Performance Improvement on a World-Class Drilling Project

by

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ABSTRACT

The Abu Dhabi National Oil Company (ADNOC) implemented a new phase of offshore oilfield development in 2009 that was intended to increase overall offshore oil production by 40% by 2017. This new development strategy was based on replacing the traditional practice of drilling small well clusters from Mobile Offshore Drilling Units (MODUs) and producing from offshore drilling platforms to developing 4 large scale offshore artificial islands and utilizing Extended Reach Drilling (ERD) to reach drilling targets up to 10 km from the islands. Early in the new development phase, it became apparent that the existing practice of liaising with drilling, completions, service contractors and vendors, and monitoring contractor performance and delivery on these contracts was insufficient for the increased level of development activities.

The author was engaged in evaluating the existing ADNOC practices for monitoring and evaluating drilling, completions, and related contracts and to provide recommendations for improving practices. This led to the development of Key Performance Indicators (KPIs) that were used as the basis for internal ADNOC activities, for developing contracts with timelines for key deliverables and performance targets, for assessing contractor performance during contracts, and for evaluating deliverables at the end of contracts. Knowledge management tools and processes were implemented to aid the development of these KPIs, including internal bin-lists, external nonconformance and non-productive time (NPT) reports, databases for lessons learned, and databases for new technology and best practices. Using

these tools, KPIs were developed for i) management and executive-level reporting, ii) Well Quality, iii) key services provided by external vendors (including directional drilling and measurements, wireline/E-line, drilling fluids, cementing, and coiled tubing), and iv) performance incentive bonuses for vendors.

Implementing these new management practices and KPIs started in 2012 and data to date had indicated improvements of average well days from 168 days to 70 days, a 140% decrease in well duration and a 42% reduction in well cost in 3 years.

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LIST OF SYMBOLS, NOMENCLATURE OR ABBREVIATIONS

AFE	Authorization for Expenditures
CAPEX	Capital Expenditure
CEO	Chief Executive Officer
DCE	Drilling & Completion Engineer
DCI	Drilling Complexity Index
DDR	Daily Drilling Report
DD	Directional Drilling
EOWR	End of Well Review
ERD	Extended Reach Drilling
HSE	Health, Safety, and Environment
IT	Information Technology
ILT	Invisible Lost Time
KPIs	Key Performance Indicators
KM	Knowledge Management
LWD	Logging while Drilling
MOC	Management of change
MWD	Measurement while drilling
NCR	Non Conformance Report
NPT	Non-Production Time
OG	Operations Geologist
OPEX	Operational Expenditure
P&A	Plug and Abandonment
POOH	Pull out of Hole
RE	Reservoir Engineer
RG	Reservoir Geologist
RIH	Run in Hole
S.M.A.R.T.	Specific, Measurable, Achievable, Realistic, Time-bound
SME	Subject Matter Experts
SSPM	Strategic Supplier Partnership Program
SVP	Senior Vice President
TD	Total Depth
VP	Vice President
WE	Well Engineer
WIE	Well Integrity Engineer
WIMS	Well Integrity Management System
WOW	Wait On Weather
WDP	Well Delivery Process

CHAPTER 1: Motivation and Scope

Being unique in execution, multi-billion dollar projects need to be continually monitored from all levels and directions, as any small positive or negative impact on performance can make a very strong influence on overall cost, quality and schedule (Project Timeline). Any minor performance enhancement above planned performance on the multi-billion-dollar project will bring significant savings (Cost Reduction), improve work delivery (Quality Enhancement), and shorten project duration (Improved Schedule) for the overall project.

Whereas, drilling projects enjoy the same benefits achieved with any performance enhancement, early delivery of the products (wells) with solid quality are considerably preferred over cost savings as early delivery brings early production which results in early profitability with high-quality long-life wells. The Abu Dhabi National Oil Company (ADNOC) implemented a new phase of offshore oilfield development in 2009 that was intended to increase overall offshore oil production by 40% by 2017.

This thesis discusses all the techniques used to measure and report the project efficiency, so that project teams made appropriate decisions with real-time actions. The techniques, which vary from the setting of KPIs for various activities to the awarding of incentives to good performers, will be discussed in the thesis.

1.1 The Company

Abu Dhabi National Oil Company (ADNOC) is a diversified and integrated group of energy companies. The following ADNOC businesses are responsible for all aspects of oil and natural gas exploration, evaluation, development and production:

- ADNOC Onshore
- ADNOC Offshore
- ADNOC Drilling
- ADNOC Sour Gas

ADNOC Offshore was formed in 2017 through the consolidation of two of ADNOC's upstream oil and gas companies: Abu Dhabi Marine Operating Company (ADMA-OPCO) and Zakum Development Company (ZADCO). ADMA-OPCO's shareholders were ADNOC, which holds a majority share of 60%, JODCO, BP (British Petroleum) and Total. ZADCO's shareholders were ADNOC, Exxon Mobil, and JODCO (Japan Oil Development Company).

ADNOC Offshore manages several oil and gas assets, including the Umm Shaif, Lower Zakum, Upper Zakum, Satah, and Umm Al Dalkh fields. The company operations extend across several oil operation centers at Das Island, Zirku Island, Arzanah Island, six artificial islands, and the company offshore super-complexes. Crude oil from the company fields is transferred to Zirku Island and Das Island for further processing, storage, and export (ANDOC Offshore 2019).

With an output of approximately 1.4 million barrels of oil per day, ADNOC Offshore contributes more than 40 percent to ADNOC's current daily production of around 3 million barrels. ADNOC Offshore also produces 3 billion standard cubic feet of gas per day, around two-thirds of which is supplied to ADNOC's gas companies, with the remaining third injected into the company reservoirs for pressure maintenance (ANDOC Offshore 2019).

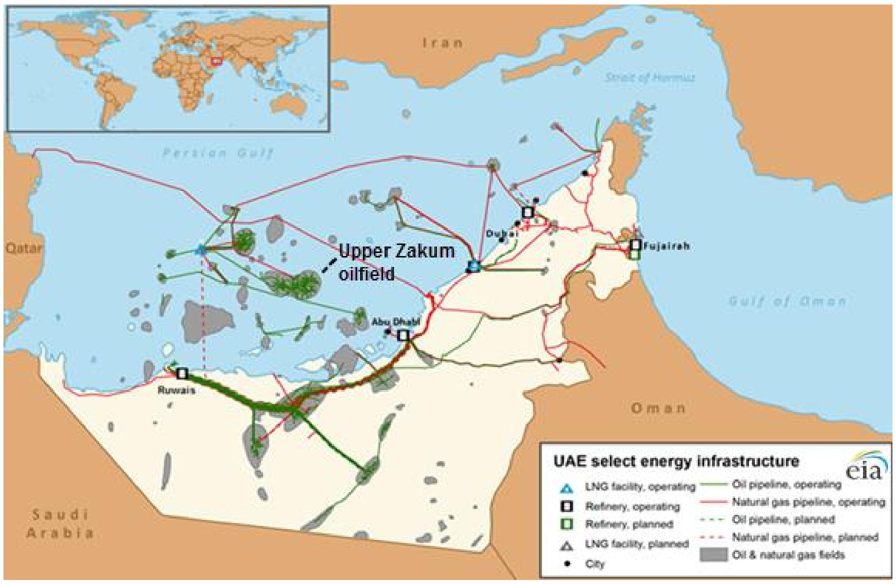

Figure 1a: Upper Zakum oilfield (www.eia.gov/todayinenergy/detail.php?id=23472)

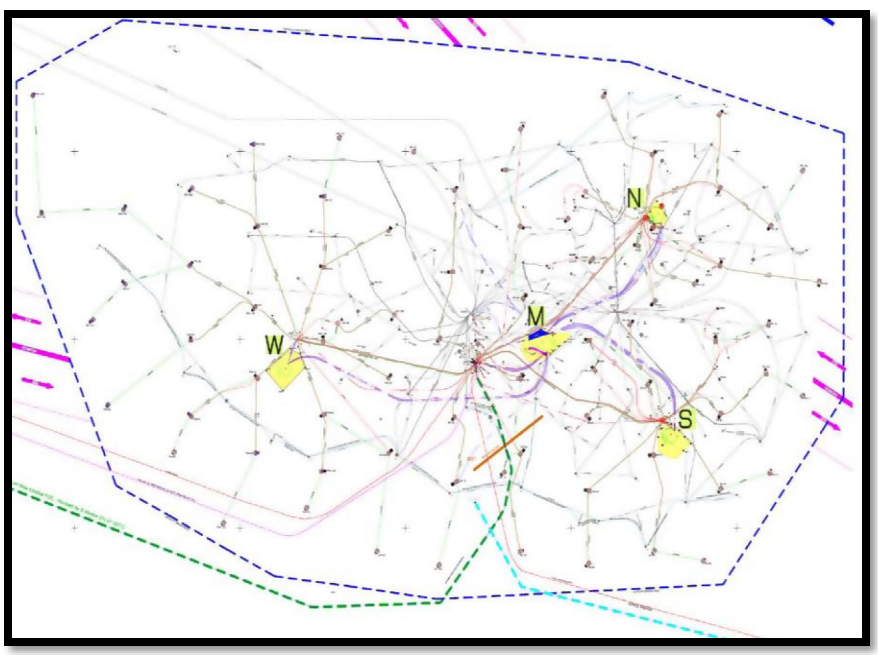

Figure 2b: Upper Zakum oilfield Layout (Rashid et al. 2017)

1.2 The Project – UZ750

The company "ZADCO" was established in 1981 to operate in the Upper Zakum reservoir. The idea to build the Artificial Islands project was initiated early in 2006. In 2008, ExxonMobil became a partner in the Upper Zakum field. ExxonMobil took the lead and established a separate Drilling Department. Before all the drilling projects were handled by the drilling department of the sister company, ADMA-OPCO. All the drilling procedures and practices including teams were taken from the sister company. Initial two years, processes and procedures remained unchanged. ZADCO started to establish a new team by hiring new employees, by moving people from shareholders, ExxonMobil and JODCO.

This world-class mega drilling project named UZ-750 was officially launched in 2009 in the Arabian Gulf. UZ stands for upper Zakum and 750 stands for 750,000 bbl/day, an initial production target set for 2017. The main objectives of the Artificial Islands were not only to enhance the existing oil production capabilities of one of the world's largest oilfields but also to replace the ageing wells with more efficient wells considering maximum ultimate recovery and long-term reservoir integrity. The conceptual design for further development of the field resulted in the building of four Artificial Islands, a revolutionary concept in offshore drilling. A detailed discussion on the artificial islands was covered in the Society of Petroleum Engineers (SPE) Paper MS-162611"Artificial Islands for a Middle Eastern Oil Field Project" presented by Talbot, Al-Ahbabi, and Bouwmeester. Figure 1 shows the boundary of the field and the location of these four Artificial Island highlighted yellow by S, N, M and W, where "S", "N", "M" and "W" represent South Island, North Island, Middle Island and West

Island. The Middle Island was later renamed to Central Island.

Table 1: Reservoir characteristic of ZAKUM field (Fox et al. 1968)

RESERVOIR	AVERAGE ROCK CHARACTERISTICS			AVERAGE RESERVOIR CRUDE CHARACTERISTICS				
	POROSITY %	EFFECTIVE PERMEABILITY md.	WATER * SATURATION. %	RESERVOIR PRESSURE PSIG	BUBBLE POINT PRESS. PSIG.	DATUM ELEVATION. FT. SS.	TEMPERATURE. °F	H_2S CONTENT OF RESERVOIR CRUDE % WT.
Zone I	24	1.5	11	n/a	n/a	7,000	195	Nil
Zone II	29	30	11	3,750	1,000	7,500	206	Nil
Zone III	19	15	24	3,750	1,400	7,500	206	Nil
Zone IV	28	60	11	4,220	3,200	8,300	221	Nil - 0.5
Zone V/VI	17	30	20	4,220	4,000	8,300	221	Nil - 1.5

1.3 Drilling Challenges

Historically, wells were drilled ranged from 8,000 ft to 18,000 ft (2,500 m to 5,500 m), with a profile landing in pay zone at 30-60-degree deviation with a 3000-6000 ft (1,000 m to 2,000 m) horizontal section. With Extended Reach Drilling (ERD) technology the expected Well Profile was landing of pay zone at 45 to 80-degree deviation with an 8,000 ft to 18,000 ft (2,500 m to 5,500 m)horizontal section.

The Company planned hundreds of oil wells drilled from these artificial islands, changing satellite platform drilling to cluster type drilling, with the development of high-technology extended-reach drilling (ERD) wells whose depths range from 18,000 ft to 35,000 ft (5,500 m to 11,000 m).

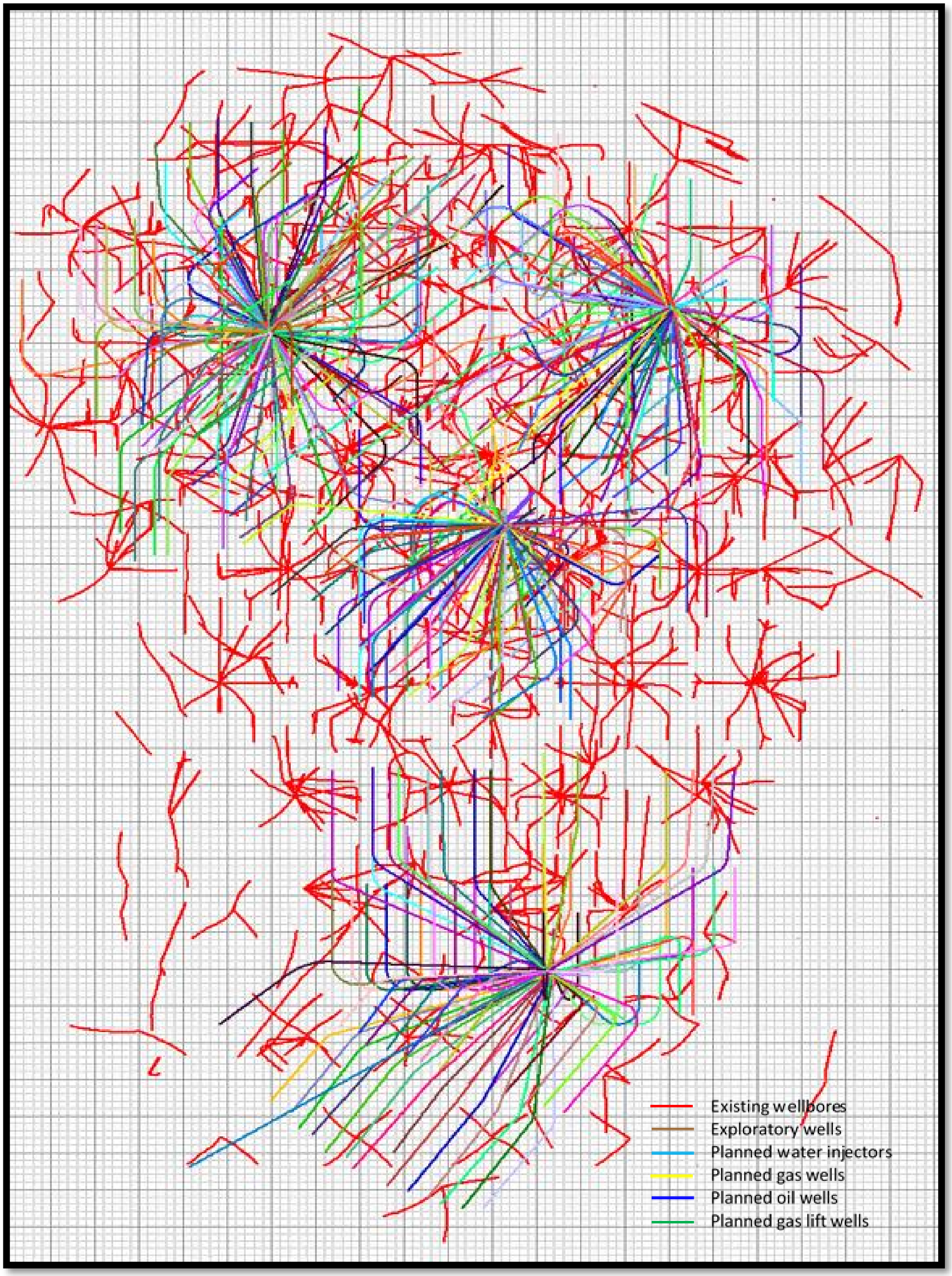

Figure 3: Future and Existing Well Profile (Top view) (Rashid et al. 2017, np)

The existing field consisted of ±800 existing wells with ±2400 wellbores from +200 satellite towers, making it the most challenging field for placing +1000 more wells from newly built artificial islands. Figure 2 shows the top view of the field with the existing wells (red lines) drilled from platforms and the planned future wells (blue lines) to be drilled from the artificial islands. The figure shows clearly that the complexity to place new wells in the field increases after placing these ERD wells one by one. A separate detailed study on the existing well for the quality control of wellbore surveys and improvements was made to make sure well were placed collision-free. This study was presented at Abu Dhabi International Petroleum Exhibition & Conference, 2017 by Rashid, Kolakkodan, Al Katheeri, and John. The Society of Petroleum Engineers (SPE) paper 188658-MS "4-Tier Anti-Collision Policy Adapted in a World Class ERD/MRC Drilling Project Covering Satellite Platforms and Artificial Islands for Collision Free and Optimum Wellbore Placement" describes the technical challenges and the implemented solutions.

Figure 3 shows a typical ERD Well Profile; 20" conductor was planned to be placed at 300 – 400 ft (100 m to 150 m) depth, 13 3/8" casing to be placed from 5000 – 6500 ft (1,800 m to 2,000 m) at 20 – 60O degrees and 9 5/8" casing to be placed from 10,000 – 17,000 ft (3,500 m to 5,000 m) at 80 – 90O degrees. A pre-perforated liner with Inflow Control Devices (ICD) was planned to be placed from 18,000 – 36,000 ft (5,500 m to 11,000 m) at 90O degrees.

1.4 Performance Expectation

With the challenging drilling profile and the complex Well Placement environment, the UZ-

750 drilling project was considered one of the world's top-ranked projects. After a partnership with ExxonMobil, one of the world's largest oil companies, the project became a high profile project with an investment of over a billion-dollar per year drilling these wells. Each small effort had a great impact on the project and long term business relationships as well for long-term production sustainability.

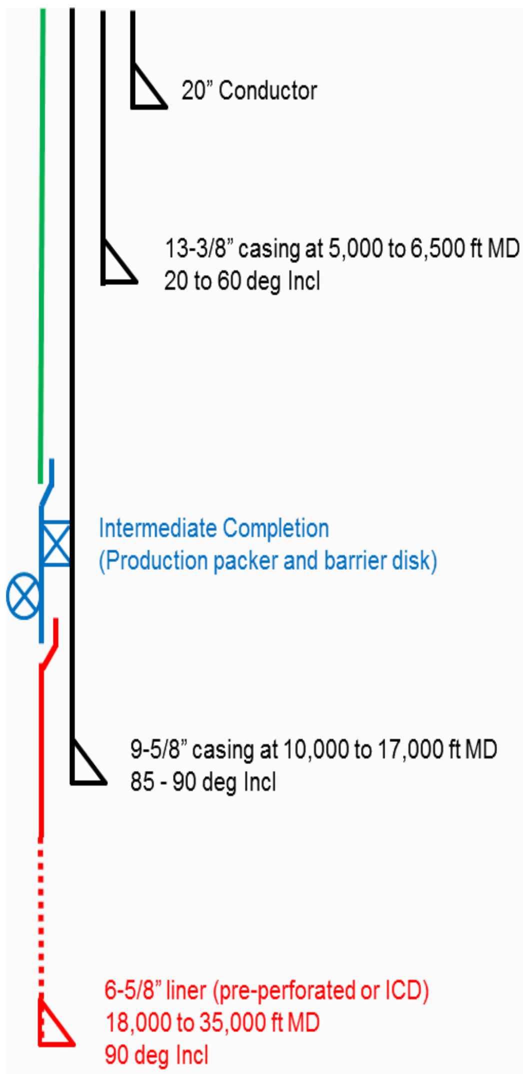

Figure 4: Typical Extended Reach Drilling Well Profile

The performance expectation was set very high (30% reduction in well duration and 30% reduction in well cost) on the newly developed drilling team to deliver the project on schedule and meet the production targets, 750,000 bbl oil per day by 2017. Detailed work was carried out to tackle all the issues at every level, including internal & external processes improvement. Certain KPIs were established at every level, from drilling teams to vendors, to make sure that each team performed equally to achieve the desired results. A detailed discussion will be done in the corresponding chapters.

This thesis is a STUDY of the efforts by the author to improve the project performance, to bring awareness among team members on performance reporting and to set the right target for the high performance. The thesis also represents his observations and learnings in many areas during developing and implementing new processes and KPIs for the areas of improvements ranging from operations to data integrity.

1.5 Thesis Scope:

It is quite important to understand the main purpose of the thesis. As stated earlier, the thesis is the study of the work conducted by the author on one of the unique world-class drilling projects. This thesis represents the detailed work from the start of the project bringing the marvellous achievements and learnings which can be implemented on other future projects.

Initially, the thesis "Performance Improvement on a World-Class Drilling Project" entailed the "Impact of Knowledge Management Processes on the Drilling Project". After developing and Implementing Knowledge Management Practices, the author got involved in the core areas of the project due to the change in his position and responsibilities on the project. Later, he became a focal point for the project performance and got engaged to report project performance with a certain analysis to all stakeholders at all levels. After reviewing the existing practices, it became imperative for the author to play a key role in leading the teams in the right direction by analyzing the data and interpreting the results. After the development and the implementation of management KPIs (Level-1, Level-2 and Level-3), Well Quality KPIs and Key Services KPIs, etc, a significant improvement in project performance was observed, so it became imperative to include these developments in the thesis's discussion. Existing KPI definitions and the tracking system were so fragile that the results of the project could be confused and might present vague analysis.

This thesis does not provide conventional engineering analysis like an Engineering Thesis but the author tries his best to present an implicit experience, tacit knowledge and indirect learning into conclusive words. This thesis provides a lot of valuable information that can be explored further for research in the relative areas, especially in project management and operations enhancements. In the thesis, the author discusses the need for his work, the challenges faced during implementation and the impact of his work on the project.

A large amount of content to be covered in the thesis format was a challenge for the author. After multiple reviews with the supervisor, some major works are presented in the different chapters and some are grouped in appendixes to make sure the thesis does not lose the grip on the core areas; KPIs adaptation and Knowledge Management Practices. This thesis revolves around the description of the existing practices, the improvements made by the author, the reasoning behind improvements, the challenges faced during the implementation and the analysis of key results.

The author tried his best to deliver the thesis in an organized structure and to provide concise conclusions based on the analysis conducted on the various data after implementing the newly developed processes. The author tried his best to avoid unnecessary discussion and irrelative material to have a satisfying overall conclusion of his work.

1.6 The layout of the Thesis

The thesis is distributed among 8 chapters. Chapter 1 provides the company info, project scope, thesis scope and summary of each chapter. Chapter 2 discusses some industry published work and the author's contribution to the project. Chapter 3 discusses the problems and challenges by discussing the existing practices in the company. Chapters 4, 5, and 6 discuss the implementation of the solution and enhancements and show the author main work. Chapter 7 shows the results of the implementations over time with various data analyses. Chapter 8 provides the conclusions and way forward.

1.7 Review of all Chapters

Chapter 1 introduces the company background and the working interests in the region especially its major projects. It also highlights the main project, UZ-750, and the motivation behind its development and shareholder's expectations. Chapter 1 also outlines the project scope and some major challenges. The scope of the thesis and its limitations are also discussed in chapter 1 to encompass the expectation for the readers.

In chapter 2, the author discusses briefly the studies led by Robert M. Grant (2013, np) and Professor Ramanigopal (2012) on the importance of knowledge management in the oil and gas industry. The author also discusses the knowledge management practices in his company. Later, the author discusses briefly his contribution to the project and his efforts for each initiative. He adds a summary of each initiative with the challenges faced during implementation. Chapter 2 also summarizes the Well Delivery Process (WDP). WDP is referred many times in the thesis, so it is quite important to have some briefing on the process.

In chapter 3, the author debates the existing practices in the Company, their deficiencies with examples. Vague definitions and wrong target settings are the major deficiencies in the existing practices. Started with Level-1, the author describes the deficiencies in each set of KPIs, a discussion for change and impact on the project of each KPI including Well Quality KPIs. The author further discusses the absence of Level-2 and Level-3 KPIs, Knowledge Management practices, End of Well Review (EOWR) Process and Service Companies KPIs. The author also mentions about weak KPI reporting practices with examples in chapter 3.

