unidad Operativa Comalcalco. July 1st, 2009.

## KPI Drilling Database

## Drilling Process Synergy Achieved Through A Systematic & Analytic Approach

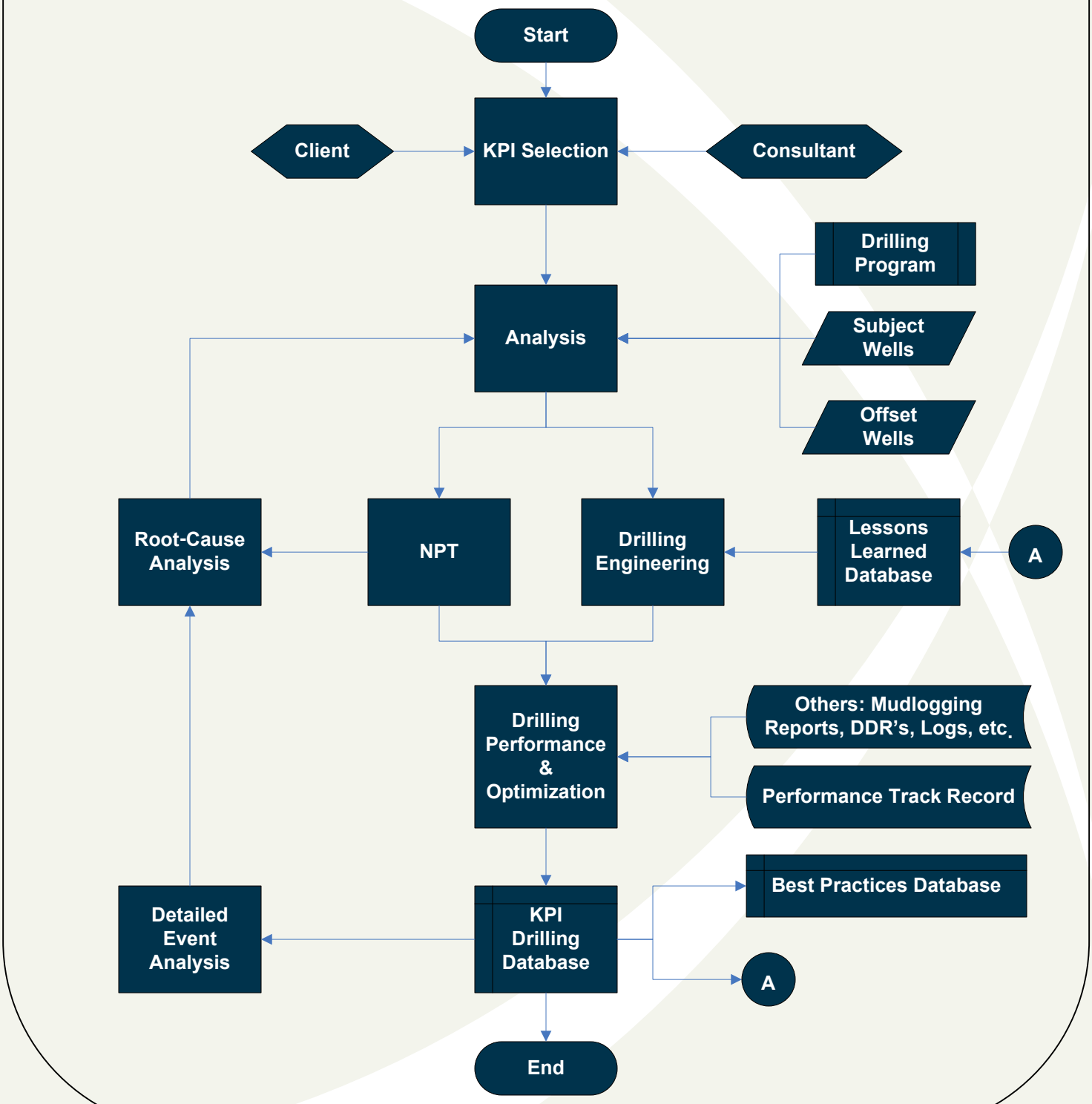


Chart 1. KPI Drilling Database Process.