Chapter 4 covers the immediate solutions to the existing KPIs and lack of processes and focuses on the development and implementation of Management KPIs. The chapter describes the rules used by the author in developing and implementing the KPIs. The author goes over new KPIs for each level and describes the calculation method and reasoning for each KPI. The Author discusses the KPIs for the key services and challenges associated with the KPIs.

Chapter 5 describes the core work done by the author after fixing the management KPIs. The chapter represents the major work of the author "Implementation of Knowledge Management Practices". It starts with the objectives of the knowledge management practices and implementation strategy. It discusses the 4 key implemented knowledge management tools/processes in good detail. Learning from these knowledge management tools transformed into a database. The Author discusses the format of the database in chapter 5.

Chapter 6 encompasses one of the major work implemented by the author for the project performance enhancement. New Well Quality KPIs are described in detail including comparing conventional KPI and new KPI approaches. Each KPI of New Well Quality KPIs is discussed in detail. The reporting and verification method is also discussed. KPIs Scoring method and gain analysis are presented in chapter 6.

Besides all the improvements that were implemented and adapted for the project, the accurate interpretation of the results was very important. An innovative approach was used for the project to monitor the right performance. Chapter 7 discusses this innovative approach and the results achieved over time after implementing various fit-for-purpose KPIs and improved processes. Chapter 7 finalizes each KPI achievement and impact on the project by showing various analyses for each KPI.

Based on the work accomplished, many conclusions and recommendations were observed. These conclusions and recommendations are discussed in chapter 8. Later, some ideas are also proposed in the way forward section for the project and the company to achieve further performance enhancement on the project. Application of Artificial Intelligent and real-time performance monitoring will bring significant value for the project. With the availability of different Data applications across the company, Data Integrity became challenging. The solution to such Data Integrity issues is discussed in the way forward section of chapter 8.

CHAPTER 2: Literature Review and Author contribution

At the beginning of any project, existing processes, work, and procedures are reviewed to analyze if the need to change these procedures and processes is required or not. Similarly, on the mega drilling project, the existing methods and procedures within the company were reviewed to evaluate whether these would support the project or not. Some of the good literature on Knowledge Management in the Oil and Gas industry is conferred in this chapter to evaluate if Performance Management is linked with Knowledge Management.

2.1 Previous Work in the industry on Knowledge/Performance Management

"Every day that a better idea goes unused is a lost opportunity" (John Browne, Ex-CEO BP). The above statement in a few words covers the importance of knowledge management for performance improvement on any project. The author discusses concisely two important studies in Knowledge Management in Oil & Gas done by Robert M. Grant (2013, np). and Professor Ramanigopal (2012, np). At the time when the author started to work on the project, very limited studies were available on Knowledge Management in Oil and Gas.

2.1.1 The study by Robert M. Grant (2013)

A detailed study conducted by Robert M. Grant (2013) presented in UNIVERSIA BUSINESS REVIEW on "The Development of Knowledge Management in the Oil and Gas Industry," clearly states the role of knowledge management in the Oil & Gas sector, its impact on the companies' performance, and the conditions for the implementation of the best Knowledge

Management system.

Grant studied the Knowledge Management applications and processes of various international leading Oil & Gas companies, such as BP, Royal Dutch Shell, Chevron, ExxonMobil, ConocoPhillips, Schlumberger, Halliburton, etc. “Not only did all the companies we surveyed institute KM systems and processes, at most of these companies’, senior managers offered explicit recognition of the importance of all of these companies testified to the importance of knowledge management within corporate management systems as a whole and as a major contributor to performance enhancements” (Grant 2013, np). This indicates the link of performance improvement with the application of knowledge management practices explicitly. Robert M. Grant discusses the importance of Knowledge Management, its needs, and key areas to focus in promoting knowledge management activities in different companies by studying different Knowledge Management practices in the major oil & gas companies, such as Chevron, BP, ExxonMobil, Halliburton, Schlumberger etc. Below is a detailed review of the paper, comparing the practices with the Company:

2.1.1.1 The Motivation for Knowledge Management (KM) (Grant 2013, np)

While a common set of industry forces encouraged the oil and gas companies to adopt KM during the late 1990s, each company having different circumstances had an important influence on the KM strategy adopted by each company (Grant 2013, np).

The Company, which is a national oil and gas company, relies mainly on the Knowledge Management practice of the service providers, especially international service providers, to bring the value. However, the Drilling Department realizes the need and a knowledge management engineer is assigned to the project.

2.1.1.2 What knowledge is management (Grant 2013, np)

- Tacit and Explicit Knowledge
- KM in Different Businesses

The practices of the transformation of Tacit Knowledge (People to People) to Explicit Knowledge (People to Information) are different from company to company. Most of the organization did not appear to differentiate between types of knowledge to be managed, so most companies emphasized the broad challenges of knowledge rather particular types of knowledge (Grant 2013, np).

Lack of such practices to convert the Tacit Knowledge into Explicit Knowledge was evident in the National Oil Company, and no support was provided at a centralized level to develop centralized Knowledge Management. However, Knowledge Management Practices were adopted at a limited level by the department lead and by the Knowledge Management & Best Practice Engineer, limiting the support to NPT investigation, Performance Analysis, and collection of lessons learned.

2.1.1.3 Systems and tools for managing knowledge (Grant 2013, np)

- Technology-based
- Databases
- Software Tools
- Portals
- Groupware
- People-based
- Communities of Practice
- Best Practices Groups
- Virtual Teams
- Peer Review Groups
- Training
- Global Benchmarking Group

“When you start talking about knowledge, it’s really about people” (Shell Oil Co). Not surprisingly, information technology (IT) played an essential role in knowledge management systems in the oil and gas industry, but it is all about people. IT tools help to convert explicit knowledge to tacit knowledge through people based knowledge activities (Grant 2013, np).

The Company lacked such a practice, and there was no such system available to convert explicit knowledge to tacit knowledge, so IT support and other resources were not available to implement the detailed knowledge management system in the company. The drilling department realized the need to capture lessons on these +1000 wells to be drilled on four different islands and was looking to transfer the experience into tacit knowledge. A small-scale effort was launched for knowledge management within the drilling department, which became very useful for the project on-time delivery.

2.1.1.4 Implementing knowledge management (Grant 2013, np)

- Top-down versus Bottom-up Initiatives
- Formalization of KM
- Culture and incentives
- Integrating KM into everyday work practices

However, for KM initiatives to take root and flourish within the companies, top management leadership was an essential ingredient. For most of the companies, KM evolved rapidly from decentralized to centralized initiatives (Grant 2013, np).

As the knowledge Management initiatives were taken only at the drilling department, the drilling head (Vice President Drilling) in the company provided full support to the teams to achieve the required goals.

2.1.1.5 Performance Outcomes

- Quantifying the performance benefits of KM (Grant 2013, np)

“I believe this priority was one of the keys to reducing our operating costs by more than $2 billion per year—from about $9.4 billion to $7.4 billion— over the last seven years” (Derr, 1999, Chevron). In 2001, the program’s (InTouch) cost savings and revenue generation to Schlumberger totalled more than $200 million; the time required to solve difficult operational problems had been cut by 95%; the time needed to update engineering modifications reduced by 75%. Also, reductions in technical support costs saved $30 million. Finally, InTouch helped to shorten the 3-year Schlumberger research and engineering cycle by bringing the technology (Grant 2013, np).

The drilling department in the company enjoys the benefit of the implementation of limited Knowledge Management Practices. Only in 2017, a $350 Million savings was recorded based on the business plan, and 14 additional wells were drilled. A total +85 initiatives were identified and implemented jointly in the company, rigs, contractors, and vendors.

- What works? What doesn’t work?

The clear implication is that linking people to people is a more effective KM strategy than linking people to information (Grant 2013, np). Grant describes the relationship of implementation of Behavior, Tools, and Application of Knowledge Management to the Performance Enhancement. More alignment among three will have more performance enhancement. IT-based knowledge management systems facilitate knowledge storage and sharing, yet the ability of an organization to learn, develop, and share knowledge is mainly dependent on how organizational members behave.

Ultimately, the knowledge and value chains should be incorporated to contribute to enhancing profitability. Otherwise, knowledge management systems can quickly turn into a garbage pool, which can exacerbate the problems of knowledge overload (Grant 2013, np).

The above comments concluded very well on the effectiveness of the Knowledge Management practices. The Company uses the Knowledge Management tools at an insufficient level with limited resources. Initially, a lessons learned database was established to share the lessons learned among all drilling groups; later, due to extra resources requirements, its use became limited, and another useful approach was adopted. All the lessons learned database information was converted in the improvement of the sources documents, such as programs and procedures. Instead of developing a vast repository of unused and ineffective knowledge, learning from failures was transferred to the correction of programs.

Though the Knowledge Management practices were not fully adopted for implementation in the company, it has achieved its maximum benefits based on provided resources. Chapter 5 discusses the Knowledge Management practices used in the project. It is no doubt that effective Knowledge Management brings many efficiencies and improvements in any company, but implementation should be targeted and limited to the targeted objectives.

2.1.2 The study by Professor Ramanigopal (2012, np)

A detailed study on Knowledge Management by C.S. Ramanigopal, Professor and Head, Faculty of Management Studies, Vinayaka Missions University, Salem – India is presented in *ASIAN JOURNAL OF BUSINESS AND ECONOMICS VOLUME 2* as "Knowledge Management for the Oil and Gas industry: Opportunities and Challenges". Professor linked the performance of any organization with knowledge management practices including tools and processes. "The primary objectives of the Knowledge Management initiative in any organization are to enhance the performance of the people involved along with the organization. It is not mere knowledge sharing but also valuable bi-product of the business process, by explicitly designing and implementing tools, processes, systematic approaches, structures, principles to improve the decision making with indirect improvements in identifications, capture validations and transformation of knowledge relevant for decision making (2012, np)".

Moreover, Professor Ramanigopal (2012, np) agreed using a versatile Knowledge Management System. He also insisted on a position "Chief Knowledge Officer" within a company to promote Knowledge Management practices among employees. This represented the author's situation in his company very well. The author started his job in his company as

“Knowledge Management and Best Practice Engineer” for the drilling department. The position was created at the department level, So the drilling department realized the need for knowledge management very well, but at the company level, there was no support available to have a comprehensive knowledge management system.

The studies of Knowledge Management in oil and gas by Professor Ramanigopal (2012, np) do not provide the same analysis in the implementation of Knowledge Management as the studies conducted by Robert M. Grant (2013, np). However, both Professor Ramanigopal and Robert M. Grant have agreed that performance enhancement is possible through better Knowledge Management practices.

2.1.3 The study by Gupta, B., L.S. Iyer, and J.E. Aronson

The study by Gupta, B., L.S. Iyer, and J.E. Aronson on “Knowledge Management: Practices and Challenges,” Industrial Management and Data Systems, compiles the various studies on the knowledge management (KM) and summaries key issues realedt to the the knowledge management (KM). The study concludes the various aspects of the Knowledge management (KM) by quoting examples from Dow Chemical Company, Siemens, Buckman Laboratories, AT&T, US West, 3M and International Paper Company etc. Gupta, Iyer and Aronson clearly link the Knowledge management (KM) with the performance and define “the Knowledge management (KM) is a process that deals with the development, storage, retrieval, and dissemination of information and expertise within an organization to support and improve its business performance.” And linked the Knowledge management (KM) to problem solving, dynamic learning, strategic planning and decision making. Hence this study clearly supports the author approach to improve the project performance by the application of Knowledge management (KM) at the project level. The author initiatives to implement NCR system is pure transferring the tacit knowledge into explicit knowledge as Gupta, Iyer and Aronson states the goal of Knowledge management (KM) is to convert tacit knowledge to explicit knowledge and disseminate it effectively in their study.

Gupta, Iyer and Aronson cover the trends of KM in two ways; first, Measuring the intellectual capital of an organization: developing measurement ratios/indexes and benchmarks and second Knowledge mapping: capturing knowledge gained by individual and disseminating it throughout the organization, mainly via information technology. When the author joined the company, he did not find any trend of KM inside the company at any level. This clearly indicates the challenges faced by the author in implementation KM practices at the department level. Gupta, Iyer and Aronson summarise the study of Demarest (1997) on the challenges linked with KM in 6 areas;

1) the culture, actions and beliefs of managers about the value, purpose and role of knowledge;

2) the creation, dissemination and use of knowledge within the firm;

3) the kind of strategic and commercial benefits a firm can expect by the use of effective KM;

4) the maturity of knowledge systems in the firm;

5) how a firm should organize for KM; and

6) the role of information technology in the KM program.

It was observed by the author that with passage of the time drilling KM practise were become the culture of the department even tough with limited supports from co-operate level and Information technology department.

In conclusive remarks, Gupta, Iyer and Aronson discuss the need to develop accounting procedures for valuing intangible assets of organization as well as incorporating models of intellectual capital that in some way quantify the speed of innovation and the development of core competencies.

2.1.4 Existing Knowledge Management Practice in the Company

As discussed above, no compressive knowledge management system was available in the Company and no centralized support was available to the author to start his work. Lack of such practices to convert the Tacit Knowledge into Explicit Knowledge was evident in the Company, and no attention was observed at a centralized level to develop the centralized Knowledge Management system. However, Knowledge Management Practices were adopted at a limited level by the department lead by the Knowledge Management & Best Practice Engineer, who limited his attention to NPT investigation, Performance Analysis, and collection of lessons learned.

IT support and other resources were not available to implement the detailed knowledge management system in the company. A small-scale effort was launched for knowledge management within the drilling department, which became very useful for the UZ 750 project. As the knowledge Management initiatives were taken only at the drilling department, the drilling head (Vice President Drilling) in the company provided full support to the teams to achieve the required goals. The drilling department in the company enjoyed the benefit of the implementation of limited Knowledge Management Practices. Only in 2017, a $350 Million savings were recorded based on the business plan, and 14 additional wells were drilled. A total of +85 initiatives acquired from various knowledge management resources; NCR (Non-Conformance Reporting) investigation system, bin-list tracking system and lesson review meetings and review, were identified and implemented jointly in the company at the department level, at the drilling rigs, among drilling contractors and vendors.

Though the Knowledge Management practices were not fully adopted for implementation in the company, it had achieved its maximum benefits based on provided resources. Chapter 5 discusses the Knowledge Management practices used in the project in more detail. It is no doubt that effective Knowledge Management brings many efficiencies and improvements in any company, but implementation should be targeted and limited to the performance objectives.

2.2 Process Improvement Programs and Review

The literature on the process improvements is overwhelmed over the internet, where hundreds of books and thousands of articles by the process improvements experts are available. These authors have discussed different methodologies for process development, implementation and improvements. In the industry many process improvement programs are available. Below is the summary of each program to get a quick understanding of them.

2.2.1 Total quality management (TQM)

Total quality management (TQM) consists of organization-wide efforts to "install and make permanent climate where employees continuously improve their ability to provide on demand products and services that customers will find of particular value." "Total" emphasizes that departments in addition to production (for example sales and marketing, accounting and finance, engineering and design) are obligated to improve their operations; "management" emphasizes that executives are obligated to actively manage quality through funding, training, staffing, and goal setting. While there is no widely agreed-upon approach, TQM efforts typically draw heavily on the previously developed tools and techniques of quality control. TQM enjoyed widespread attention during the late 1980s and early 1990s before being overshadowed by ISO 9000, Lean Management and Six Sigma. [Wikipedia]

2.2.2 ISO 9000

The ISO 9000 family of quality management systems (QMS) is a set of standards that helps organizations ensure they meet customer and other stakeholder needs within statutory and regulatory requirements related to a product or service. ISO 9000 deals with the fundamentals of quality management systems, including the seven quality management principles that underlie the family of standards. ISO 9001 deals with the requirements that organizations wishing to meet the standard must fulfil. Third-party certification bodies provide independent confirmation that organizations meet the requirements of ISO 9001. Over one million organizations worldwide are independently certified, making ISO 9001 one of the most widely used management tools in the world today. However, the ISO certification process has been criticized as being wasteful and not being useful for all organizations. [Wikipedia]

2.2.3 Six Sigma:

Six Sigma (6σ) is a set of techniques and tools for process improvement. It was introduced by American engineer Bill Smith while working at Motorola in 1986. Jack Welch made it central to his business strategy at General Electric in 1995. A six sigma process is one in which 99.99966% of all opportunities to produce some feature of a part are statistically expected to be free of defects. Six Sigma strategies seek to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing impact variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has specific value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits. [Wikipedia]

2.2.4 Lean Management:

Inspired by the Toyota Production System, lean management is a method of managing and organising work with the aim of improving a company's performance, particularly the quality and profitability of its production processes. Lean management helps optimise processes by reducing non-value-added activities (unnecessary operations or transport, waiting, overproduction etc.), poor-quality costs and complications. This method relies heavily on a management strategy that allows employees to work in the best possible conditions. Ultimately, the approach has two main objectives: complete customer satisfaction and employee success. [https://www.manutan.com/blog/en/glossary/lean-management-definition-and-tools]

Lean management and Six Sigma are two concepts which share similar methodologies and tools. Both programs are Japanese-influenced, but they are two different programs. Lean management is focused on eliminating waste using a set of proven standardized tools and methodologies that target organizational efficiencies while integrating a performance improvement system utilized by everyone, while Six Sigma's focus is on eliminating defects and reducing variation. Both systems are driven by data, though Six Sigma is much more dependent on accurate data. [Wikipedia]

2.2.5 Application of the process improvement program to the project

While working on the project, the author did not use any process improvement program as a whole. Because implementation of any program is required industry research on the application of any process improvement program on similar types of projects. In absence of any qualified program, the author adopted the flexibility to implement any approach based on needs and to adapt the fit-for-purpose solutions to get the results.

After a close comparison, the author found the techniques used for the project were very similar to Six Sigma. Though no six sigma detailed analyses were conducted and no systematic approach was adopted, the six sigma methodology DMAIC (Define, Measure, Analyze, Improve and Control) was visible in all works adopted for the project. Starting from developing KPIs, defining the KPI was his first approach, and outing systems to measure/capture the data was the second step in his major works. After continuously analyzing the data, improvement plans were shared and communicated along with improved procedures/programs. Later the control was done by cautiously monitoring the results and presenting them to the management. During these improvements, the continuous improvements were always got full attention. Though the author did not follow the DMAIC methodology closely and use a similar methodize as per needs which confirms that the six sigma methodology – DMAIC is very close to the needs of any process improvement. The author does have an extra step besides using Define, Measure, Analyze, Improve and control which is confirmed. This step is in between Analyze and Improve. Confirmation of any strategy has a similar importance to other steps. Without confirmation, the improvement will not be recognized.

The blog “A Brief History of Process: From the Industrial Revolution to today” written by Craig Reid on https://www.processexcellencenetwork.com is elaborate on the issues with the current process improvements methodologies. He said “Unfortunately, rather than being seen as a means of improving organizational effectiveness and productivity it became synonymous with corporate downsizing – a PR disaster for the process movement that lasted many years. Nothing typified this period more than Michael Hammer’s eponymous quote that when implementing process change organisations should "carry the wounded, but shoot the stragglers!".” He is absolutely right that the process improvements most of the times are linked with the downsizing which should not be linked with the process improvements. It is an unhealthy cost-cutting activity. Any companies involved in such practice have no right to survive the current competitive market.

Craig mentioned the failures of the six sigma and lean management for a certain industry. He said “So where are we today? Methodologies such as Lean and Six Sigma (or a combination of both) are still used extensively in organizations, but both have their share of critics who cite the lack of practicality when rigidly implementing the methods. Many process experts also argue that techniques historically developed to suit manufacturing industries are not well suited to service industries and "knowledge work", which exhibit less linear processes.” Which proved the author's claim on the modification by adding an extra step “Confirm” between Analyze and Improve for the improvement of the processes related to the services. The Author always took extra efforts to get confirmation before implementing the improvement plan. In a service industry where the processes are not linear, get the approval to align the teams to achieve the goals collectively.

Where the author concurs with Craig's final remarks "The arguments over methodologies and systems will always be with us, but as long as we are continuing to look at new ways of adding value to organizations the future of process thinking will continue to be bright for many years to come." and stresses that the process improvement is an evolving phenomenon and will keep continue till the humanity live and grow.

2.3 The Author's Contributions

The author has been working in the oil and gas sector since 1996. While working at Schlumberger, an international oilfield service company for 15 years, he was exposed to highly competitive and challenging environments providing technical and project management services to companies like ExxonMobil, Chevron, Husky, Total, etc. Upon joining the drilling team as Knowledge Management & Best Practice Engineer at ZADCO in 2011, he applied the best engineering and management practices to bring high earned values for the project as well for the company. After implementing various initiatives, he was promoted to the position of Manager, Performance Reporting and Business Solutions.

As described earlier, this thesis is a study of all his efforts to improve the project performance, to bring awareness among team members on performance reporting and to set the right target to get better output. The thesis also represents his observations and learnings in many areas during developing and implementing new processes and KPIs for delivering the right performance in areas for improvements from operations to data integrity.

The author had implemented many new processes to help teams to improve overall project performance. He introduced new methods for capturing and reporting accurate KPIs. He conducted many technical and engineering detailed analysis reviews with shareholders, senior management and team members before any changes in existing procedures or any new methods or procedures were implemented. Below is the summary of all the work introduced by Author while working on the project;

2.3.1 Implementation of Knowledge Management Practices

Knowledge Management practices in the drilling department were implemented by the author at a limited level in 4 areas;

- NCR (Non-Conformance Reporting) System
- Bin-list (a tracking system for internal issues)
- End of Well Review (lessons learned review and new ideas)
- Lessons Learned Database

2.3.1.1 Implementation of NCR (Non-Conformance Reporting) System

In the absence of a sound failures investigation system, the correct lessons were never got discovered. Most of the lessons learned became just a simple follow-up without any learning and future improvements became limited to Service Companies' interest. The author introduced a simplified form (NCR form) along with roles and responsibilities for each stakeholder from the drilling team to the services companies. To implement the process successfully, the author captured the first +90 NCRs himself and got involved in every step of the investigation to make sure each NCR was successfully closed-out with valid lessons learned and to make sure those lessons learned were applicable immediately and brought efficiency to the project in term of reduction in well duration and well cost. He trained +36 Engineers on how to log the NCR in the system. After realizing the importance of the system, senior management made it compulsory to report all failures through the NCR system. To make sure the system is running properly, the author led +400 investigations for accurate lessons learned captured in the system. In four years more than 1700 NCR were captured. NCR implementation, its benefits and outcomes are discussed in more detail in chapter 5.

2.3.1.2 Implementation of Bin-list (a tracking system for internal issues)

This process was introduced by the author to track internal critical issues. An NCR system was capturing and tracking all external issues related to contractors and vendors. The author became the owner of the bin-list system to capture the items, to discuss with the senior management including Vice President Drilling and to assign the tasks to different teams within the Drilling Department. The author followed up on each task, updated in the portal and conducted the review with senior management. After management approval, the author shared the outcome, lessons learned, improvements etc. with all team members for implementations. Chapter 5 discusses bin-list implementation and benefits in more detail.

2.3.1.3 End of Well Review (lessons learned review)

The author took one more step by introducing the End of Well Review process and reviewing with team members well by well to collect lessons learned and new ideas quickly when the minds were fresh on recently finished well. The author led more than 30 End-of-Wells reviews and established the End of well review procedures. Though an End of the Well Review (EOWR) was one of the stages of the Well Delivery Process (WDP) but no record of End of the Well Review (EOWR) was available. The Well Delivery Process (WDP) consisted of six different stages of a Well; Pre-appraise Stage, Appraise & Select Stage, Program Stage, Mobilize Stage, Execute Stage and Review Stage. Initially, WDP did not provide clear guidance and role with responsibilities for the End of the well Review process. Each WDP stage had one owner who led the stage by reviewing the stage related documents and information with the teams and finalized the stage. The author became the owner of the review stage. The author revised the review stage guidelines to make sure the purpose "collection of lessons learned and sharing them among team members" was achieved. More discussion will be provided in chapter 5.

2.3.1.4 Lessons Learned Database

After starting the Knowledge Management processes, it was imperative to capture all the leanings in a single database accessible to all users. The author established the lesson learned database practices and defined the format for adding lessons to the database. Without any centralized support and cooperation from the IT (Information Technology) department, the author learned the SharePoint Portal Application and established the approved lessons learned database. Initially, the first +500 lessons were captured by the author. The author trained an office admin for the data entry in the lesson learned database. Later, all engineers were responsible for entering lessons learned in the database and some training sessions were provided. However, a detailed discussion of the lesson learned database is covered and presented in chapter 5.

2.3.2 Correction, Development and Reporting of Management KPI

Being working as Manager, Performance Reporting and Business Solutions, authors realized that Key Performance Indicators (KPI) set for Level 1, (CEO to shareholders) and Level 2 (SVP to CEO) and Level 3 (VP to SVP) were not appropriating addressing the project performance timely. Many of these KPIs were laggard. The author involved the shareholders and hold two KPI improvement workshops with shareholders and senior management. He proposed the new KPIs for all levels with clear definitions. Chapter 3 discusses the lack of existing KPIs and tracking methods in detail. Chapter 4 discusses the changes made to Level-1, Level-2 and Level-3 KPIs by the author. All the work related to KPIs was accomplished by the author involving all the stakeholders at every level to make sure the implementation was recognized and accepted at all levels. The author holds + 30 meetings to explain KPIs to shareholders, senior management, team members, and senior management from sister companies.

2.3.3 Well Quality (Delivery) KPIs

These KPIs are purely related to the technical and engineering works completed from planning to the execution phase during the Well Delivery Process (WDP). Well Delivery Process (WDP) consisted of six different stages of a Well; Pre-appraise Stage, Appraise & Select Stage, Program Stage, Mobilize Stage, Execute Stage and Review Stage. The author led seven different teams of the subject matter experts from each KPI area;

- Drilling & Well Placement,
- Casing & Cementing,
- Stimulation & Completion,
- Wellbore Accessibility,
- Data Gathering and Evaluation,
- Well Integrity
- Well Performance

After extensive discussions and multiple reviews with each team of subject matter experts (SME), the author was able to conclude the Well based KPIs to evaluate the quality of delivered wells of the project at Well Delivery. A detailed charter with the scope was prepared for SMEs to make sure objectives were met in developing Well Quality KPIs. The existing Well Quality KPIs were discussed in detail with areas to improve in chapter 3. The development of new KPIs, Analysis, a versatile scoring mechanism and Implementation of these KPIs were discussed in detail in chapter 6. However, it took almost 2 years for the author to finalize the Well Quality KPIs after multiple reviews with shareholders, senior management and team members. After making many changes and testing for two years, Well Quality KPIs were implemented in 2014 for official use and became part of Level 1 (CEO to shareholders) KPIs.

2.3.4 Problem Events, NPT, Scope Change and DDR Guidelines

A detailed document on "Problem Events, NPT, Scope Change and DDR Guidelines" was developed by the author in a very timely manner to control a mal-practice regularly conducted by the performance team. A discussion on the mal-practice is discussed under vague definitions in chapter 3. The detailed document written by the author provided very clear definitions of various NPT situations and differentiated the Scope Change clearly from the NPT. The author standardized the Daily Drilling Reporting (DDR) among all rigs by establishing clear guidelines. All the data analyses including KPIs calculation are dependent on the Daily Drilling reporting. So, it is very critical to have consistency in reporting among all rigs. For referral on the actual guidelines, see Appendix A.

2.3.5 KPIs for Key Services

After fixing Level-1, Level-2, Level-3, and Well Quality KPIs at delivery, it was deemed important to make sure each key service related to Drilling and Completion was performed within acceptable performance limits. The author organized the various sessions with subject matter experts from major service companies such as Schlumberger, Halliburton, Baker Hughes and Weatherford to develop an initial set of KPIs of key services. The author identified 5 key services; Directional Drilling, Drilling Fluids, Cementing, Wireline and Coiled Tubing. The author held educational and awareness sessions with the key people from each key service of major services companies to get feedback before implementation. The field trials were conducted by each major service companies to make sure KPIs were executable and recordable before these were released for implementation. Once field trials were finalized, the author discussed the KPIs with his senior management and key members of the drilling team and released the KPIs for Implementation. Later these KPIs were shared with the contract team to make sure all contracts had accommodated these KPIs in the contacts. More meetings were organized with the headquarter by the author explaining the advantages of the implementation of KPIs. Later these KPIs became code of practice approved by the headquarter team. The development and implementation of the KPIs for the key services are not discussed in the thesis to limit the scope of the main issues. However, chapter 3 and chapter 4 discuss the needs of the KPIs and impact on the project to have a comprehensive set of KPIs for the services companies. A copy of the KPIs is also added in Appendix F for reference.

2.3.6 Performance Incentive Bonus Scheme (PIBS)

Once significant results were observed and performance started to improve, a need to reward the hard work executed by drilling contractors including rigs was recognized. The author prepared the draft scheme and shared it with senior management. Due to confidentiality, the scheme was discussed only with senior management. Once the senior management was agreed, detailed guidelines were prepared by the author to make sure the bonus scheme was followed strictly due to the money involvement. These guidelines were shared with the finance and commercial teams for review. Later the scheme was approved by the Chief Executive Officer for implementation. The development and implementation of the Performance Incentive Bonus Scheme (PIBS) are not discussed in the thesis to limit the scope to the main issues. However, an original copy of the (PIBS) is added in Appendix G for reference.

2.3.7 Standard Operations Codes and Definitions

While working as Manager, Performance Tracking and Business Solutions, the author introduced a third party application that automated the Authorization for Expenditures (AFE). To implement the application, cost codes was required to be updated by cost engineers. It became a serious issue once these cost codes were not aligned with existing operation codes. The author took the responsivity to improve the operation activities codes and the definitions of these codes. With the help of different team members, the author was able to implement the improved codes for Drilling and Completion activities. After implementation, the headquarter team insisted to implement these codes across all the sister companies. A Code of Practice (COP) was issued after multiple meetings with sister companies. The development and implementation of the Standard Operations Codes and Definitions are not discussed in the thesis to limit the scope to the main issues. However, a copy of the Standard Operations Codes and Definitions is added in Appendix B for reference.

2.4 Well Delivery Process

Well Delivery Process consists of 6 stages of a well to be delivered;

- Pre-Appraise
- Appraise-Select
- Program
- Mobilize
- Execute
- Review

Each Stage is led by different departments and teams. Each stage of the Well Delivery Process has key activities and deliverables. Table 2 summarizes the Well Delivery Process with key activities. A detailed discussion of one Well Delivery process is out of the scope of the thesis.

Table 2: Overview of Well Delivery Process

Stage	Lead	Key Activities & Deliverables
Pre-Appraise	Field Development	**Well Business Case Definition.** Objectives, Location, Geology, Performance, Feasibility, Time, Cost, Risk Well Approval by Shareholders.
Appraise - Select	Field Development Drilling/ Completions Engineering	**WDB Deliverable.** Detailed screening of well options / architecture. Selection of final well location for well objectives. Economics and high-level risk assessments for final well design, drilling and well services planning.
Program	Drilling Completions Engineering	**Issue Well Program and AFE for approvals.** Optimize the drilling and completion well design and ops plans, drilling engineering analysis, geo-steering, formation evaluation completions and stimulation design, time and cost estimates, risk assessment, mitigation actions, testing and preparations for well-handover to production operations (Site) , life cycle integrity.
Mobilize	Drilling Operations NDC & Contractors	**Plan rig moves, materials supply for drilling, hook-up, stimulation and testing.** Batch drilling and SIMOPs with well pad construction, well clean-up and testing.
Execute	Drilling Operations NDC & Contractors	**Drill, complete, hook up and prepare for handover to production including clean-up, stimulation and testing.** Real-Time Operations Centers (RTOC) for monitoring and analyzing drilling parameters to improve operations, geo-steering and 3D well placement in the reservoir, formation evaluation and final lower completion component settings and space out.
Review	All	**Final Well Report Deliverable.** Determine well KPIs and capture Lessons Learned for WDP well planning and execution processes.

CHAPTER 3: Review of Existing Practices in the Company

As discussed in Chapter 1, the drilling department was established after ExxonMobil joined the ZADCO in 2008. Before all the drilling activities were managed by a sister company, ADMA-OPCO, an ADNOC company. Once the Drilling Department was established in ZADCO, people were mobilized from ADMA-OPCO to ZADCO. The team carried over all ex-procedures and processes. Coming from a different work environment and organization structure, the adaptation of the team as well as procedures and processes to a new work organization became challenging. The procedures turned ineffective and the process cycles became incomplete. Later the author found that many of the processes and procedures were poorly written and could not be sustained without good understanding and support. It became a great challenge for the drilling department to re-establish new processes, procedures before the drilling activities were started at Artificial Islands. Meanwhile, a new team was constructed to handle the UZ750 project alongside the old drilling team which was mobilized from the sister company. The new team started to look after the UZ750 Project, meanwhile, the old team was responsible to keep continue drilling using the existing platform to meet the production requirements until the new project became self-sustained. After the author joined the project in 2011 and realized that he had to work smartly with both teams to make sure processes and procedures were adaptable and acceptable for both teams. The author started to address the lack of processes and procedures especially in Knowledge Management, Performance Reporting (KPIs) and Data Management. The author worked on Management KPIs, lesson Learned processes, Data Reporting and Integrity on a priority basis and highlighted the deficiencies in these areas. Solid and long term solutions were proposed and implemented to achieve project objectives. Below were the areas addressed at priority;

3.1 Deficiency in Existing Level-1 Key Performance Indicators (KPIs)

Only Level-1 KPIs (KPIs between CEO to Shareholders/Directors) were existed in the company and were reported yearly basis. A formal reporting process set by the cooperate planning department was used to receive the KPI numbers from each department including Drilling. Corporate Planning held two meetings per year. Both meetings used to hold at the beginning of the year; First meeting to announce the results of the previous year KPIs and second meeting to discuss with each department the targets of the starting year. A base target and a stretch target against each KPIs were set to measure the performance. The Level-1 KPIs were distributed among four (4) categories: HSE, Organization, Operations, and Values. The Drilling Department was accountable for following three (3) KPIs under the operations category:

- Drilling Efficiency
- Well Cost Index
- Well Quality

The Level-1 KPIs had many limitations which raised a need to replace or improve these KPIs with a better understanding of a newly developed team. Below the main reasons to replace the existing level-1 KPIs applied to all level-1 KPIs.

a) Vague definitions and calculation:

A little documentation was available for most of the existing KPIs. A calculation sheet presenting the calculation method was used for KPIs calculations. In the absence of the detailed guidelines, some definitions were so vague that results could be manipulated easily. For example; the team was not able to differentiate between Non-Productive Time (NPT) and Scope change. The lost time occurred due to the failures that were usually transferred to the scope change. A general rule "any NPT without explanation is a scope change" was a mal-practice that was commonly used to calculate KPIs due to the unavailability of clear documentation. Due to that mal-practice, it would never be possible to track properly the scope change and non-productive time and learning would never be clear for improvements. Similarly, on many occasions, NPT was considered a productive time due to the unclear definitions of NPT events. On many occasions, a short time was reported for NPT due to a lack of documentation on the start and end time of the NPT.

The above examples explain the importance of clear definitions of all elements of the KPIs and consistency in KPI reporting.

b) Absurd Target setting practices:

The KPI target setting practice was not based on the S.M.A.R.T (Specific, Measurable, Achievable, Realistic, Time-bound) criteria. The targets were used to set without comparing the past results and without considering the achievability. For Example; if a base target of a KPI was set for 90% and a stretch target for the KPI was set for 95% and the achieved target was 85%. The following year's target would be based on the capabilities of the team and the resources assigned to make sure it could be achievable. But the approach from corporate planning was not to disturb the target. So the team had to work around to get the KPI. This practice was an absurd practice, which compelled the team members to report numbers as high as possible. That practice discourages the team to perform better as the KPI target was not achievable. That could be one of the reasons for not having a detailed description of the KPIs, as teams could have the flexibility to adjust the KPIs numbers. For example; NPT days were confused with scope change to get an advantage to achieve a high score. Similarly, the start and end dates of a Well were not captured consistently across all wells. The reporting fewer than actual days the wells against plan days inflated the Drilling Efficiency KPI. For Well Quality KPIs, no written guidelines were available. In the absence of any guidelines, everybody used to report “All is good” as the target was 99%. Due to that approach “All is good” resulted in a 100% score for the existing Well Quality KPIs for all past years. These were very clear examples of how the incorrect target setting practices turned the KPIs reporting as a formal process. No learning was ever captured under that mal-practice. More examples will be discussed under each KPI section.

After many reviews with the corporate planning team, it was clear that the corporate planning team was not interested to change its target setting practice, as the team used a similar approach for all departments in setting targets. So it became very important for the drilling team to bring a different set of KPIs for Level-1 which would be more practical and meet the target setting practices.

3.1.1 Deficiency in Exiting KPI - Drilling Efficiency

Based on the existing calculation sheet for KPIs reporting, the definition of existing Drilling Efficiency KPI was the ratio between the actual well duration excluding wait on the weather (WOW) to the planned well duration calculated during Authorization for Expenditures (AFE). Any extra days due to scope change were added to the plan days and any days related to cancelled activities were also subtracted from planned AFE days.

$$\text{Drilling Efficiency (Existing)} = \frac{\text{Actual well Day} - \text{WOW}}{\text{Planned days } + \text{Scope change days} - \text{ Cancelled activities}}$$

Equation 1: Existing Drilling Efficiency Calculation

The KPI was calculated after the completion of a well. Any value less 1.0 was considered a good performance for the well. Meeting the targeted planned days was considered as the base target, which was set at 1.0. The stretch target was set at 0.9, which represented a 10% saving in drilling well duration.

3.1.1.1 Discussion for change and impact on UZ-750 project:

The existing formula was the ratio of Actual days to Plan days, which was contrary to the basic definition of “efficiency”. If a well was drilled in fewer days than planned days, the efficiency should be greater than 100%, but when existing drilling efficiency formula

(Equation 1) was applied. Efficiency became less than 100%. Similarly, if the actual days of a well were more than planned days, the drilling efficiency became more than 100%. A bad performance should decrease the score. So, it was very confusing for the author and all of the people who were new to the project. An efficiency of more than 100% should be treated as a good sign, it was considered a bad efficiency for the drilled well and any number less than 100% was considered a good number. For Example; a well was drilled in 130 days. The planned days was 99 days. The drilling efficiency based on the existing calculation was 131%. Similarly, another well was drilling and completed in 79.5 days and planned days were 105 days. The drilling efficiency based on the existing calculation was 75.7%. It was confusing why a well drilled in fewer days had low-efficiency numbers. Hence it was clear that the existing definition to be replaced with better definition. The author raised the concern to all the stakeholders and proposed a revised calculation (Equation 2), which will discussed in chapter 4.

A major concern was also observed that the Planned Days (AFE days) was not linked to the budgeted project days. Below gave more explanation on it.

a) An AFE (Authorization for Expenditures), a separate process, was based on an average calculation of each activity for the past wells with a risk factor. An AFE was prepared by the Drilling & Completion Engineer who used the historical information of similar types of wells from past and AFE calculation varied from one engineer to another engineer. AFE was approved by the Vice President of the Drilling Department.

b) The budgeted days were based on the type of the wells, where average overall days were considered for each type well separately. The drilling budget was assigned based on budgeted days, prepared by the Cost Engineer and approved by Senior Management and Shareholders.

c) The difference between AFE planned days and budgeted days was noticed. Sometimes the difference was less and many times it was more. As drilling efficiency was based on AFE days, it became critical to introduce a new KPI to make sure the right information and performance were captured. For senior management and shareholders, it was very important to know how much budget was utilized and what was the Earn Value for the work achieved against the budgeted days.

Based on the above reasons, it was proposed to remove the Drilling Efficiency KPIs from Level-1, CEO to shareholders, to Level-2 (SVP to CEO), as Drilling Efficiency was a good KPI to monitor the AFE and Actual days comparison. Chapter 4 provides more detail on new KPIs and new KPIs structure (Table 3).

3.1.2 Deficiency in Existing KPI - Well Cost Index

The Well Cost Index was used to compare the cost of a recently drilled well with similar wells in past. The KPI was defined as the normalized well cost divided by the historical well cost of each well-category. The normalized well costs included the normalization of the rig rates, service charges, and material costs. Any extra costs such as coring or special logging etc. were excluded from the calculation. Besides excluding some key services, the calculation excluded all Exploration, Appraisal and, Plug and Abandon wells. For the historical data, “like-for-like” wells drilled in the previous year were used for comparison. If no “like-for-like” wells were drilled in the previous year, then all “like-for-like” wells drilled in the last two years were used. If there were no “like-for-like” wells within the last two years, then that well would be excluded from the calculation.

3.1.2.1 Discussion for change and Impact on the 750- Project

The below points became strong reasons for the change;

a) No documentation was available for the KPIs except a calculation sheet prepared by an analyst who was calculating the KPI based on the assumptions mentioned above in the definition.

b) The normalization “like-for-like” was not a realistic approach as many of the important wells were missed from the calculation. So, KPI out was very vague and presented misleading information.

c) The base target by the corporate planning team always set for 0.95. It meant new well would be drilled at 5% low cost compared to last year well regardless of the length of the well. Thence, it became clear for the senior management that targets setting practice was absurd and impractical especially for the well cost index KPI.

After many reviews with the corporate planning team, it was clear that the corporate planning team was not interested to change its target setting practice. So it became important to bring different KPI for Level-1. See table 3 for the new KPI structure.

d) The Well Cost Index KPI was not suitable for the wells drilled for the UZ-750 project. As the majority of project wells were extended reach wells. Those project wells would get deeper day by day. The total cost of a long well was proven to be higher than the shallow wells as more days were required to drill and complete longer wells. Under a similar category with similar construction design but different depth, the well cost index for the category would higher for longer wells. Thence, well cost index KPI was not right KPIs to compare the well cost of extended reach project wells.

Base on the above reasons, it became necessary to find the best approach to track project cost KPIs. OPEX and CAPEX variation were started to use instead of Well Cost Index. The well cost index KPI was completely removed from all levels and was discontinued from all calculations.

In brief, the existing Level-1 KPIs were not S.M.A.R.T. (Specific, Measurable, Achievable, Relevant/Realistic, and Time-bound/Time-phased) KPIs to be implemented for the project. The need to replace old KPIs with new KPIs was ultimately necessary. Senior management and shareholders' meetings were organized to admit the need for the change. It was essential to reflect the right KPIs at level-1 so the right attention can be given on the areas for improvements on the project instead of filling in some numbers and meeting only the formalities of KPI.

Table 3: Existing Well Quality KPI Score Distribution

Element	**Weighting (Points)**
Well Performance (28 Points)	
– Recommended Technical Rate	6
– Reservoir Pressure	4
– Productivity/Injectivity Index	10
– Water Cut	8
Well Integrity (40 Points)	
– Zonal Isolation	6
– Casing Integrity	20
– Completion Integrity	8
– Wellhead Integrity	6
Well Operational Requirement (24 Points)	
– Target/Horizontal Hole Placement	8
– Stimulation/Enzyme Treatment/Clean Up	8
– Coiled Tubing Accessibility	8
Data Gathering (8 Points)	
– Coring & Logging	8
Grand Total	**100**

3.1.3 Deficiency in Existing KPIs- Well Quality KPI

The existing Well Quality KPI was a set of many KPIs comprised of 4 core elements: Well Performance, Well Integrity, Well Operation Requirements, and Data gathering. Out of four core elements, three elements; Well Integrity, Well Operation Requirements, and Data gathering were related to the execution phase (Well Delivery Phase), and the fourth element, Well Performance KPI, was related to reservoir pressure and flow rate.

Table 3 shows 4 core elements and the further break down of these core elements into subcategories. The table also shows the scoring distribution of each category toward the total score.

3.1.3.1 Discussion for change and impact on UZ-750 project

Existing Well Quality KPIs based on the above table were applied by the author on ten project wells. The author came up with the following conclusion for the senior management and requested revolutionary change in the existing Well Quality KPIs;

a) Existing Quality KPIs were not specified and defined clearly. On many occasions, a full score was assigned due to not having clear guidelines. Engineers had to assume and make a guess to find the results of the KPIs. For example; KPI for Zonal Isolation; It was not clear when to give a full score, when to give a partial score and when to assign a “nil” score. All were based on personal judgment. It was also not clear who would report and who would verify the results. Every time the “All is good" report was given for all KPIs regardless of serious zonal communication issues existed on the wells. If someone assigned a low score, the person had to go through high criticism supported by many technical chunters of why the score was given low. If no solid explanation was provided, the score changed to full marks by the management. So it became the habit of engineers not to deviate from "All is good" in reporting KPI score unless there were some concerns from shareholders. So, "All is good" was supported at every level. Similarly, the reporting of Casing Integrity, completion Integrity, Wellhead Integrity KPIs became critical too as the detailed scoring guidelines were not available. So always "All is good" was reported for these KPIs.

b) The Scoring Criteria in existing KPI was always a challenge. Due to the absence of guidelines on scoring, each time teams were going through many discussions on how to report the score and to convince each other for the final score. Besides reporting "All is good" for the KPIs, still, engineers were going through discussion on how to score the KPI. It was a frustrating exercise among subject matter experts. Sometimes management did not support the subject matter decision as no documents were available to define the KPIs. For example; Most of the time, the scoring for Coring and logging KPIs became an issue as on many wells, coring and logging programs were cancelled. Both Coring & Logging carried 8 points out of 100. There was always a debate If Coring and Logging were not applicable, then what would be the score of the well.

c) The scoring method did not reflect the Well Objectives. Some wells such as multi-lateral wells contained a high number of activities, where each lateral had multiple logs and separate drilling intervals. Similarly, some wells such as plug and Abandon wells had a very limited number of activities. So KPI scoring should accommodate such major change based on the objectives of a well. For example; If the main objective of a well was to plug and abandon the well, all the scores should be assigned to plug and abandonment activities. Completion KPIs should not be considered, as no completion work was performed. But existing KPIs did not support that and a full score was always assigned to the completion KPIs. It became clear that the existing KPIs had limitations and could not apply to a variety of wells. so the need to have a dynamic and versatile scoring method based on well type and complexity was recognized by the author.

d) Some of the KPIs did not meet the "Time-Bounded" criteria for the KPIs. For example; Well Performance KPIs required more than six months till the stability in the flow of the well was achieved. Below was the sequence of the operations before the Well Performance KPIs were captured for reporting;

i. The well was finished and Rig was moved to a new location.

ii. The well was hooked to the main flow line, either producer or Injecting system.

iii. The well was operational for 3-4 months.

iv. An acid stimulation job was conducted on the well

v. Well remained under operation either producing or injecting till the stability in the flow was achieved.

vi. KPIs were recorded

e) It used to take 6 months to 2 years to finalize the KPIs reporting. The report on all the KPIs captured during the drilling and completion phase of the well remained on hold, till the Well Performance KPIs were ready. That practice was causing significant delays in reporting the final KPI Score for the wells and the Well Quality KPIs always were not reflected in the same year. The reporting of a 2 to 3 years old set of Well Quality KPIs always created confusion for the stakeholders.

f) Some of the existing Well Quality KPIs were Non-Specific for Drilling Activities such as Well Performance KPIs, which were linked with the reservoir performance and were dependent on many factors including the reservoir management and the simulation results. The drilling department did not have any control over it. So the author proposed to split the KPIs; Well Quality KPI (Delivery) captured at the delivery of the well to the production team and Well Performance KPIs captured after well was operated by the production team and was stabilized. Drilling Management supported the idea as it was imperative for the drilling team to have dedicated KPIs for drilling activities to be reported at the delivery of the Well, so the leanings could be applied to next well quickly and effectively.

g) An inconsistency in KPIs reporting was observed on many occasions. As discussed earlier, Roles and Responsibilities were not defined in existing KPIs which caused different response times and different responses based on each engineer’s understanding of the KPIs. At the end of a well, it was not clear who would report KPIs and who KPIs would verify. The drilling analyst followed up with various team members to capture the KPIs. The drilling analyst did not have any drilling experience and always relied on the output from the engineers without any questing the results. Each engineer reported KPIs based on his/her understanding, so different KPIs scoring was reported for the same activity with the same output for different wells. For example; Casing Integrity KPIs were reported differently based on each engineer's judgement. On one well, when the cement job was not executed as per plan, the engineer reported a partial score for the casing Integrity. Similarly, on another well with the same condition, another engineer reported the full score. This raised serious concern on the integrity of the Well Quality KPIs reporting system.

h) Less importance was given to Well Integrity KPIs in the existing KPIs and was not addressed properly. Some wells with serious Well Integrity issues were scored high and never got a red flag. For example; A wellhead on a well was not installed properly and Wellhead integrity was compromised. Only the 6 points were deducted from the overall score and the rig was moved to next well. That was a very serious issue. The author alarmed the senior management during the end of the well review, but no action was taken as the KPI score was enough to accept the well. After handed over to the production team, well was ranked as a high-risk well and then a workover rig was mobilized to fix the well. If that issue was captured during KPI reporting with the "nil" score, the rig would not move till the well was fixed. But weak KPIs reporting could not flag the issue timely.

Based on the above findings, drilling management captured the need for change to improve the existing Quality KPIs to meet the mega drilling project needs and it was stated as "During WDP (Well Delivery Process), it should be stated what can be done and what can't be done. Well Quality KPI needs revision. Well Quality KPI should be based on the clear goals discussed during WDP considering each well an individual design (complexity, placement limitations, availability of information/data, etc.). For example, NPT targets should be based on the complexity of the well and landing point criteria to be reviewed again, etc."

3.2 Absence of Level-2 and Level-3 KPIs:

In absence of Level 2 (Senior Vice President to CEO) and Level 3 (VP to SVP), teams were not focused on any areas to improve. Level-1 KPIs were not broken down further to subcategories, so teams could focus on these areas more efficiently to achieve common goals. For example, the Well Duration reduction could be divided into four different categories;

Move Days reduction, Drilling Days reduction, Completion Days reduction, NPT Days reduction etc. Once teams worked in these sub-categories separately and achieved better results, at the end whole well duration days could improve. We will discuss the advantage of Level-2 and L3 KPI in chapter 4.

3.3 Deficiencies in Knowledge Management Practices

No organized practices were observed collectively at the company level or department level. Such Knowledge Management practices never got any attention at the company or any department level as a performance enhancement tool. Engineers applied some methods individually to run the project activities smoothly, but these practices were only at the individual level and were not interlinked with each other, so no mutual benefits were recognized.

Performance Improvement was relying on the service companies Knowledge Management practices, as some of the major service companies had robust knowledge sharing and lessons learned processes to enhance performance (Grant 2013, np). Engineers were entirely dependent on these service companies to track the previous results and to provide improvement plans. Undoubtedly, the practice was one-sided and turned in favour of service companies on many occasions. Service companies were mainly bringing in the new technologies based on a suggestion made from lessons in favour of their business improvement plans, and these service companies were not willing to share their real findings and learnings with other service companies due to competitive advantages.

The Company uses the Knowledge Management tools at an insufficient level with limited resources. Initially, a lessons learned database was established to share the lessons learned among all drilling groups; later, due to extra resources requirements, its use became limited and another useful approach was adopted. All the lessons learned database information was converted into the improvement of the sources documents, such as programs and procedures. Instead of developing a vast repository of unused and ineffective knowledge, learning from failures was transferred to the correction of programs

In short, there was no such platform available for engineers to track the learnings collectively and implement them across the fleet for performance enhancement in all areas and dimensions. Later, four lessons learned processes (NCR, Bin-list, New Technology) were introduced to establish lessons learned database.

3.4 Incomplete End of well Review (EOWR) Process

Being a part of the Review stage of the Well Delivery process, a sixth and last stage and a milestone event for knowledge sharing among different stakeholders, End of well reviews (EOWR) were not conducted by the company. Some of the End of well reviews were organized by major service companies individually by services to complete their process and most of the discussion was around one topic based on the service company. Sometimes multiple EOWRs were conducted for a well due to different services. So no joint effort was in place. The guidelines for the WDP review stage did not provide any clear instructions on the EOWR process. In the absence of End of Well review guidelines, a precious chance to collect lessons and share best practices was always wasted. A New End of Well Review process was introduced with assigned roles and responsibilities. More discussion on this topic is available in Chapter 4.

3.5 Unavailability of Service Companies KPIs

No KPIs were defined contractually for any service and expectations from Service Companies were not clear as the existing contracts did not elaborate any clause on the performance expectations. For the success of the mega drilling project, it became imperative to set KPIs for the key services with a high impact on a Well duration, such as Directional Drilling, Drilling Fluids, Cementing, Wireline, and Coiled Tubing. Past practices indicated that vendors always determined the KPIs for their performance measurement. No consistency was found among different vendors, and sometimes no consistency was found within the same vendor as the KPIs were getting changed based on performance output in the favour of the vendor. If a KPI indicated some lags, the vendors presented it only if it was in their favour and might bring more business for them. So it became essential to have KPIs for the Key services owned by the company in favour of the project.

3.6 Weak KPI reporting process

Many of the other processes, such as KPI reporting, were full of flaws with basic conceptual mistakes in the KPI definitions for each level, such as level -1 KPIs (CEO to Directors, Shareholders), Well Quality KPIs, and Service Companies KPIs.

In conclusion, there was no such platform available for engineers to track the learnings collectively and implement them across all the fleet for performance enhancement in all areas and dimensions. The author involved and lead to developing four lessons learned processes, NCR, Bin-list, End of Well Review, New Technology for the drilling department. Later, a lessons learned database was established by the author for the company. The author led the correction of Level-1 KPIs, the introduction of Level-2 KPIs (SVP to CEO) and Level-3 KPIs (VP to SVP), the replacement of existing Well Quality KPIs with new enhanced and detailed Well Quality KPIs, the introduction of Key Service KPIs for service companies and development of performance bonus schemes including streamlining the KPI reporting process.

CHAPTER 4: Immediate Solutions; Development of KPIs for Management

In this chapter, the author discusses the most important part of the project, the Key Performance Indicators. These KPIs were the indicators for success which were set at priority by the author and the company management. Any vague KPIs could not only hurt the project performance but also, caused complications on long term relationships among shareholders.

4.1 Rules for developing the KPIs and setting targets:

For the mega drilling project, it was necessary to have a systematical approach for the changes to be made and all the KPIs to be developed, so every change and new development could be traced back to the origin of the request. Below rules were set before developing any KPIs for any level.

a) The objectives of the project: The author made sure that project objectives must be reflected in the APIs. New Management was looking to improve the drilling performance by 30% over the three years. This became a good baseline for the Author to propose targets on various KPIs.

b) Know the variables: The author identified all possible variables related to the specific KPI as those variables must be addressed separately in developing new KPI and setting the targets. For example; setting days criteria for 25K ft long well, it was required which drilling activities were depth-dependent and which were time-dependent.

c) Based on S.M.A.R.T. criteria (Specific, Measurable, Achievable, Realistic, Time-bound); the author made sure that all KPIs must meet SMART criteria as specified above. If a KPI was not measurable, achievable or realistic, it would create confusion and could be rejected by any stakeholder anytime. A time-line for the KPI was always specified to make sure KPIs could be analyzed and a forecast can be projected.

d) Test the KPI before Implement. Before the KPIs were implemented, the author ran the different analyses with the past wells data and observed any anomalies to make sure variables were understood properly. For Example; During the development of Rig utilization KPI, many tests were run on the previous wells data to develop the right understanding of the KPI among stakeholders, as it was discovered one of the hard KPIs for the stakeholders to digest. Besides, a detailed analysis of past data, the KPIs results monitored over time until confidence was built to implement. The Well Quality KPIs were tested for 2 years before those were implemented, as historical data was not available for the KPIs.

Table 4 shows a comparison of the old set of KPIs and the KPIs developed by the author. It demonstrated the work and efforts behind organizing the project KPIs and presenting them to the teams to understand the expectation at each level. Without bringing each employee In the performance expectation loop, it would be hard to achieve the high-level goals.

Table 4: Old and New KPIs Overview

OLD KPIs	NEW KPIs
Level -1 (CEO to Shareholders) – Drilling Efficiency (old) – Well Quality KPIs – Well Cost Index	**Level -1 (CEO to Shareholders)** – % Well Delivered – Well Quality KPIs (Delivery) – OPEX & CAPEX variation
	Level -2 (SVP to CEO) – % Well Delivered – Well Quality KPIs (Delivery) – OPEX & CAPEX variation – Drilling Efficiency (New) – Rig Utilization
	Level -3 (VP to Shareholders) – % Well Delivered (field) – Well Quality KPIs (Delivery) – Drilling Efficiency (New) – Rig Utilization – % NPT – FT/DAY
	Key Services KPIs – Directional Drilling – Drilling Fluids – Cementing – Wireline (e-line) – Coiled Tubing

4.2 New Level -1 KPIs

After many reviews and testing different KPIs in 2012 and 2013, the author had finally agreed with the shareholders in 2015 to replace the existing Level-1 KPIs with the following KPIs.

4.2.1 Well Delivered (Actual vs Budgeted Wells)

The KPI not only covered the overall project schedule but also challenged the team to execute the fast delivery of wells. In the KPI, an actual number of wells drilled and completed for a year were compared with the numbers of the wells budgeted for the year. Below is the simple equation for the KPI calculation;

$$\text{Well Delivered (\%)} = \frac{\text{Actual number of Well Drilled \& Completed}}{\text{Total number of Well budgetd for the same period}}$$

Equation 2: New Level -1 KPI , Well Delivered %

Two significant benefits were observed after implementation;

a) First, the team got focused on the delivery of wells as the comparison was concentrated on the work accomplished against the budgeted work.

b) Second, the team started to look for the best Fit-For-Purpose technologies to finish the well as early as possible.

With the introduction of the KPI, AFE became irrelevant to the project performance. The Well

Delivered became the best health indicator for the project, and the performance evaluation became easier for the shareholders due to its simplicity as the calculation was very easy.

4.2.2 Well Quality at Delivery

A new set of KPIs was introduced focusing on the KPI measurement at the Delivery of the Well and the stringent checks for Well Integrity. Chapter 6 discusses in detail the new Well Quality KPIs as delivery (execution phase KPIs).

4.2.3 Well Cost

Variation from the CAPEX (Capital Expenditure) and OPEX (Operating Expenditure) was considered the best way to monitor the budgeted expenditure against actual expenditure under the Profitability category instead of Operations. CAPEX and OPEX variation at the company level covered all the departments. So, it became essential to capture the CAPEX and OPEX variation at all Levels. (Level-1, Level-2, Level-3). The KPI was directed to the Finance Department to report to all the stakeholders as the Finance Department monitored all the budgeted and operating costs from a single well to the company level. So it was more efficient to utilize the Finance Department for the KPI, instead of the Drilling Department maintained separately the data. It would avoid the double reporting and inaccuracy in the reporting.

4.3 New Level-2 KPIs

A Level-2 Performance contract between SVP and CEO was introduced as separate KPIs in 2015. Before the Level-1 performance contract was applicable for all levels, in Level-2 performance contract the four KPIs are linked to the drilling department under a new category called Performance:

- Well Delivered (same as Level-1)
- Well Quality (Same as Level-1)
- **OPEX & CAPEX variation (Same as Level-1, but Measured at Department Level)**
- Drilling Efficiency
- Rig Utilization

4.3.1 Drilling Efficiency

As this KPI was used to be at the Level-1, it was still considered to keep monitoring the KPI at Level-2. The definition was revised based on many discussions and data analysis to reflect the accurate outcomes for performance. The formula was revised and corrected to represent the right drilling efficiency of the project. The definition was revised to a ratio between the planned well duration based on Authorization for Expenditures (AFE) to the actual well duration, excluding wait on weather (WOW).

$$\text{Drilling Efficiency} = \frac{\text{AFE days} - \text{Cancelled Activities Days}}{\text{Actual well Days} - \text{Scope change Days} - \text{WOW Days}}$$

Equation 3: New Drilling Efficiency Calculation

Cancelled activities and scope changes were also stated clearly in the revised KPI.

a) Cancelled Activities: All the planned activities which were cancelled during operation due to any reason were considered cancelled activities. All the days associated with the cancelled activities would be deducted from the planned days.

b) Scope Change: Any additional activities that occurred during drilling and completing a well due to the change in objectives of a well or new requirements and were not mentioned based on a Well Design would be considered Scope Change. All the days spent on scope change activities would be deducted from the actual days. In past, the scope change days were used to be added in Planned days, which was a mal-practice, because the scope change days were the days spent on the activities which should be deducted from Actual Days of a well to measure an accurate performance. All the additional activities due to failure of equipment or failure to meet initial requirements would be considered as NPT (Non-Productive Time). In past, all additional activities due to failures were considered Scope Change too. That mal-practice was addressed and corrected in the revised calculation.

c) AFE Days: The days assigned by the Drilling & Completion Engineer during an AFE (Authorization for Expenditures) process. The days were based on an average calculation of each activity for the past wells with a risk factor. The AFE Days included the rig move days, drilling days and completion days till well was handed over and the rig was ready to move to a new location.

d) Actual Days: Actual well days started from the rig move till the rig was ready to move to a new location. Rig move, Drilling and Completion were part of actual days. Actual days were compared with the AFE days, so it should cover the same type of activities. All additional activities due to new requirements would be considered the Scope Change and all the activities were not performed would be considered the cancelled activities.

e) WOW (Wait on Weather) Days: All the days a rig was stand-by due to weather-related issues such as the wait on a supply boat, the wait due to high wind etc., were considered as WOW days. All the WOW days were beyond the control of the team and would be deducted from Actual Days to find the right drilling performance. However, full consideration was given to the root cause of WOW too to make sure that rig was not entrapped in the WOW situation due to bad planning. For Example; the request to supply equipment was made advance within the acceptable and agreed time frame to the logistics team. But the logistics team did not plan the boats and equipment could have arrived at the rig before bad weather would be considered NPT, not the WOW.

The new formula meets the basic efficiency definition. Meeting the AFE days resulted in 100% drilling efficiency. If a well was delayed and AFE days were not met, drilling efficiency resulted in less than 100%, and if the team performed well, actual days were reduced, which resulted in efficiency above 100%.

4.3.2 Rig Utilization

A new KPI was introduced to monitor the rig utilization for drilling and completion activities. NPT, WOW, rig move days, and extra maintenance days were considered to calculate the actual rig utilization.

$$\text{Rig Utilization} = \frac{\text{Rig Days} - \text{Actual Maintenance Days} - \text{Actual Move Days} - \text{NPT Days} - \text{WOW}}{\text{Rig Days} - \text{Planned Maintenance Days}}$$

Equation 4: New Level-2 KPI, Rig Utilization

a) Rig Days: the number of days a rig was available for the project. If a rig remained assigned for a complete year to a project, then a total of 365 days would be considered as Rig Days.

b) Maintenance Days: Maintenance Days were related to any major maintenance. It could be 2 to 3 months' maintenance after a 5-year rig remained in service or it could any major equipment replacement or maintenance during drilling or after drilling a well. Planned maintenance days were taken from the drilling rig bar chart prepared by the Planning and Cost Engineers during budget preparation. Planned Maintenance Days were considered approved once shareholders approved the business plan (number of budgeted wells and associated costs) for the year. Maintenance days were considered non-drilling related activities.

c) Move Days: Move days counted from the time rig released from the previous well to the time rig was ready to spud (picking up of the first BHA). Move Days were considered non-drilling related activities.

d) NPT Days: The time elapsed between the Non-conformance/failure events, and returning back to the same position before the event occurred or the time spent to recover from the consequences of the event or Non-conformance.

e) WOW Days: A non-drilling activity where a rig was waiting on due to weather.

Rig Utilization expressed the percentage of the rig that was utilized for the drilling and completion activities compare to its availability for the project. It became a good indicator of the performance of the drilling team. High NPT, high Move Days and higher actual maintenance days than the plan would result in low rig utilization, which required investigation and focus on areas for improvement. The KPI reflected the efficiency of the drilling department to handle the drilling activities. It was a very sensitive KPI to collective performance. Any lack of planning can and explored

Target setting was a very important step for the KPI. A poor grasp on the target understanding could result in some confusion. This KPI took a lot of attention from management at all levels due to its direct link with the rig operability and operation team skills in managing the rig.

4.4 New Level-3 KPIs

The Level-3 KPIs, the KPIs between the Vice President - Drilling and Senior Vice President –

Development, were set focusing only on the drilling unit. At this level, all the KPIs were connected to drilling activities and drilling teams. In Level 3, Level 1 and Level 2 KPIs were split further into smaller categories so that teams could focus individually on these KPIs. Meeting the Level-3 KPIs would help in meeting the Level-2 and Level-1 KPIs. For example, % NPT reduction would result in more wells to drill and complete and would also result in high rig utilization.

- Well Delivered (same as Level-1)
- Well Quality (same as Level-1)
- Drilling Efficiency (same as Level-2)
- Rig Utilization (same as Level-2)
- % NPT reduction
- FT/DAY increment

4.4.1 NPT% Reduction

NPT%, a new KPI, was set at Level-3. It was the ratio between Total Non-Productive Time for all rigs to the Total operating time for all rigs for the same period.

$$\text{NPT (\%)} = \frac{\text{Total number of NPT Days for a spefic time}}{\text{Total number Operating days for the same specific time}}$$

Equation 5: % NPT calculation KPI

The KPI had a significant influence on all KPIs. High NPT would result in low rig utilization and low drilling efficiency, and the number of wells to be delivered would also not be achieved. It was carefully chosen to make sure teams working under the Vice President of Drilling got the clear message that high NPT was not tolerated anymore. Such information helped senior management make a quick decision to educate the low performers who were dragging the overall project performance down.

4.4.2 FT/Day Increment

FT/Day expressed the average Footage Drilled in a Day, which turned a good indication to see each rig productivity per day. Two important activities; Rig move days and the completion days were not included in the calculation.

a) Rig moves duration varied a lot due to the distance between one location to another location. Sometimes it took 0.5 days for rig move from one location to another location and sometimes it took 20 to 30 days to move the rig based on location distance and move type on the Island rigs.

b) The Completion program was dependent completely on the Reservoir Team. The completion program varied from well to well due to different objectives. For example; Single Completion, Dual Completion and Completion for Injector well and production well were completely different and took different time to complete.

FT/Day was calculated for a single well as well as for all the wells drilled by one rig or multiple rigs in specified time e.g., month or year etc. Equation 6 shows the calculation for a single well and Equation 7 shows the calculation for multiple wells

$$\text{FT/DAY} = \frac{\text{Total Footage Drilled for the well}}{\text{Total days spent from spud to start of completion}}$$

Equation 6: FT/DAY calculation for a well

$$\text{FT/DAY} = \frac{\text{Total Footage Drilled for the specified wells}}{\text{Total days spent from spud to start of completion for the specified wells}}$$

Equation 7: FT/DAY calculation for multiple wells

FT/Day Calculation was performed on only the wells that were drilled to the final total depth. If a well was not drilled to total depth, it would not be included in the calculation.

FT/Day measured the overall drilling speed per well. It can be converted into monthly, quarterly, and yearly KPIs. The impact of the reduction in NPT and drilling practice improvements could be seen quickly through this KPI. The FT/DAY was proven a very leading KPI, and performance was checked anytime; monthly, quarterly or yearly.

4.5 Development of Key Services KPIs

Most of the contracts with service companies and vendors were long term and written before the start of the UZ-750 project. Those contracts were extended for the project. Those contracts were full of many gaps and were not aligned with the performance expectations of the project. In the absence of consistency for project requirements in the contracts, it was extremely important to align the expectations of the project as early as possible to obtain the right results; high quality, timely delivery, and within budget. KPIs for key services were developed to cover the expectation from vendors during providing these critical services.

- Directional Drilling, Logging While Drilling, Measurement while drilling
- Drilling Fluids
- Cementing
- Wireline (E-line)
- Coiled Tubing

After the rig activities, these major services consisted of more than 80% of all the services provided at rig-site. These KPIs were developed after detailed reviews with industry experts in each area. Segment specific HSE KPIs were also developed applicable to all services. Appendix F shows the internal approved documents on KPIs for each key service developed by the author.

4.5.1 Challenges for Key services KPIs Implementation

KPIs reporting faced the implementation challenges as the resources on both sides, company and service providers, were not enough to report and monitor accurately these KPIs. So, many service providers asked for more resources. Though these KPIs were not fully implemented across all service providers, these were recognized at all levels of the company and the vendors. The mother company, ADNOC, reviewed the KPIs and adopted them as COP, Code of Practices for implementation across all ADNOC Group of Companies.

4.5.2 Benefits for Key services KPIs Implementation

As discussed earlier due to the lack of resources available on both sides, the KPIs were not implemented to ripe the full benefits. However, service providers started to improve their internal procedures and processes using existing resources as the expectation of the project became clear on the performance delivery. Local vendors specifically took the opportunity to organize their work around those documented KPIs as these KPIs were guiding the service delivery.

One of the major advantages after releasing the KPIs was observed that the employees of the company and the sales agents form service providers became organized and started to plan to make sure KPIs expectations were met during the service delivery. The KPIs became guidance especially for the young and inexperienced engineers who were struggling to perform for the project.

One of the major benefits observed from the availability of these KPIs was the alignment of the performance expectations of the project from vendors. More than 20 vendors that provided 5 key services became aware of the expectation of the project and started to discuss in the pre and post job meetings.

Later, contract engineers started to refer the KPIs in each new contract for confirmation of service delivery. That helped to standardize the requirements from vendors and to focus them on performance improvement.

CHAPTER 5: Implementation of Knowledge Management Practices

In chapter 2, the author discusses the importance of Knowledge Management Practices in a company with some good references from the industry. Based on the number of wells to be drilled (+ 1000 wells), the amount of the work in each service area was enormous. For the success of the UZ-750 project, it became extremely important to set-up some kind of Knowledge Management Practices for capturing lessons in these services areas and dissipating these lessons among teams through the improvements in procedures and programs. It was a challenge for the author to implement such practices in the drilling department as no support was available at the company level especially from the IT (Information Technology) Department. Knowledge Management tools including processes were developed by the author at a limited scale for the drilling department with the support from the Drilling Management. After continuous efforts, the author was able to establish successfully a platform for the UZ-750 Project where the information on the improvements, best practices and lessons learned etc., were available for each service area from everywhere inside the company intranet. A database was developed to make sure the people had access to all learnings obtained since the start of the project.

5.1 Objectives of Knowledge Management Processes

Before the author worked on the development of Knowledge Management Processes, he defined the objectives to be achieved by the development and agreed with the management to make sure he had the required support in the implementation of these processes. The principal objectives of Knowledge Management Processes were to ensure that;

a) All undesired events and non-conformances, internal and external, were recorded and investigated efficiently, with appropriate actions put in place to prevent re-occurrence in the future.

b) A systematic approach was available to validate, share and approve the information.

c) Lessons learned and areas of improvement were captured in the database and ready to use.

d) Vendors were contributing the industry knowledge efficiently and bringing success to our operation

5.2 Strategy for Implementation

The author chose to implement all Knowledge Management Tools at the same time instead of implementing one by one. The main reasons were;

a) To have a comprehensive awareness of the Knowledge Management Processes as these were linked to each other

b) To spread a strong message on the Performance enhancement that was essential for the success of the project.

c) To cope with the resistance from the engineers and lower management as the high workload was anticipated on the engineers

Working on the mega project and its success carried a high level of motivation among employees that helped in the implementation of Knowledge Management tools. All the changes caused by the implementation of Knowledge Management tools were accepted by the teams. Besides having many complaints of high workload, Teams cooperated very well on all stages with the author. The author made sure that all the processes were built on simple and easy-to-adopt to

- Avoid any complications which could deviate the focus from project
- Get the lessons learned as quickly as possible to keep the project on track

5.3 Knowledge Management Tools

After the objectives were recognized, the author had full support from the Senior Management to find effective Knowledge Management tools to establish effective practices for implementation in the drilling department. Below were the knowledge management tools, the author proposed to implement;

- The Bin-List (Internal use)
- Non Conformance Report/NPT investigation Report (external use)
- End of Well Review
- New Technology and Best Practices Process

5.3.1 Bin-List

"Bin-List" was a tracking sheet to keep track of significant problems, the people working on them, the target resolution date, and a record of the actions taken. The Bin-List was introduced to deal with internal and external departmental issues within the company. Items get closed on the Bin-List when the required actions are completed. The primary objective of the Bin-List was to capture the significant problem, including non-conformances related to the operations so that duties were assigned, and appropriate actions were taken in a timely response to these problems.

5.3.1.1 Sources of Bin-List Items

Below were the sources of the Bin-List items:

- Daily Operational meetings: Issues encountered during 24 hours of operational activities deemed significant by management would be included on the list.
- Departmental meetings, End of Well reviews, and Service Performance reviews with service providers might require a follow up on outstanding issues by the team members.
- Engineering, logistics, or QA/QC could encounter material or equipment problems that were significant and required tracking.

Management could add new initiatives on the list for the team members to complete and follow up.

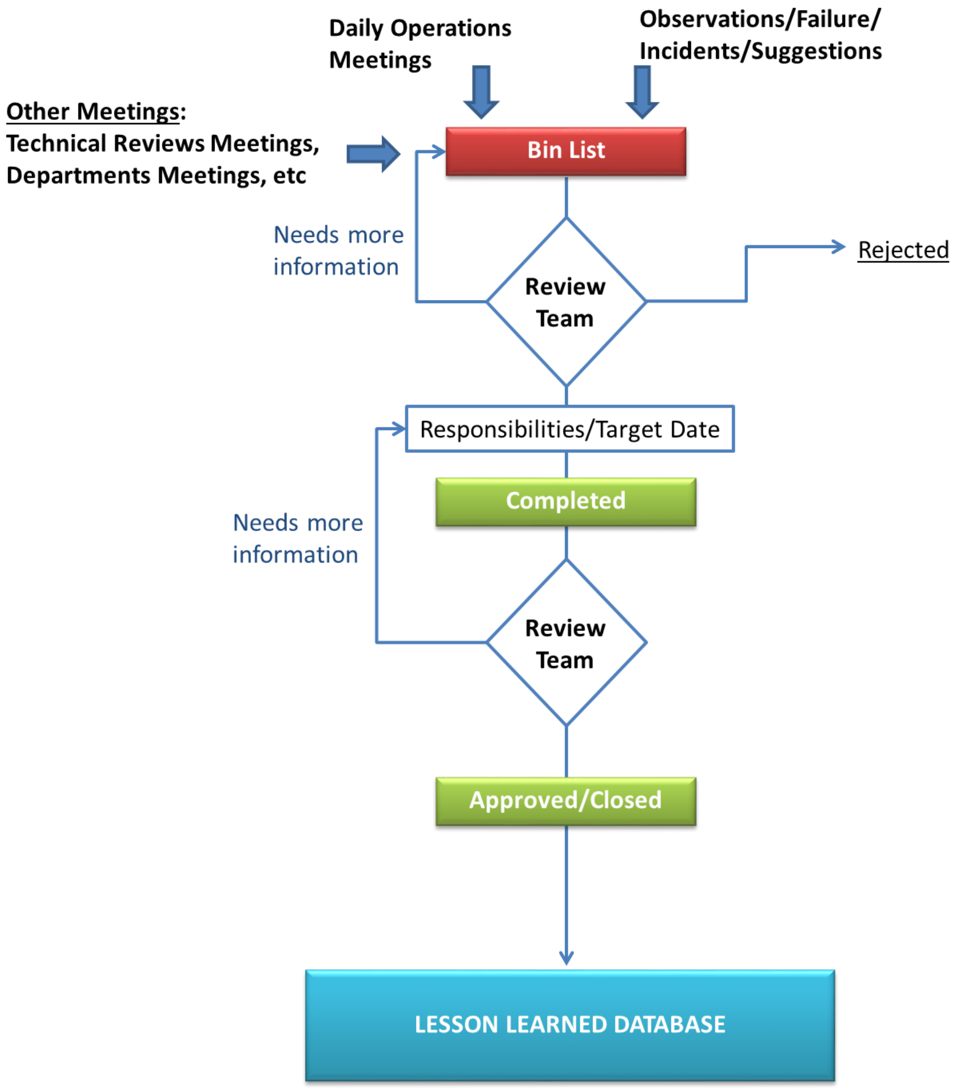

Figure 5: Simplified Bin-List Process (Rashid et al. 2013)

Figure 4 shows a simple bin list process flow chart, where a significant problem ended up in shared lessons learned as the output of the process required related to the item/event.

5.3.1.2 Review Team and Responsibilities

Drilling senior management was part of the review team responsible for making sure the

Bin-List process ran smoothly without any interruptions and solutions were proposed timely. The primary responsibilities of the review team were

a) To review the newly added items and to take appropriate actions by assigning duties and target dates.

b) To review the completed items and to decide whether all the actions assigned to an item were satisfactorily completed or not.

c) To review all the pending items and to take appropriate actions to remind the responsible teams to finish the tasks/actions on time or extend the target dates, if it was deemed required.

5.3.1.3 Bin-List Stages

During this tracking process, an item would go through the following stages:

a) **New**: Any added item/event (significant problem or a non-conformance) would be treated as "New" unless the Bin List Review team reviewed it.

b) **Active**: Item became "Active" as duties/responsibilities were assigned to the team with a target date. A notification would be issued to the team leader after duties were assigned.

c) **Pending**: An item/event becomes pending if the target date was overdue and actions assigned were not completed. A team Leader might request extra time to complete the task.

d) **Completed**: An item/event would be considered "Completed" after receiving the supporting documents confirming the actions assigned were completed.

e) **Closed**: An item/event would be "Closed" after the review team reviews a completed item and decides that all the actions assigned were appropriately completed, and further no action was needed

Figure 5 shows a simple bin list stages with actions.

5.3.1.1 Benefits of the Bin-List

The benefits of the implementation of the Bin-List were very significant and were recognized at all levels. Teams used the process to capture all critical issues. Below were some of the benefits achieved.

a) The process opened the communication channel between Drilling and different departments as limited communication protocols existed between different departments, especially Logistics, Human Resources, Information Technology, and Drilling. The Bin-List process helped teams to approach each other at a working level to resolve the internal issues without any interference from Senior Management.

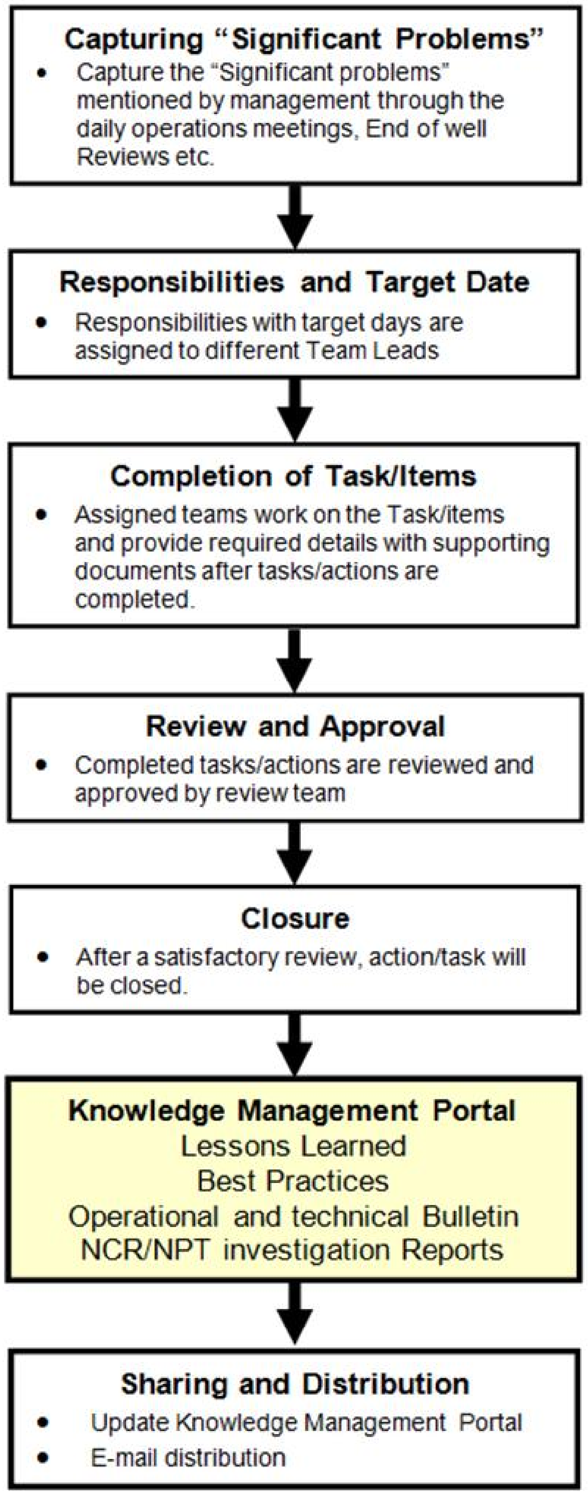

Figure 6: The Bin-list Stages (Rashid et al. 2013)

b) Teams became more efficient in follow up and took responsibilities in resolving issues as the critical issues were tracked through the Bin-List. For example, Technical and Quality teams became more focused on procedure improvements and quality enhancement of equipment and tools. Engineering teams got more focused on Well Planning and execution.

c) Teams got a platform to share the issues related to other teams within companies. For example, during the first week after launching the Bin-List process, more than twenty, items were recorded, and more than forty items were registered in the Bin-List within seven weeks after the launch of the process.

5.3.1.2 Outcomes of the Bin-list

The Bin-List was proven to be the best process, especially at the start of the project where many learnings were added to the daily operations. Figure 6 shows that outcomes of the Bin-List process were split into six different categories: follow-up and five lessons learned, which were divided further into general, best practices, equipment improvement, procedures improvement, and process improvements.

After two years of successful utilization of the Bin-List, the process started to decline as a low number of items were registered. One of the reasons was teams started to communicate directly with each other without registering issues in the Bin-List as internal issues were reduced and the various processes were improved.

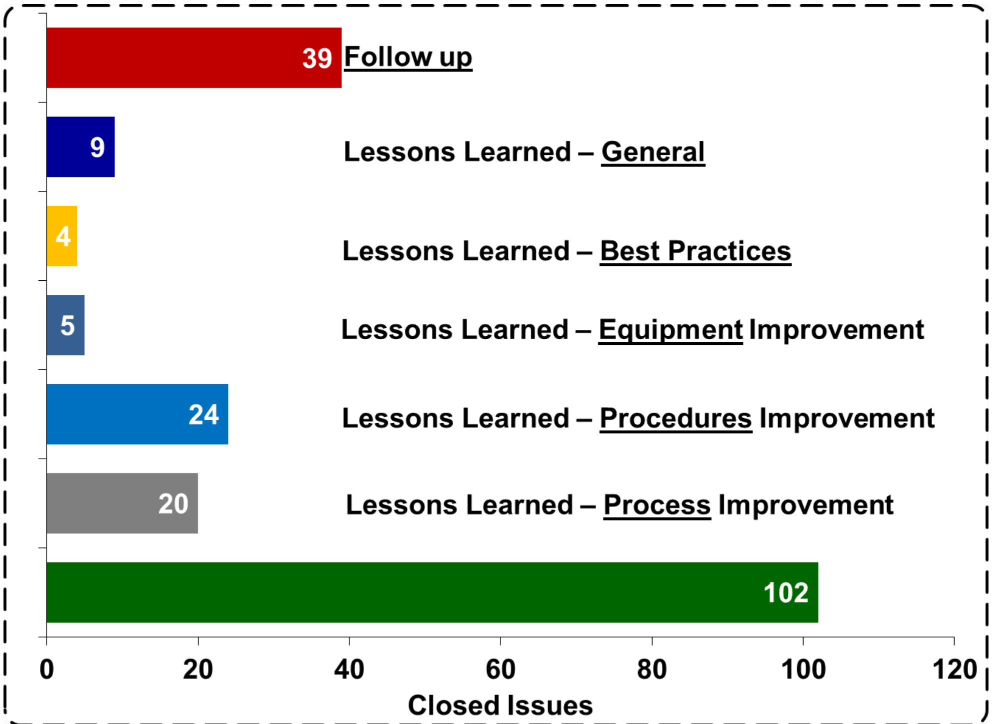

Figure 7: Outcomes of the Bin-List (Rashid et al. 2013)

5.3.2 Non-Conformance Report (NCR)/NPT investigation Process

The Non-conformance reporting system was used to capture all externally related failures. Appendix C is a published manuscript, which was presented by the author at the Abu Dhabi International Petroleum Exhibition & Conference (ADIPEC) held in Abu Dhabi, UAE, November 10-13, 2013. In the published manuscript, the author discussed the need for the NCR system, its objectives, its benefits on the project, changes in culture, etc. The major benefits were discussed in detail in the manuscript (Appendix C) and repeated. The below contents were taken from the published manuscript and were formatted to fit the thesis format.

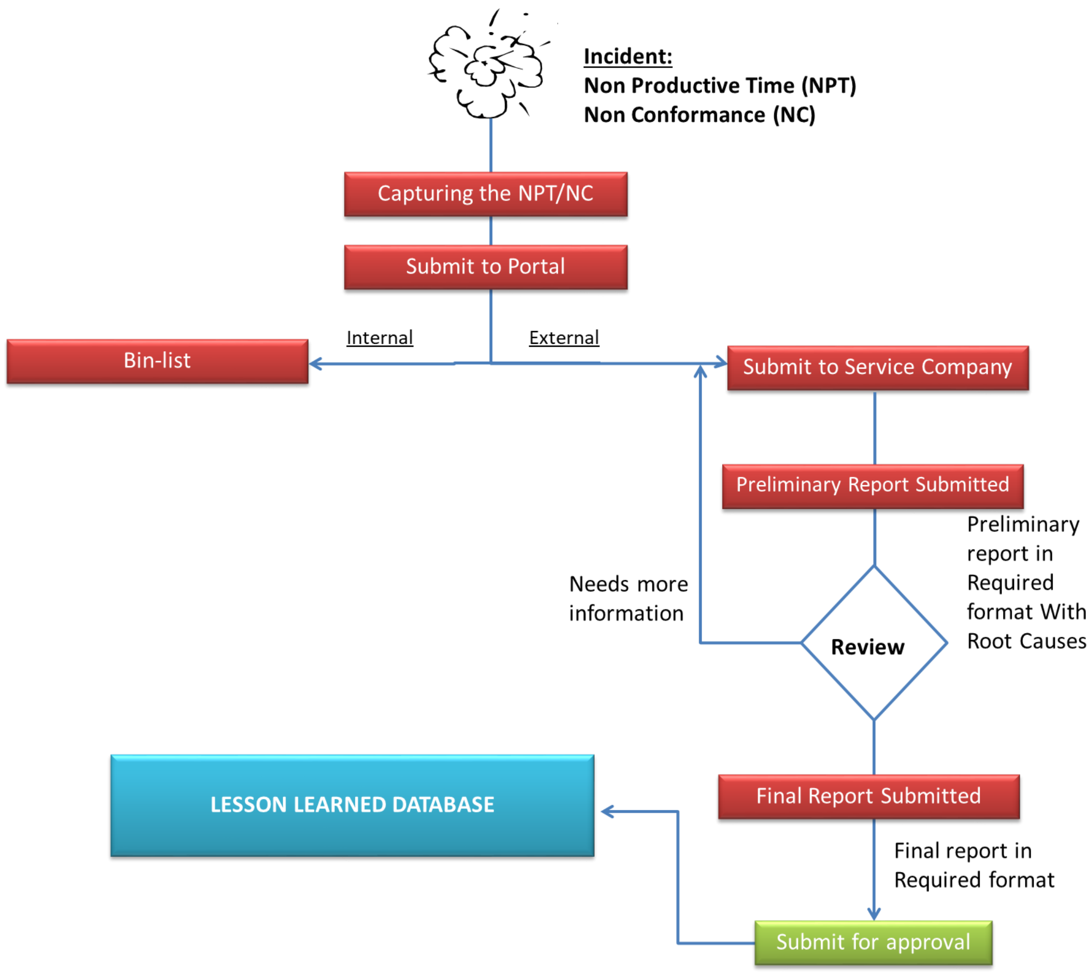

Figure 8: NCR/NPT Investigation Process (Rashid et al. 2013)

5.3.2.1 The purpose

The purpose of the process was to establish a system to investigate all the Operational Incidents, Near Misses and Non-Conformance, where service companies, vendors or third parties were involved in the Drilling activities on the UZ-750 project. This process made sure that all the Non-Conformances and Service Quality Incidents by service companies must be investigated regardless of the severity of the incident and made sure that lessons learned were collected with root causes. The areas for improvement would be identified from the root causes.

5.3.2.2 The Process

It was very imperative to start with a process that could be easily adaptable by Engineers and a variety of different service companies (+32 service companies were providing services to the Drilling Department). Not only a simplified process was considered, but also the ease in reporting incidents, failures, non-conformances were taken into account by providing a portal-based solution. Figure 7 illustrates the simplified NCR/NPT investigation report process.

A simplified process was developed which includes;

- A formal process to capture the Non-Conformance/NPT (a written request for an investigation of the incident)
- Record of all NCR/NPT for future tracking
- Agreed recommendations and future actions by service providers
- The approval process to the recommendations
- Monitor the service providers' performance and use the tool to select the best performer to reduce operational failures and project risks.
- Areas to focus on improvements for the service companies based on the defined

root causes.

As per the process, an NCR/NPT investigation report was initiated after a Non-Conformance incident or failure on one of the drilling activities by the vendor and the vendor had completed the initial investigation report. After the operation and engineering team review, a final report was generated by the vendor. The NCR/NPT investigation report got closed with appropriate actions to avoid a similar failure in the future. During the review, if the initial investigation did not meet the satisfaction criteria, the vendor was required to re-investigate the failure further in detail. An NCR/NPT investigation report was remained opened till all parties were agreed on long term corrective and preventive actions. Figure 8 discusses the stages (step by step) of the NCR/NPT investigation process.

5.3.2.3 The Form

A wide range of service companies from local to international and small to large footprint with different origins were working on the mega drilling project. Some international companies owned the best failure investigation process. Small vendors were always struggling with the investigation reports and processes due to manpower issues. So it was imperative to bring consistency across all companies in investigating the failure and non-conformances. A minimum standard was established with a standard NCR/NPT investigation form to make sure all the necessary information was captured as a minimum and analysis can be conducted on the same scale for companies. Figure 9 shows the "NCR/NPT Investigation Request Form" used for the project.

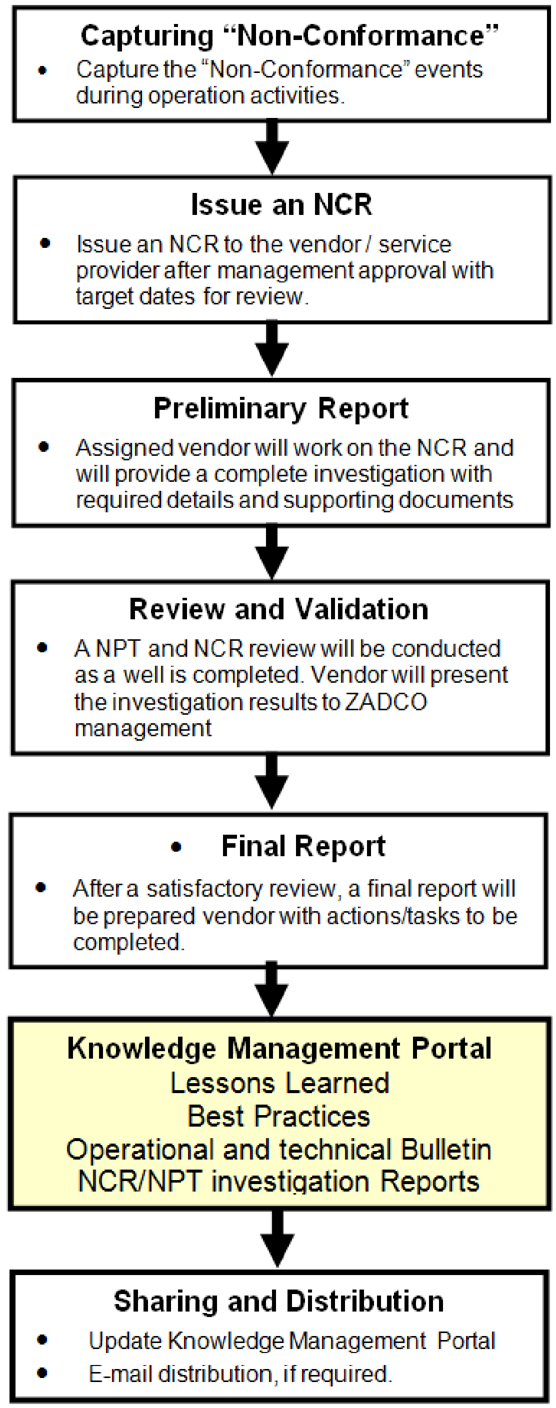

Figure 9: Stages of NPT/NCR Investigation Process (Rashid et al. 2013)

Drilling
Non-Conformance / NPT investigation Report

1 NCR/NPT Log No: Status : Date:

2 Location: Well Name/Number: Type:

3 Vendor Responsible for the Non-Conformance:

4 Non-Conformance initiated by: Initial report is required by:

5 Focal Team (ZADCO): Final Report is required by:

6 Vendor Representative Involved: Contract/Order No:

7 Type of Non-Conformance:

8 Description of the non-conformance

Depth (MD)	
Temp	
Repeat Failure?	
Cost to ZADCO:	
NPT/NCR severity:	

9 NPT as a result of this non-conformance / failure? **Hours?**

10 Contributing factors to the non-conformance/failure such as hole conditions or abnormal operating parameters?

11 Immediate corrective actions taken (Problem fix/deposition):

12 Corrective actions are approved by:

13 Root Cause Analysis is required for all non-conformances and NPT events

☐ Inadequate Supervision/Leadership	☐ Out of Spec. Application	☐ Lack of Resources	☐ Ineffective Internal Communication
☐ Inadequate Work Instructions	☐ Inadequate System/process	☐ Inadequate Contracting	☐ Ineffective External Communication
☐ Inadequate Engineering	☐ Lack of Implementation	☐ Inadequate Logistics/Delivery	☐ Lack of Training/Competency
☐ Inadequate Manufacturing	☐ Faulty Equipment/Tool	☐ Lack of Quality Control	☐ Personal factors
☐ Inadequate Maintenance	☐ Excessive Wear and Tear	☐ Inadequate Purchasing	

Note: Root Cause Analysis should be supported by a systemetical cause analysis such as Immediate casues, contribution factors etc.

14 Long term corrective or preventive actions:

15 Preventive actions are approved by:

16 ZADCO Initiator: Signature: Date:

17 ZADCO Representative: Signature: Date:

18 Vendor Representative : Signature: Date:

Administration instructions for submitting this NCR:

a) NCR will be initiated by Rig Supervisor/Drilling & Completion Engineer with relative details (first 9 items. minimum) as soon as a non-conformance occurs. An alert will be issued to Managers, Team Leads, NCR administrator and Contracts administrations for the record

b) NCR administrator to issue the hard copy within 3 working days to the responsible Vendor. Vendor to close out with ZADCO within 4-8 weeks (Initial Report is due within 4 weeks, final report is due within 8 week after Non-compliance occurrence date or described above. Please attach details Root Cause Analysis report with the NCR and fill items 10 to 14. Only KM & Best Practice Engineer will close the NCR, after NCR response is accepted by ZADCO Management.

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Figure 10: NPT/ NCR Investigation Request Form (Rashid et al. 2013)

The NCR/NPT investigation request form contained the following information:

- NCR/NPT information
- NCR log No
- Status of NCR
- Location and Well Information
- Vendor responsible for the Non-conformance
- Type of Non-Conformance
- Description of the non-conformance
- Contributing factors to the Non-Conformance or failure
- Immediate corrective actions were taken (Problem fix/deposition)
- Root Cause Analysis
- Long term corrective or preventive actions

Two important points related to the immediate and long term corrective & preventive actions were:

a) Immediate corrective & preventive actions: Troubleshooting experience played a significant role to reduce the operation failure cost per hour. The chances of success and failure to fix the problem were dependent on the type of failure and availability of resources with competency at the location or in the area. Most of the time, the experience helped to implement the corrective action quickly and accurately. In case of a lack of appropriate experience, a small incident could lead to catastrophic failure. The information captured in the section educated the inexperienced people to respond under failure properly and accurately to reduce the failure time.

b) Long term corrective & preventive actions: Regardless of the immediate solutions were successful or not, long term solutions played a very significant role in the rectification of the problem. So, these long term solutions must be in place for all the failure events. The long term actions were dependent on the investigation techniques in the area. International companies brought valuable long term solutions based on experience from other areas. Later the learnings were available to all service companies including local companies. In short, the NPT/NCR investigation process brought significant values by utilizing different companies' experiences on the project. As a result, overall project performance was improved drastically.

5.3.2.4 Root Cause Categories

It became compulsory to report the Root Causes of each failure in the NPT/NCR Investigation report. A total of 19 categories were identified in the NPT/NCR investigation form. The root because categories helped a lot to identify the areas of improvement for a single service or multiple services of a vendor or all vendors.

Table 5: List of Root Cause Categories

Inadequate Supervision/Leadership	Lack of Resources
Inadequate work Instructions	Inadequate Contracting
Inadequate Engineering	Inadequate Logistics/Delivery
Inadequate Manufacturing	Lack of Quality Control
Inadequate Maintenance	Inadequate Purchasing
Out of Specification Application	Ineffective Internal Communication
Inadequate system/process	Ineffective External Communication
Lack of Implementation	Lack of Training/Competency
Faulty Equipment/Tool	Personal Factors
Excessive Wear & Tear	

5.3.2.5 Successful Implementation

For the successful implementation of any new process, many factors were considered and all the hurdles were recognized and removed with the appropriate support and hard work from all levels. Especially for vendors, to implement the new NCR/NPT investigation process it became compulsory to provide an adequate level of support in closing the NCR/NPT investigation requests. The major elements of this implementation and vendor support include:

a) Need vs Change: It was an important factor in the implementation of the process. The need to have a systematical process to capture all the failures and learning from them was realized while the author was working to investigate failures. The lack of systematical investigation protocol, lack of lessons learned database and lack of failure tracking with service companies made a strong case for the author to get support from the management to introduce the NCT/NPT investigation system, a platform where engineers could raise their concerns against service providers. The resistances against the change in the existing practices from all levels were observed too, but the need for the implementation of the process overcame on all the resistances.

b) A simple process: After the recognition of the need, the author introduced a simple process that was easy to understand, to adapt and to implement. Figure 8 shows the step by step stages of the NCR/NPT Investigation request. It was clear at the beginning of the project that an overly complicated process could hinder the implementation of the NCR/NPT investigation process, so a simple process was required.

c) End-user believes in: For the success of the implementation of the NCR/NPT process, end users (engineers) need to believe that the process would bring improvements not only in follow up with service companies but also in the selection of a right vendor for the job at a later stage. Initially, all the NCR/NPT investigation reports were issued under the authority of Sr. Drilling Manager, which showed management commitment to support the process.

d) Self-sustained process: For the successful implementation of the NCR/NPT investigation process, it was clear that the process must be self-sustained with little supervision, otherwise the process would be overwhelmed with resources and may end up a complete failure. Initially, the process was initiated with the help of KM & Best Practice Engineer, later end users (engineers and rig supervisor) started to initiate the NCR/NPT process themselves. Figure 10 shows the number of the NCR/NPT investigation requests recorded per month since it started in 2012 till August 2013 (Paper Submission Date). It shows clearly that the utilization had been increasing radically in 2013. An average of 12 NCR/NPT

e) investigation requests per month was recorded in 2012, which had been increased to an average of 20 NCR/NPT investigation requests per month in 2013. Figure 11 shows two pie-charts; the pie-chart at left shows the distribution of the status of NCR/NPT investigations reports in numbers till August 2013, the pie-chart at right shows the distribution of the status of the NCR/NPT investigation reports in percentage till August 2013. As of August 2013, a total of 309 NCR/NPT investigation requests had been recorded, where 120 (39%) NCR/NPT investigation requests had been either closed or were ready to close. Figure 11 also shows the number of the NCR/NPT investigation requests closed out as of August 2013. Ready to close means that NCR/NPT investigation requests were reviewed & agreed and under circulation for signatures.

f) Ownership: For the successful implementation, it was required someone must own the process. Once the process was adapted successfully and becomes self-sustained, it was required to monitor the process making sure that roles and responsibilities were intact and a close follow-up with vendors was handled vigilantly. One of the drilling departments took full ownership of the process and set resources for the continuity of the process.

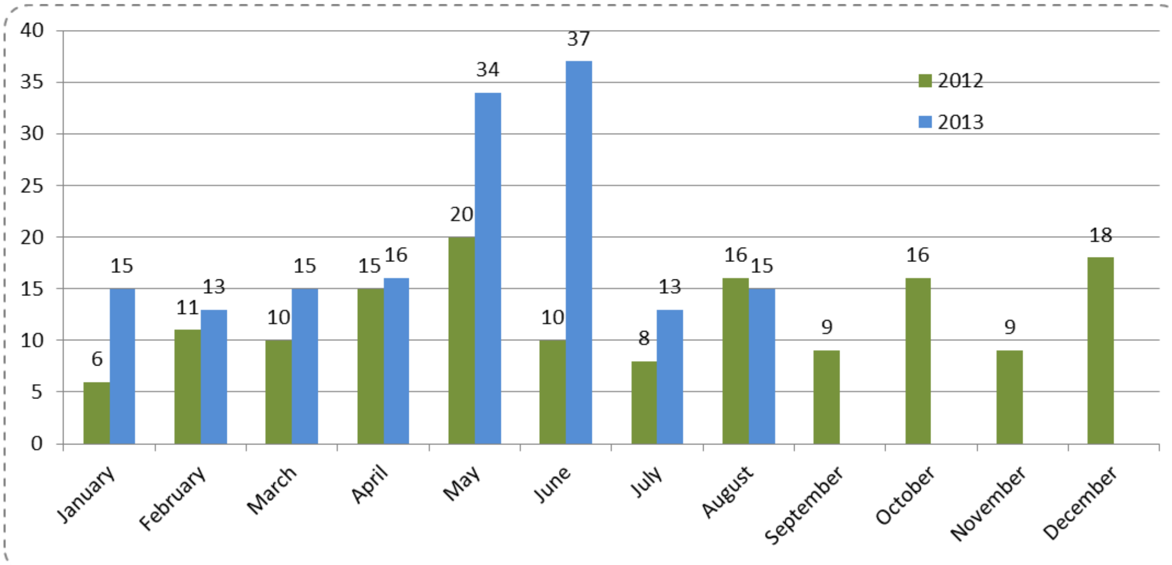

Figure 11: NCR/NPT investigation requests to August 2013 (Rashid et al. 2013)

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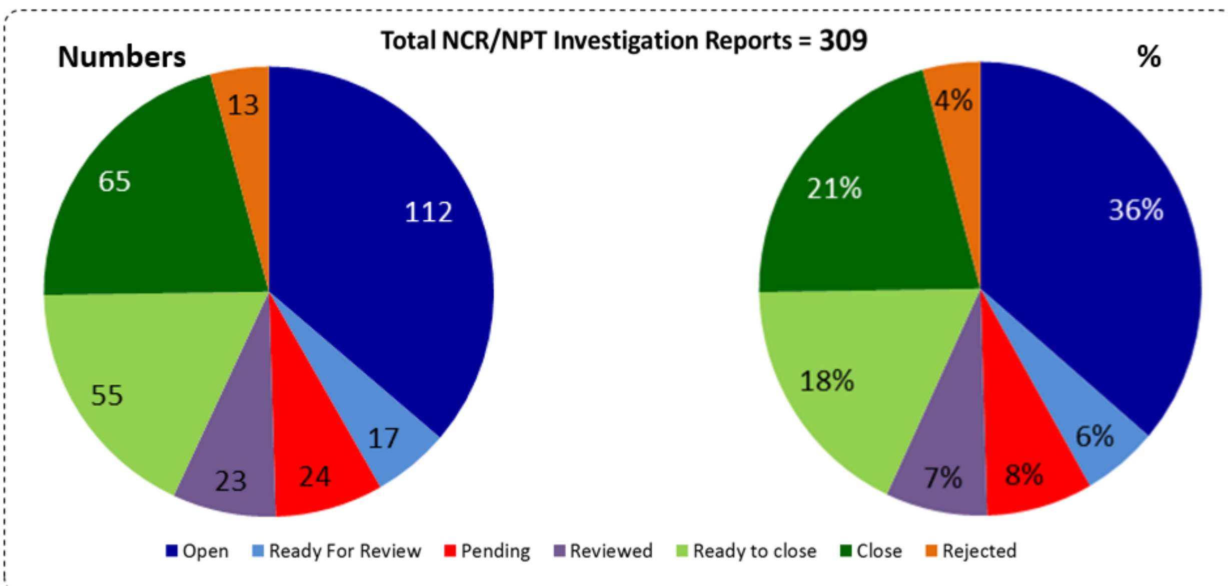

Figure 12: NPT/NCR Investigation Status as of August 2013 (Rashid et al. 2013)

h) Management support: Like other projects, the NCR/NPT investigation process implementation required management support. The VP-Drilling was the sponsor of the NCR/NPT investigation process. All managers provided the full support to make sure the process was running with any hurdle at any level.

i) Information Technology (IT) Support: Similar to other processes, IT support was very important for the implementation of the process, so each user would create NCR/NPT documents on the portal base system, attach the reports as required and then fill the data to finalize the NPT/NCR investigation report. As discussed in previous chapters that due to lack of support at the company level, the NPT/NCR System did not have any official support from the IT department. Only the IT support from the drilling data management team was utilized to create the workflow based on the existing templates on the portal.

Besides all the above factors, an approach "each NPT event must have NCR/NPT investigation request" helped to enforce end-users to create/initiate the request. Time to create an NCR/NPT investigation request was also taken into consideration. As it was recognized that the longer time required in initiating an NCR/NPT investigation request could create major resistance among end-users not to support the process. An average time to create an NCR/NPT investigation request was around 1-3 minutes.

5.3.2.6 Areas for Improvements:

One of the main objectives of the NCR/NPT investigation process was to ensure that lessons learned were captured and areas for improvements for an organization/service company were developed and implemented. The root cause categories were recorded at the closure of each NCR/NPT investigation request after the agreement with each service company. After closing 10-15 NCR/NPT investigation requests, there was sufficient data available to analyze the areas for improvements for a company, for any service etc. Similarly, we can develop the same analysis for all companies jointly showing as the industry. Figure 12 shows a pie-chart analysis of the all closed-out NCR/NPT investigation requests (112 NCR/NPT investigation requests) for the local industry (almost 24 companies). Figure 12 clearly shows that Inadequate systems and processes, Inadequate maintenance programs and Lack of training & competency were the major concerns of the local industry. Such information became a baseline to evaluate and compare each company's performance and management style. An Excel Sheet was developed by the author to narrow down the areas of improvements from the overall industry to a Company, to a department of a company, to a segment of a company after selecting the relative failures and root causes. This Profile, Pie chart was developed well by well to discuss with the engineers the development plan to handle vendors. The Profile, Pie-Chart of areas to improve, was utilized for all types of reporting to the Senior Management to find the real issues on the project, with a vendor or with a team. Well-By-Well Review of NPT/NCR failure analysis helped to improve planning and discuss ahead issues with vendors to improve performance. Figure 13 shows the root cause categories distribution of Company A (an internationally renowned company), where Inadequate systems/processes, Lack of training & competency and Lack of implementations of procedures/processes were the major concerns. A comparison was run. For the industry, 16.82% of failures were linked to the Inadequate systems/processes, whereas for company A, 24.62% of failures were linked to the Inadequate systems/processes. Similarly, 10% of failures were linked to Lack of training and competency for the industry, but for company A (an international company), 15.38% of failures were linked to the Lack of training and competency. So, it became clear that Company A must work to improve processes and must provide adequate training to the workers. So, Figure 13 represents the company A's profile at this moment and shows how the company was running the business at the time of failures. The information led to further discussion to implement changes to improve each company's profile. For example, Company A was an international company. Why was the "lack of systems and process" the major concern for Company A in the region? It was unrealistic for a company working in more than 80 countries to have a lack of systems/processes. So upon further analysis, it was found that a lack of competency and lack of management commitment was the major underlying issue. So the company made significant changes into its competency program for the local industry with a greater commitment from management.

Figure 14 and Figure 15 are the profiles of the same company for different periods. Figure 14 shows Company A's profile after closing the NCR/NPT investigation reports of 2012 failures. Figure 15 shows Company A's profile after closing the NCR/NPT investigation reports until August 2013 failures, a significant shift in the company profile. NCR/NPT investigation process also helped to focus and identify the areas for improvements for specific services of a company.

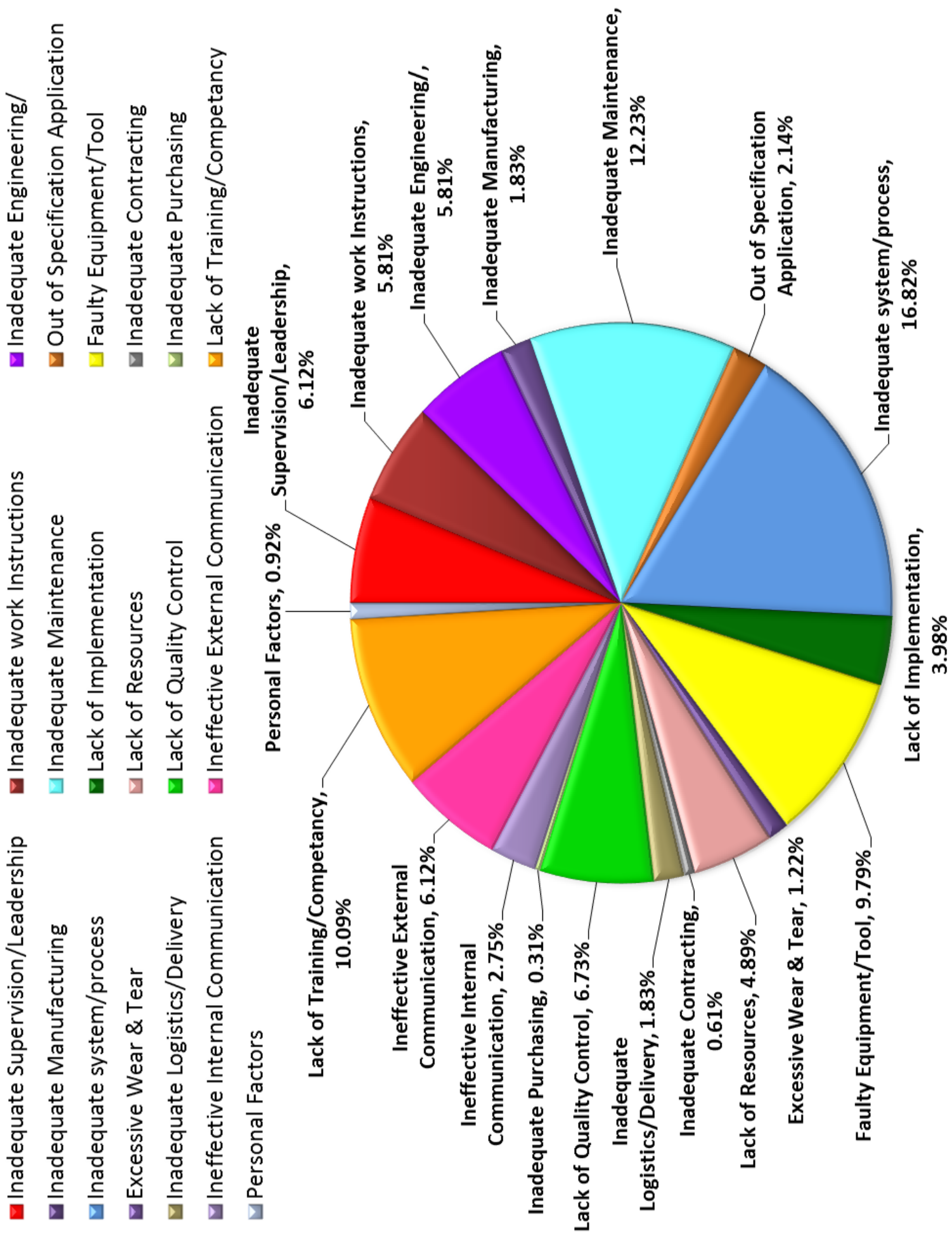

Figure 13: Root causes - the whole Industry (+24 companies) (Rashid et al. 2013)

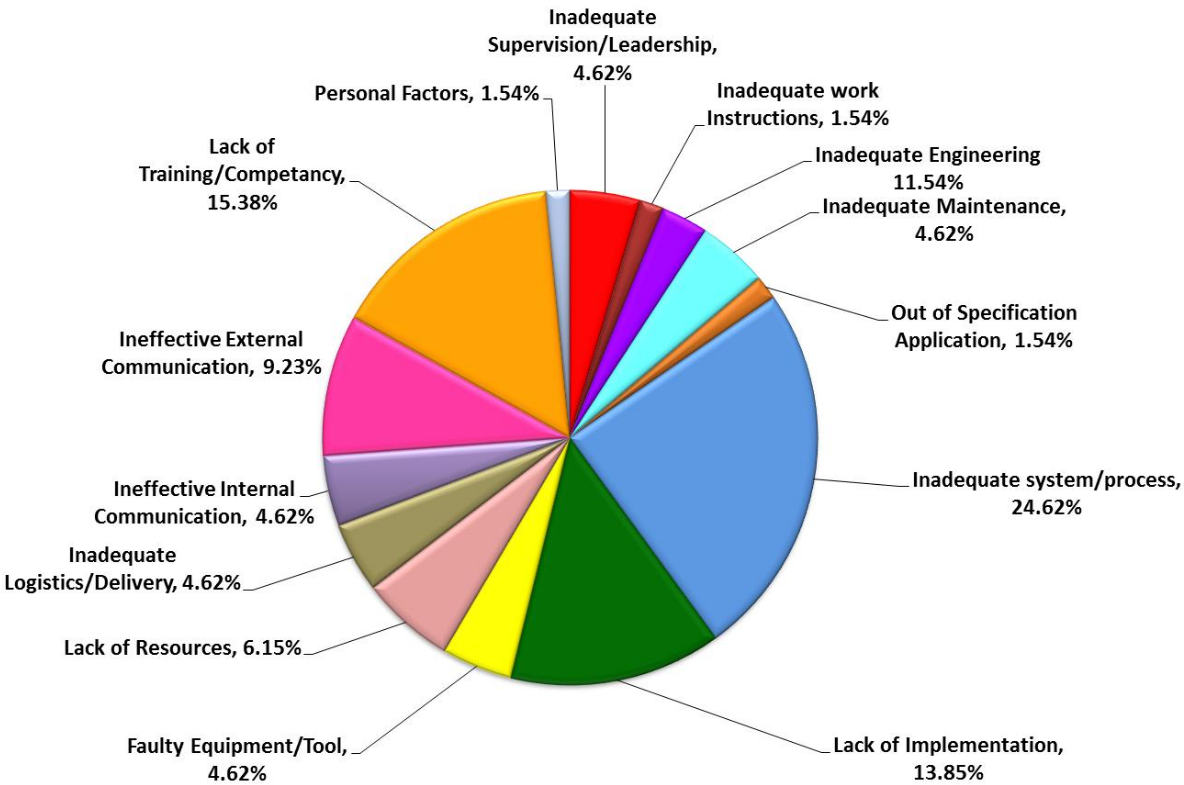

Figure 14: Root causes of Company A, an International Company (Rashid et al. 2013)

Figure 16 shows the root cause distribution profile of Company A for its certain services (associated with a single department of Company A). So, with the help of NCR/NPT investigation process, we were able to focus on certain departments or segments of a company, which provided the Drilling Management with a chance to intervene in the service company to improve its business model or practices, otherwise, the service company might lose business based on the documented poor performance and commitments. On many occasions, the drilling management cancelled some contracts based on the NPT/NCR investigation data.

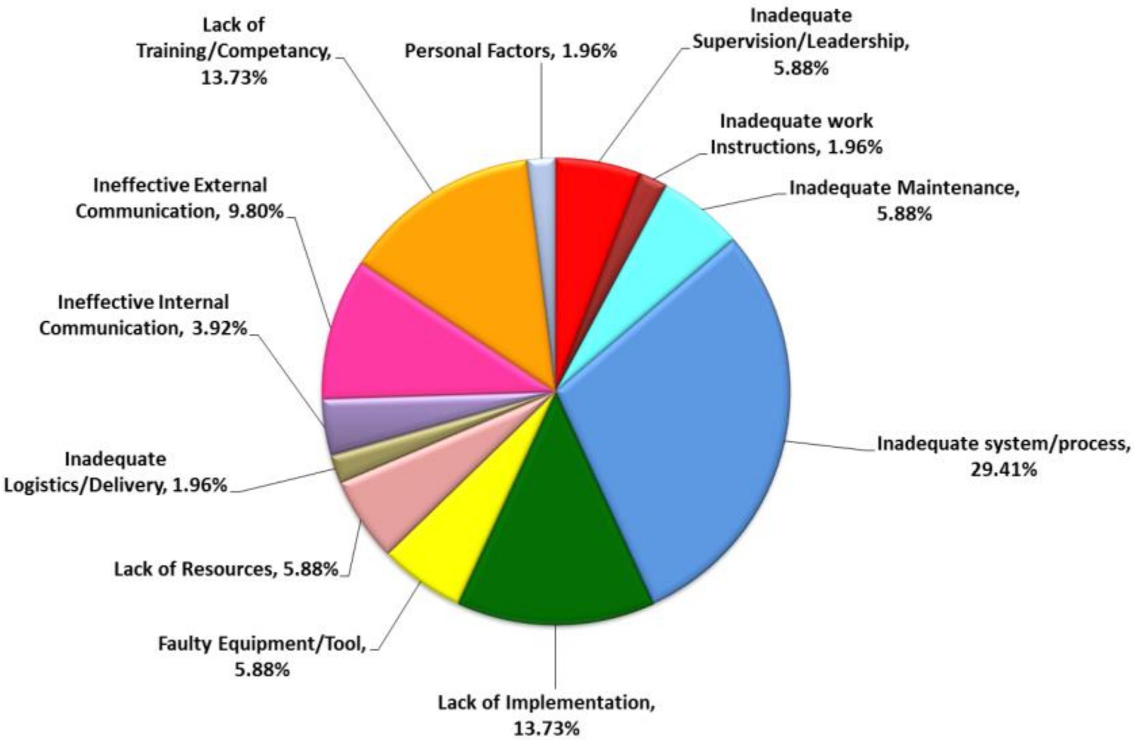

Figure 15: Root causes of 2012 failures - Company A (Rashid et al. 2013)

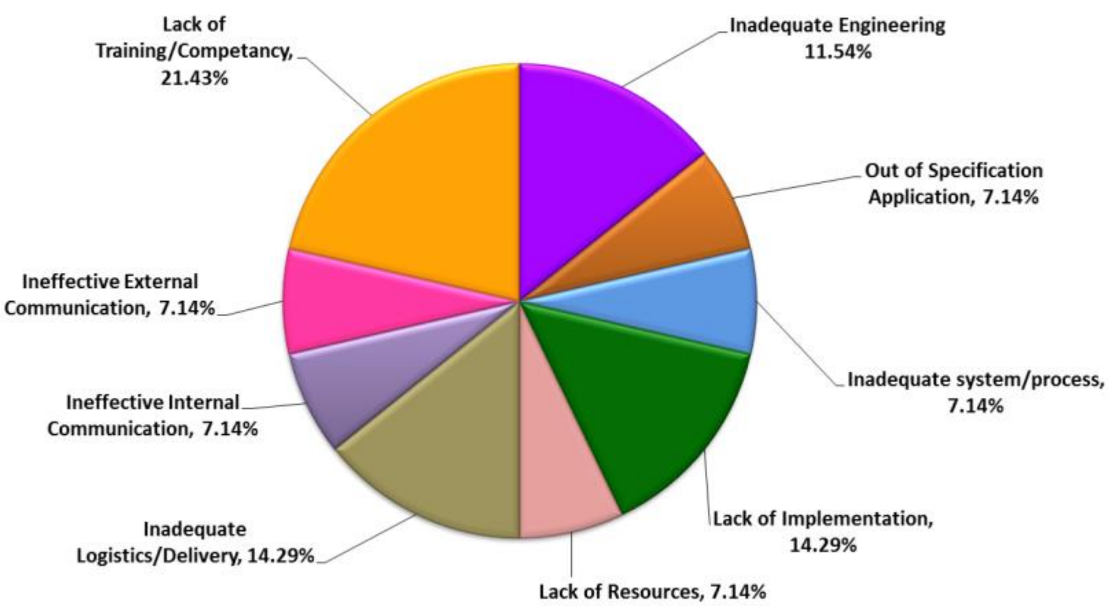

Figure 16: Root causes of 2013 failures - Company A (Rashid et al. 2013)

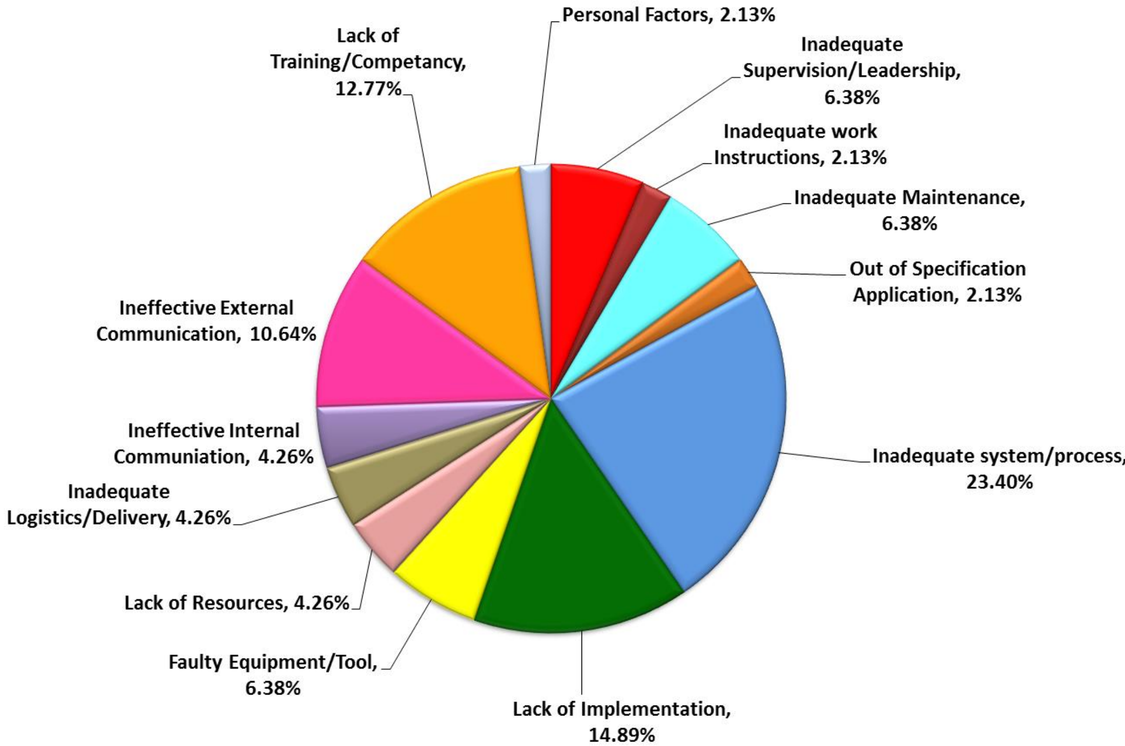

Figure 17: Root Causes of a department - Company A (Rashid et al. 2013)

Figure 17 shows the root cause profile for Company B, a local company. The profile shows that company B had serious issues with its maintenance program. The Drilling Management informed Company B's management to improve the maintenance program. The performance of Company B was continuously monitored for two years. No significant improvements were made by Company B. Finally, company B was removed from the project. Later Company B made a partnership with one of the renowned international companies and started to work on the project. Company B recognized the importance of the NCR system. Further to the above discussion, with the help of the NCR/NPT investigation process, the root cause profile for a well (well A) based on the failures occurred on the well with different vendors started to use at End of well Review to show the overall vendors' performance on the Well.

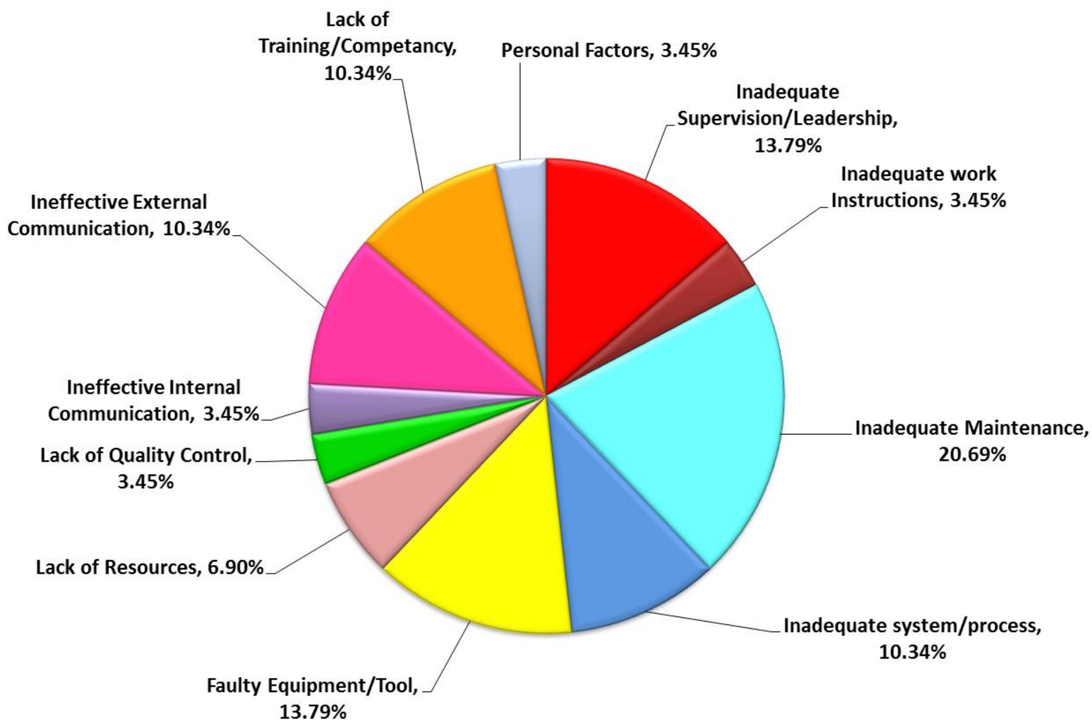

Figure 18: Root Causes of Company B (Rashid et al. 2013)

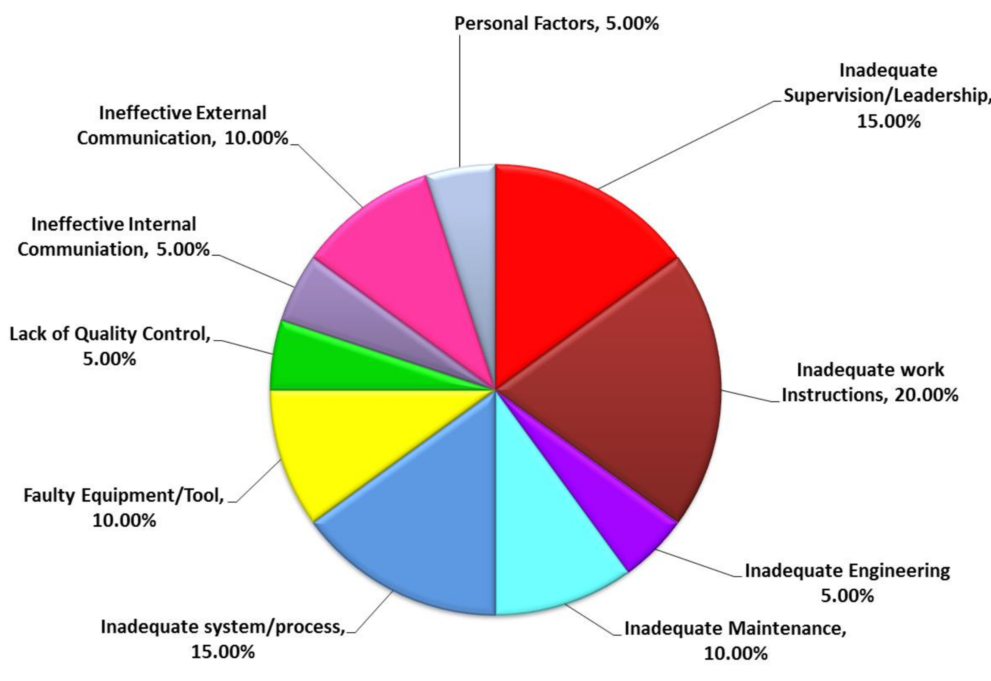

Figure 19: Root causes of the Well A (Rashid et al. 2013)

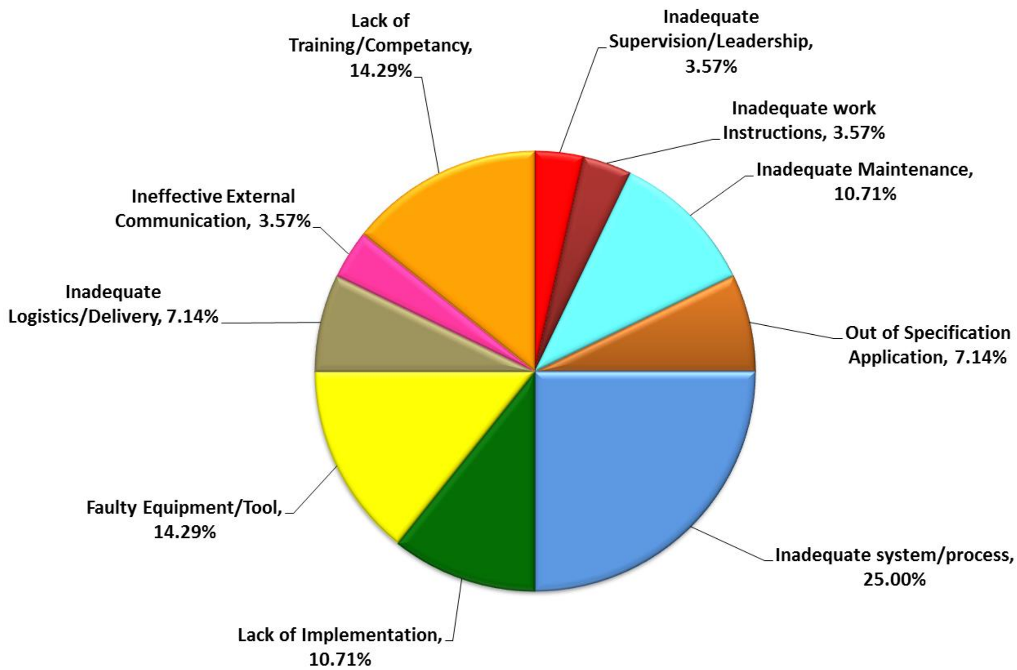

Figure 20: Root causes of Well B (Rashid et al. 2013)

Figure 18 shows a Well Profile where Inadequate Work Instructions, Communications and Lack of Leadership were the main issues and caused failures. Such a profile shown to Drilling & Completion Engineers to make sure vendors must have good support and planning was adequately done by vendors as well as by the engineer.

Similarly, Figure 19 shows a root cause profile for a different well (well B), which indicates different issues and areas to improve. The above analyses are from the paper published in 2013. Most updated data analysis on the NPT/NCR investigation process will be presented in Chapter 7 for further discussion.

5.3.2.7 Benefits of NPT/NCR Investigation Process

a) Availability of a platform to raise concerns: With the implementation of the NCR/NPT investigation process, engineers were comfortable raising their concerns with vendors facing during the drilling & completion phase of a well. Before all the concerns remain on e-mails and get lost after some time.

b) Availability of traceable database: All the issues (NPT, NCRs) were recorded in the system. These NCRs remained open till a resolution was proposed and approved. During performance review with vendors, the status of NCRs was discussed with the senior management from both sides for their support to close these NCRs on time. NCT/NPT investigation database was available to all for future references and trackback similar types of failures for a constructive report.

c) Bringing the consistency: It was observed that the majority of International service companies comprised of much better NPT investigation process compared to that of local service companies. Before the implementation of NCR/NPT investigation process, it was considered to have the process simple and easy to understand, so that multiple companies could adapt the process easily and consistently. Enforcement of filling the form regardless of how the investigation report was arranged brought the consistency in the investigation and the reporting. All the companies filled the same form to close the NCR/NPT investigation report. Whether it was a local company or an international company, it was the same process for all and the same type of information was required to close the incident report.

d) Areas for improvement: As discussed earlier, one of the main benefits was to have the areas to improve for a service company and its subsidiaries as well as for the whole project jointly or individually to see what could be done differently to avoid the repetition of failure in future.

e) Bringing value to the industry: Once a service company passed through the improvement process and made significant changes to the management style etc. added more resources to avoid failures, such efforts brought improvement for the project as well as for the local industry. So overall, this NCR/NPT process brought value to the whole industry in the region over time.

5.3.3 End of Well Review

The End of Well Review process was established to discuss briefly all the events related to the well and highlights learnings and summarize the for future use. The purpose of the process was to bring awareness to the importance of sharing and discussion to collect lessons learned as much as possible. Besides the objectives of the process, rules were also defined to make sure that good quality of lessons learned were captured and utilized effectively by the teams and service companies on the project. End of Well Review was the best event to practice such efforts.

5.3.3.1 The Objectives of the End of Well Review

The main objectives of the End of Well Review process were

- To record all the lessons learned and improvements by having maximum participation from all parties.
- To be ready to use/implement all lessons learned/improvements to all running operations and jobs.

5.3.3.2 Rules for capturing Lessons learned/ Improvements

Clear rules for lessons learned were defined to make sure good quality of lessons learned were captured and brought value to the project. Below were the rules defined for capturing of lessons learned during the End of Well Review;

a) Lessons learned or improvements could be captured by anyone who was involved in any activity or job related to any Well operation.

b) Lessons learned must be captured in a required format so they could be sorted out easily based on job type, well type, section type, service type.

c) End of well Review meeting must be scheduled within 2 weeks after a well was completed. All the service providers involved were required to participate in the review.

d) Lessons learned would be discussed and validated during the End of Well Review.

e) All the Team leads and Engineers (Drilling, Completion, Mud, Cementing, etc.) involved in the operations were required to attend the review meeting.

f) The target was set to report a minimum of 2 lessons learned per job.

g) The rules were set stringently helping the teams to collect lessons learned as much as possible especially at the start of the project.

5.3.3.3 End of Well Reports

Drilling & Completion Engineers started to prepare the End of Well Report based on the below data within one week of the End of Well Review.

- Well Objectives including any major MOCs related to Well objectives captured
- Well Cost
- Daily Ops Summary
- Wellbore Schematic /Casing Diagram
- Directional Survey
- Well Profile with Formation Tops/Geological Information
- Drilled Footage Report
- Completion Diagram
- Wellhead Diagram
- AFE vs. Actual Days
- AFE vs. Actual Cost

- NPT Summary
- Lessons Learned

The End of Well reviews and reports started to organize drilling teams toward meeting and finalizing the lessons learned and adjusting programs for future jobs. It was a good knowledge sharing event where all the team members reviewed the learnings and applied on coming wells to get maximum benefits from the lessons learned.

5.3.3.4 Benefits of End of Well Review

The major benefits achieved from the End of Well review were;

a) Data Availability (End of Well Report): All the wells drilled in the past did not have enough End of Well Reports. All of the information on old wells were missing, which caused very serious concerns and surprises during the workover of many old wells. With the implementation of the End of Well Review Process, End of Well Reports were available for all the wells drilled for the project. It was one of the great benefits of the End of the Well Review process to have the End of Well reports ready right after a well was completed.

b) Improved Communications: One of the major benefits observed was the improved communications between all teams; Asset Team, Well Integrity Team, Drilling and Completion Team, Service Companies etc. The various teams started to meet at every End of Well Review meeting and shared common issues during the meetings. It started to resolve the issues on time such as miscellaneous data availability, timely approval of programs, communications gaps etc.

Table 6: End of Well Review Duties

Documents/Slides	Responsible	Slides
Well Objectives and Operations Summary / Well Diagram	Drilling & Completion Engineer	
– Pre – Drilling (If any)	Completion Engineer	1-2
– Drilling (Section by Section summary)	Drilling Engineer	3-5
– Completion Phases including Completion Diagram	Completion Engineer	2-3
– Stimulation (If it is with rig)	Completion Engineer	1
– MOCs (List the all MOCs)	Drilling & Completion Engineer	1
– Lessons Learned (Major Lessons)	Drilling & Completion Engineer	1-2
Geo-Steering and Well Placement (Only for Drilled wells)	Operations Geologist	
– Geological & Drilling Target	Operations Geologist	2
– Well Placement including diagram		
– Formation Tops		
– Well Logs (Recovery & Quality)	Operations/Reservoir Geologist	1-2
– Lessons Learned (Major Lessons)	Operations Geologist	1
Well Survey QA/QC (Only for Drilled wells)	Drilling Survey Engineer	
– Definitive Survey Summary	Drilling Survey Engineer	1
– QA/QC report Including Lessons Learned	Drilling Survey Engineer	1
Coring Results (If any)		
– Coring Recovery	Operations Geologist	1
– Coring Quality	Operations Geologist	1
Well Integrity		
– Zonal isolation	Well Integrity Engineer	1
– Casing integrity including casing logs recovery and quality	Well Integrity Engineer	
– Completion integrity	Well Integrity Engineer	1
– Wellhead integrity	Well Integrity Engineer	
Well Services		
– Well Services operation summary	Well Service Engineer	1
– Wellbore Accessibility, i.e. Coiled Tubing etc.	Well Service Engineer	
Well KPIs		
– Drilling Efficiency without Reconciliation (Section by Section)	Performance Analyst	1
– Drilling Efficiency with Reconciliation (Section by Section)		
– Well Cost KPI		
– WOW %		
– NPT %		
NPT Analysis + Review of High Severity NPT Events	Drilling & Completion Engineer	3 - 4
Well Delivery KPIs including Lessons Learned	Drilling & Completion Engineer	1
Well Document Archive (% loaded with Documents)	Drilling & Completion Engineer	1

5.3.4 New Technology and Best Practices Process

New Technology and Best Practices Process was one of the very active processes and was continuously used by engineers. A joint weekly meeting among all drilling teams was regularly scheduled. In the meeting, senior management reviewed the weekly performance of each rig. After this weekly review, a technical topic based on negative or positive learning or new technology or best practices was shared by different assigned engineers.

Figure 20 shows the process of sharing best practices with teams by engineers. Nearly 40 topics were discussed each year for the past six years. The main benefit of this process was observed that Engineers had a platform where people from all teams listen to their thoughts, resulted in motivated and productive employees.

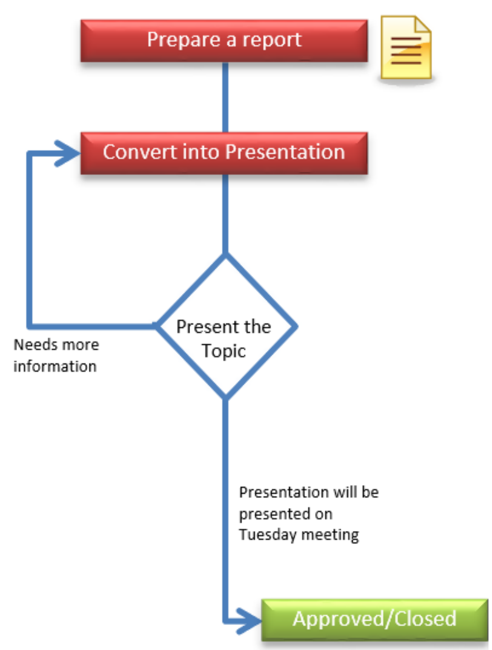

Figure 21: Best Practice Process Flowchart (Rashid et al. 2013)

5.4 The Lesson Learned Database

The outcomes of all the above processes, except New Technologies and Best Practice processes, were recorded in one database. This database was easily accessible from all locations, including rig-sites within the company intranet, as the database was created on the portal. Initially, the Lessons Learned database was used very efficiently; after growing tremendously, the database management became challenging. Some of the lessons were contradicting each other. These lessons should be updated regularly. Later, instead of updating the database, engineers were more comfortable updating the lesson in the engineering programs instead of updating the lessons learned database. This practice improved the programs and procedures on the spot and brings significant improvement in the Well Duration reduction.

5.4.1 Required Format

A required format was set at the beginning, so lessons learned can be filtered and searched easily. Table 7 shows the format of the lessons learned captured by teams. Below were the requirements of each lesson:

Table 7: Lesson Learned Format

Lesson #	Well Name	Hole Section (in)	Category	Job Type	Opr/NPT Code	Lessons Learned/Improvements (What, when, Why ….. It is happened)	Recommendations (How and who…. Will fix it)
1							
2							
3							
4							
5							

- Well name: the name was required for all lessons learned

- Hole Section: Type of hole section must be listed

I. In case there were two selections, select the section where the lesson learned was observed. For example, lesson learned running 9 5/8" casing under 13 3/8" casing or 12 ¼" Open Hole based on where the lesson learned was observed. If lessoned was learned before setting the 13 3/8" casing, it would be captured under 12 ¼" Open Hole, otherwise, it would be captured under 13 3/8" casing.

II. If a lesson learned was captured while working inside tubing, select tubing.

- Category: Select the main category from "Drilling, Completion, Work-over, HSE, Formation Evaluation."

Table 8: Job Types

Environment	Cased Hole Logging
Safety	Completions/Testing
Rig Equipment	Completion Fluids
Directional Drilling	Artificial Lift
Directional Drilling - Tools & Surveying	TLC Wireline
MWD/LWD	Slickline
Bits	Perforating
Coring Operations	Acid Stimulating
Drilling Surveillance	Coil Tubing
Drilling Fluids	Fishing
Solids Control & Cuttings Re-injection	Production Surveillance
Cementing	Production Logging
Casing	Fast Drill
Wellhead Equipment	Information Management
Downhole Equipment	Mooring and Risers
Open-hole Logging	Logistics

- Job Type: A list of job type was provided. Select the right job type from the list sated in table 8.

- Operational/NPT code: An operational/NPT code would be assigned to each lesson learned. It would help to filter the lessons learned based on the code.
- Lesson Learned/Improvements: Describe a lesson learned in a way that would be easy to understand. Minimum information, "what, when, why, how, etc." was required.
- Recommendations: Suggestions based on learnings. Describe "How was it fixed or how it would be fixed?" For improvements, suggest "should we continue or not and at what conditions solution should be implemented".

The Knowledge Management Engineer supported the initial End of the Review process; later, it was assigned to Drilling & Completion Engineers to arrange reviews and lessons learned during the process. Roles and responsibilities were defined as described in Table 6.

CHAPTER 6: Well Quality KPIs; Development & Implementation

Drilling a well is comprised of multiple activities that are linked to the Well objectives and requirements set in the design phase. Some of the activities have short-term impacts on the well such as logging a section etc., and some of the activities have long-term impacts on the well such as cementing, wellbore accessibility etc. It is quite important to list the activities based on their impact on a well and rate them individually to get the overall impact on the objectives of a well by these activities.

This chapter discusses in detail the need for the enhancement in Well Quality KPIs and the work done by Rashid et al., 2018[5]. The contents of this chapter are from the previously published manuscript for SPE/IADC [5] which was presented at the SPE/IADC Middle East Drilling Technology Conference and Exhibition held in Abu Dhabi, UAE, 29–31 January 2018" and customized to fit with the thesis format.

6.1 Conventional Approach

Conventionally a Well Quality score was reported 6-12 months after a well was completed. The quality cycle to improve the performance of a well became ineffective and irrelevant due to late reporting. The results of the activities of a completed well were so late that many wells had been drilled and completed during the reported period.

a) The KPI reporting flow turned the existing Well Quality KPIs into laggard KPIs, which were not contributing to enhancing the quality of a delivered well and overall of the project.

b) The Well Quality score was distributed among four different categories where Well Integrity was an isolated category, and a Well Integrity issue had minimum impact on overall Well Quality scoring.

c) The scoring guidelines were very generic and were depended on the evaluator's judgment. A lack of verification of the results was also evident during KPI reporting, which made the KPIs score skeptical and unreliable.

d) A fixed scoring structure was used to evaluate all types of wells on the same scale. Such as the scoring of a complex well was treated in the same manner as scoring on a workover well.

e) Some activities were ignored in the Well Quality scoring such as Coring Quality, minimum Well Integrity requirements etc. The overall score did not represent the actual picture of a well using existing Well Quality KPIs, which was impacting the overall project quality score.

6.1.1 The validity of the Existing Approach

With the launch of mega drilling project, the existing Quality capturing practices were re-evaluated to know;

- Did the Existing Quality capturing practices support updated drilling procedures and practices?

- Did the practices represent the department performance accurately with breakdown analysis?
- What values were these practices bringing to improve the Well Operations as well as Performance?
- Were these practices fit the SMART (Specific, Measurable, Achievable, Realistic, Time-Bounded) Criteria?

6.2 New Approach

A new approach was adopted to capture the Well Quality score right after a well was delivered so that improvement ideas could be implemented to the drilling wells that were in the execution phase at that time and on-ward wells in the design phase without any delays. The quality cycle was improved resulting in shorter well duration with lesser Well Integrity issues. A new weightage system was introduced to capture all activities in a well that activities were evaluated individually. The scoring criteria for each activity were defined clearly. Based on the deviation from the planned activity, the actual score was recorded accordingly by the user. Later these activities were verified by the end-users, so verification had enhanced the trust as well the validity of a lesson learned. Users and end-users were connected at an early stage after a well completed to capture the feedback. The Improvements got quickly implemented as the quality cycle was short and quick. The new scoring method introduced a wide range of Well Integrity checks based on rigorous and clear guidelines and failure to meet key Well Integrity policies could result in nulling the overall score of a well.

New Well Quality scoring guidelines delivered a clear and efficient approach to scoring the key performance indicators of a well at the right time. Consistency in scoring, timely reporting and right weightage for Well Quality scoring resulted in high-quality Well Programs, application of fit-for-purpose technologies and better knowledge transfer among team members.

6.3 Actual vs. Plan

Instead of measuring the KPIs against pre-set definition or targets as previously used in the old set of KPIs [9], a different methodology was used to make sure KPIs applied to all type of wells, complex to simple, long horizontal to vertical, and new drilling well to workover etc. The methodology comparing actual results with the plan provides the significant flexibility to measure the quality of works delivery on all types of wells and provides the chances to improve the Well Design during the planning phase based on the learnings from previously delivered wells. Traditionally a benchmarking method was recognized globally for target setting. The new approach Actual vs. Plan provided fit-for-purpose KPI to improve the performance by comparing the results with plan requirements.

To accommodate the changes to the plan, MOC (Management of Change) becomes compulsory. Otherwise, the KPIs score would be affected based on the completed work using the detailed scoring guidelines. In some cases, where the change in the plan can cause major casing design change and impact of the future production profile, KPIs score would be considered nil for that category. For example, Running Casing to the planned depth required all strings to be run at the planned depth within the tolerance limit. If a failure to the compliance can result in more casing strings, high well cost and affecting main objectives of the well, the score under running casing to plan depth would be considered '0' regardless a MOC was provided or not.

6.4 New Well Quality KPIs

A realistic approach to align the KPIs with Well Delivery Process was adopted, and Well Quality KPIs were mainly linked with the measures of the quality of the works delivered during the drilling phase before the well was handed over to the production team. Well Quality KPIs were split from Well Performance KPIs which used to measure the performance of the well comparing with the reservoir management basics such as well flow rate, reservoir pressure, etc. Both set of KPIs, Well Quality KPIs (Delivery) and Well Performance KPIs, were split to be measured separately by two different teams as the different timelines were required with different objectives. This paper discusses only the Well Quality KPIs (Delivery) at Well Delivery.

The detailed guidelines were developed to discuss the roles and responsibilities of each team, and scoring criteria of each KPI of each major category. Maintaining Well Integrity was one of the key objectives of every activity of a well. Due to its importance, Well Integrity became a necessary component of every work conducted on a well and was linked with all major KPI categories of Well Quality KPIs. Figure 21 shows the interrelationship between Well Integrity and other key categories of the Well Quality KPIs.

Figure 22: The elements of New Well Quality KPIs (Rashid et al. 2018)

Well Quality KPIs (Delivery) focused on all the activities and operations conducted by the rig and evaluated the level of achievement in each activity separately. KPIs were split into further six major categories and discussed in detail.

In the case of a multilateral well, each lateral would be scored separately. An average score from all lateral would be applied. However, weightage would be increased based on the number of laterals.

6.4.1 Drilling & Well Placement KPIs

1) Landing point location (north/east coordinate and vertically in target reservoir) as per plan;

The actual location of landing point (north/east coordinate & vertically in target reservoir) within target as per plan or MOC. The full score would be applied in case of landing as per plan or MOC, otherwise, the Nil score would be applied for not landing within the target limits.

The landing point target must be agreed in Appraise and Select Stage during the Well Delivery Process.

Weightage Guideline: 4.0 weightage was assigned to single lateral (Deviated or Horizontal), 4.0 weightage was assigned to each lateral, in Multi-lateral well, and 2.0 weightage was assigned for a pilot hole and all vertical hole wells. For long and highly complex lateral, 4.0 - 8.0 weightage can be assigned with an agreement with Operational Geologist and Drilling & Completion Engineer based on DCI (Drilling Complexity Index).

DCI of a well was calculated based on multiple information such as length of the well, inclination, formation to be drilled, single or multi-lateral, horizontal length etc. Then well was scored from 1 – 10 scale to identify the complexity of the well.

2) Total horizontal length in the target layer achieved as per plan

The actual total horizontal length in the target layer should be as per program or MOC. A percentage score would be used if the actual horizontal length in the target layer was within 70% of the planned horizontal length in the target layer (Only 30% tolerance was allowed). If the total length was less than 70% of the planned horizontal length in the target layer, a Nil score would be applied. The actual score (% of the actual in the target layer) would be used if a minimum of 70% of the planned horizontal length in the target layer was achieved.

Weightage Guideline: 4.0 weightage was assigned to single lateral (Deviated or Horizontal), 4.0 weightage was assigned to each lateral, in Multi-lateral well and No weightage for a pilot hole and vertical wellbore. For long and highly complex lateral, 4.0 - 8.0 weightage could be assigned with an agreement with OG and DCE based on DCI.

6.4.2 Running Casing & Cementing KPIs

1) All casings successfully landed in planned formation (Landing points & sizes) as per plan

The landing of each casing at the planned depth was very important. It might cause a significant change in Well Path or well flow if all the casings were not landed at desired depths, especially for ERD wells. The full score would be given if all the casing strings were landed in planned formation at the planned landing point. If a casing was landed shallower than planned and resulted in a major change in Well Plan/path or casing designs, or well costs, a Nil score would be given. All casing strings must satisfy these criteria, otherwise, the nil score would be applied.

Weightage Guideline: 2.0 weightage was assigned to each casing run. If 3 casing strings were designed for a well, total weightage was 6.0.

2) Successful cementing and testing as per plan

Criteria for successful cementing and casing testing would be determined by the Cementing Engineer and Well Integrity Engineer. Successful Cementing and Casing Testing should include;

i. Cementing had been conducted as per the plan. Pumped cement slurry density should be within +/- 0.2ppg of the designed slurry. Spacers and slurries volumes were pumped as per design. Displacement rates were as per designed rates.
ii. After WOC, no wet shoe issues. At least 10ft hard cement inside the casing shoe must be found.
iii. Cement tops were confirmed and matched with the final cementing program. Cement tops can be confirmed with mechanical job parameters or with cement bond logs.
iv. Casing/liners were successfully pressure tested to the value as prescribed in the drilling program.
v. Shoe bond integrity for Casing and Formation was confirmed by pressure test to the value as prescribed in the drilling program.

In case any of the above criteria were not met for a cementing job, a 0 score can be applied for that cement job in consultation with Drilling Engineer and Well Integrity Engineer.

In case of cement plugs (P&A, sidetrack plugs, plug back plugs, etc) all the cement plugs must be successfully placed at the planned depth with planned length and plugs were tested as per plan to get full score. In case verification of depth and length of the placed cement plug was not available, the best judgment can be made for the KPI scoring based on the execution of the cement plug job and while drilling if planned. For example, if the execution meets all the planned requirements, a full score for cement plug would be applied, otherwise a 0 score. In case, there was a pressure test was planned and the pressure test was failed, a 0 score would be applied for that plug.

Weightage Guideline: 2.0 weightage was assigned to each primary cementing job. 1.0 weightage was assigned to each plug job as per plan. Any Extra plugs other than the plan would not be added in total weightage.

Each cementing job would be scored separately. An average score would be used for the KPI. For Example, 3 casings and 1 plug were planned for a well, but actually, 3 casing jobs and 2 plugs were placed. Total weightage would be 7.0 regardless of the extra plug was placed. In case one casing job did not meet the requirements, then 5/7 (0.71) would be used for the score.

3) Casings were corrosion protected at the surface (conductors, surface casing etc.)

The conductor pipe was coated and cemented to the surface or the mud line. The surface casing was cemented to surface as per guidelines. Fluids left in all the annulus contain corrosion inhibitor as per guidelines. Cellars on inland wells were left dry.

A full score would be applied for full compliance, otherwise, 0 scores would be applied.

Weightage Guideline: 2.0 weightage was assigned to the casing protection at the surface.

4) Liner hangers/packers were run, set and tested successfully

Liner hangers and all packers were run and set as per plan. The packers were successfully pressure tested to the value as prescribed in the drilling program. An injectivity or pressure or any other type of confirmation test was performed to check no flow across the packer.

A full score would be applied for running, setting and testing the Liner hanger and packer etc. as per plan. An average score of packer/hanger run would be captured as the KPI.

Weightage Guideline: 2.0 weightage each was assigned to each planned packer and hanger run.

6.4.3 Completion & Stimulation KPIs

1) Completion successfully run to target set depth within tolerance limits as per plan

The setting of completion especially lower completion at the right depth was critical for Well Productivity and well life. The program must discuss the desired setting depth and tolerance to it. 0 score would be applied if the completion was set outside the tolerance limits. Tolerance limits should be discussed and recorded in Appraise and Select phase. In absence of tolerance limits, actual planned or MOC depth would be used for KPI scoring. If the completion was run to the setting depth, but the packer was not set, a 0 score would be applied.

Weightage Guideline: 2.0 weightage was assigned to each completion run. In the case of ESP completion, an extra 2.0 weightage was assigned.

2) Successful completion equipment tests including, DHSV, wellhead tests

A full score would be applied for having successful following tests as per plan;

i. Tubing strings was successfully pressure tested to the value prescribed in the completion program.
ii. Tubing hanger body seals were successfully pressure tested to the value prescribed in the completion program.
iii. Tubing & casing annulus was successfully pressure tested to the value prescribed in the completion program.
iv. SC-DHSV function test was confirmed
v. All X-mass Tree valves were successfully function tested & pressure tested to the value prescribed in the completion program.
vi. All valves of the Casing Housing & Tubing Head Spool (annuli valves) were successfully function tested & pressure tested to the value prescribed in the completion program.

In case of failure to test any above equipment, a 0 score would be applied.

In the case of dual completion, each completion would be scored separately. An average score from all completion would be applied. However, weightage would be increased based on the number of completion strings.

Weightage Guideline: 2.0 weightage was assigned to each completion run.

3) Enzyme/breaker treatment spotted

The full score would be given for all successful Enzyme/breaker treatment as per plan. 0 score would be applied in case of any deviation from the original plan.

Weightage Guideline: 2.0 weightage was assigned to each planned enzyme/breaker treatment.

4) Stimulation program was executed (only with the rig) as per plan

A full score would be given for successful implementation of the stimulation plan as per requirements after the confirmation of the following:

- Acid volume pumped as per plan
- Acid access to multilateral (where applicable)
- Acid access to Design Depth
- Treatment distribution as per design confirmed by Production/Injection logs, if available.

In case acid volume was not pumped as per plan (a low volume was pumped), a percentage

(%) score would be calculated based on volume pumped. In case volume pumped was less than half of the volume planned, a 0 score would be applied.

Weightage Guideline: 2.0 weightage was assigned to each enzyme/breaker treatment.

6.4.4 Wellbore Accessibility KPIs

1) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, Tractor etc.

The full score would be given for all successful wireline open and cased-hole jobs as per plan and wireline accessibility to the planned depth. The score of accessibility would be calculated according to the percentage of coverage length in the zone of interest. In case the wireline was not run to the desired depth, a percentage score would be applied based on actual planned length coverage.

In the case of multiple wireline runs, each run would be scored separately. An average score from all runs would be applied. However, weightage would be increased based on the number of planned runs. Scoring would be calculated based on successful runs regardless number of runs.

Weightage Guideline: 2.0 weightage was assigned to each wireline planned run. Any Extra runs other than planned would not be added in total weightage.

2) Wireline Accessibility (Completion)

The full score would be given for all successful wireline jobs inside completion as per plan and wireline accessibility to the planned depth. In case the wireline job through completion was not planned, then the score would be applied after confirming a wireline clearance inside the tubing string and in the nipples' profile in the actual completion assembly.

In the case of dual completion, each completion would be scored separately. An average score from all completion would be applied. However, weightage would be increased based on the number of completion strings.

Weightage Guideline: 2.0 weightage was assigned to each wireline planned run for each string.

3) Coiled Tubing Accessibility

The full score would be given for all successful Coiled Tubing jobs as per plan. The score of coiled tubing accessibility was calculated according to the percentage of coiled tubing coverage length to the planned wellbore section.

Weightage Guideline: 2.0 weightage was assigned to each coiled tubing planned run.

6.4.5 Well Integrity KPIs

1) Zonal Isolation successful

Successful zonal Isolation was a very important KPI for a newly drilled or a sidetrack well to make sure all the reservoirs were isolated and no communication among layers was expected or observed.

Full score to be applied in case of;

- Zonal isolation between the reservoirs
- No suspicious communication between layers

Zonal Isolation would be confirmed by the Well Integrity Engineer in consultation with Cementing Engineer by evaluating all the cement job executions and the interpretation of all cement bond logs if run. In case the cement bond log was not run, a detailed post job analysis was required to confirm the cement tops as per plan.

Weightage Guideline: 6.0 weightage was assigned to the zonal isolation success.

2) Well Integrity was confirmed as per THE COMPANY procedures (WIMS) before rig departure

Integral Wells were operating within the design and their integrity was assured and did not have any known integrity issues or concerns, such as:

i. An external leak from the tree or wellhead
ii. Tree and wellhead valves which fail to function or leak test
iii. DHSV system fails to function or leak test (passing)

iv. Tubing to casing, or casing to casing communication

v. Annuli in communication with the reservoir

vi. Un-bleedable annulus pressure

vii. Any well with tubing clearance or obstruction issues

The Well Integrity of any well delivered by rig/barge would not be compromised. A 0 score would be applied, in case any of the above conditions were met on the well.

Weightage Guideline: Due to the importance of the Well Integrity, this KPI would be treated as KILLER KPI for the Well Delivery KPIs overall score.

Responsibility: It was the responsibility of the Well Integrity Engineer to report the KPI and Well Integrity Manager and Drilling Engineering Manager would verify and confirm the KPI.

6.4.6 Data Gathering & Evaluation KPIs

Data gathering KPIs were focused on the data recovery and the quality of the recovered data for all data gathering activities related to the Well Delivery

1) Coring

2) Core recovery (% Core recovery)

A percentage score would be applied based on the actual recovery of the core to the planned core agreed upon in the Appraise and Select phase during the Well Delivery Process.

Weightage Guideline: 2.0 weightage was assigned to each core recovery activity/job (not runs).

3) Core quality & usability (Mechanical stability of the core)

A percentage score would be applied based on the percentage of core quality and it's usability compared to planned use. This KPI was linked with the mechanical stability of core as determined on the rig or shortly afterwards onshore (KPIs to be finalized 2 weeks after rig departure from well.)

Weightage Guideline: 2.0 weightage was assigned to each coring job (not run).

4) LWD data (Recovery and Quality)

5) Geo-steering well log data (quality and frequency, sample/ft.) - Real-time

The score was divided into two parts;

I. 50% score was linked with the recovery of the Geo-steering well logging data in real-time mode. If the recovery of the data was 100% as per plan (needs were met) then a 0.5 score would be applied.

II. 50% score was linked with the quality of the Geo steering well logging data in real-time mode. If the quality of the geo-steering data was attained as per plan (needs were met), then a full score of 0.5 would be applied.

Weightage Guideline: 2.0 weightage was assigned to geo steering well logging data.

6) Reservoir Data (memory Data)

The score was divided into two parts;

I. 50% score was linked with the recovery of the reservoir data in memory mode. If the recovery of the data was 100% as per plan (needs were met) then a 0.5 score would be applied.

II. 50% score was linked with the quality of the reservoir data in memory mode. If the quality of the data was attained as per plan (needs were met), then a full score of 0.5 would be applied.

Weightage Guideline: 2.0 weightage was assigned to reservoir data on memory mode for each planned run.

7) Wireline logging data (Recovery and Quality)

8) Cased Hole Data (Gyro, Corrosion, cement log, etc...)

This KPI covered all the wireline logs related to cased hole sections, i.e., gyro data, corrosion logs, cement evaluation logs etc.

The score was divided into two parts;

I. 50% score was linked with the recovery of the logging data. If the recovery of the data was 100% as per plan (needs were met) then a 0.5 score would be applied. In case multiple logs, an average score would be applied.

II. 50% score was linked with the quality of the logging data. If the quality of the data was attained as per plan (needs were met), then a full score of 0.5 would be applied. In case multiple logs, an average score would be applied.

Recovery and quality would be added to the final KPI.

Weightage Guideline: 2.0 weightage was assigned to each planned cased hole run.

9) Open Hole Data (reservoir data)

This KPI covered all the wireline logs related to reservoir data.

The score was divided into two parts;

I. 50% score was linked with the recovery of the logging data. If the recovery of the data was 100% as per plan (needs were met) then a 0.5 score would be applied. In case multiple logs, an average score would be applied.

II. 50% score was linked with the quality of the logging data. If the quality of the data was attained as per plan (needs were met), then a full score of 0.5 would be applied. In case multiple logs, an average score would be applied.

Weightage Guideline: 2.0 weightage was assigned to each planned open hole run.

10) Post completion Data (Reservoir surveillance)

This KPI covered all the activities such as wireline logs (PLT), injection tests, flow tests etc. conducted for Reservoir surveillance using the Rig. The score was divided into two parts:

- If injection or flow tests were carried out, then the score would be based on the confirmation of the well Injection of flow.

- If the job conducted with a tool, then the job was as per planned or not;

I. 50% score was linked with the recovery of the surveillance data. If the recovery of the data was 100% as per plan (needs were met) then a 0.5 score would be applied. In case multiple logs, an average score would be applied.

II. 50% score was linked with the quality of the surveillance data. If the quality of the data was attained as per plan (needs were met), then a full score of 0.5 would be applied. In case multiple logs, an average score would be applied.

Weightage Guideline: 2.0 weightage was assigned to each planned post-completion data run/job (test).

6.5 Reporting and Verification

The majority of the KPIs were captured by the admin staff. These admin staffs were not technically competent to verify the KPIs. Most of the KPIs reporting was normally depended on the single reporting structure, where the KPIs' values were confirmed by a single person. New Quality KPIs had a new feature where a verifier was also required to confirm the KPI score. An admin contacts the related person of the well for reporting and gets confirmation of the KPI by different person equally qualified to calculate the KPIs. Table 2 shows each sub KPI under Well Quality KPIs with reporting and verification responsibilities.

6.6 Scoring Logic

A drilling and completion program of a well was comprised of many subprograms such as cementing, logging a section etc. A Macro and Micro KPI concept [15] was used to capture overall Well Quality KPI (Macro KPI) for the company by monitoring and measuring KPIs (Micro KPI) at a planned activity level.

A weighting scheme was introduced to assign more weightage to the KPIs where multiple or extended activities such as multiple logs, Multilateral wells, Extended Reach wellbore etc. were planned. For example, 4.0 weightage was assigned to High Deviated or Horizontal single lateral, 4.0 weightage was assigned to each lateral, in Multi-lateral well, and 2.0 weightage was assigned for a pilot hole or a vertical hole under Well Placement KPIs. All the weights were later added to give a full score of a well. More of the work was conducted on a well, more of the weightage was assigned to the well. Figure 22 shows different wells with different KPI weightage, where the grey bar represents the total weightage of a well assigned due to the planned activities on the well and the blue bar represents the sum of the score

Table 9: Well Quality KPI with Reporting and Verification responsibilities

Well Quality KPIs (Delivery)	KPI Responsibility	
A program executed within planned limits (including MOC);	Reporting	Verification
1) Drilling and Well Placement		
a) Landing point location as per plan	OG	DCE
b) Total horizontal length in the target layer achieved as per plan	OG	DCE
2) Running Casing and Cementing		
a) All casings successfully landed in planned formation as per plan	DCE	OG
b) Successful cementing and testing as per plan	DCE	WIE
c) Casings were corrosion protected at surface (conductors, surface casing etc.)	DCE	WIE
d) Liner hangers/packers were run, set and tested successfully	DCE	WIE
3) Completion and Stimulation		
a) Completion successfully run to target set depth within planned tolerance limits	DCE	WIE
b) Successful completion equipment tests including, DHSV, wellhead tests,	DCE	WIE
c) Enzyme/breaker treatment spotted	ME	DCE
d) Stimulation program executed (only with the rig) as per plan	DCE	DCE
4) Wellbore Accessibility		
a) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc.	DCE	WIE
b) Wireline Accessibility (Completion)	DCE	WIE
c) Coiled Tubing Accessibility	DCE	WWE
5) Well Integrity		
a) Zonal Isolation successful	WIE	RE
b) Well Integrity confirmed as per THE COMPANY procedures (WIMS) prior to rig departure	WIE	WIE
6) Data Gathering and Evaluation		
a) Coring		
1. Core recovery (% Core recovery)	OG	RG
2. Core quality & usability (Mechanical stability of the core)	RG	RG
b) LWD data (Recovery and Quality)		
1. Geo-steering well log data – Realtime data	OG	DCE
2. Reservoir Data (memory Data)	OG	DCE
c) Wireline logging data (Recovery and Quality)		
1. Cased Hole Data (Gyro, Corrosion, cement log, etc...)	WIE	DCE
2. Open Hole Data (reservoir data)	OG	DCE
d) Post completion Data (Reservoir surveillance)	RE	DCE

achieved against each activity. Well-1 was consisted of more activities compared to Well-2, where Well-1 was a multilateral well with a pilot hole and coring and Well-2 was a simple work-over well to fix completion integrity. After assigning a weightage based on planned activities under single KPI, a score was assigned based on actual work completed. A different methodology was adopted for different KPIs. Some of the KPIs received either full score or 'nil' based on the compliance to the KPIs described in the detailed guidelines. For example, landing point location as per plan within target zone would receive a full score based on 0.0 to 1.0 scale, otherwise missing the target would receive minimum score '0'.

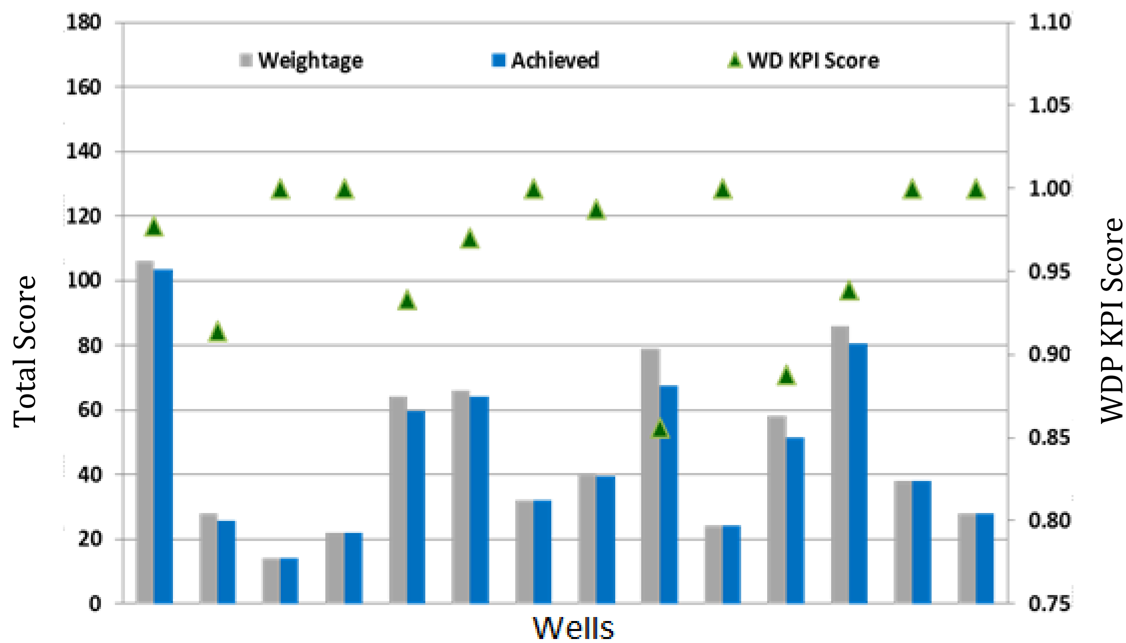

Figure 23: Different Wells with Different Weightage (Rashid et al. 2018)

Some of the KPIs receive a partial score or '%' of the total score based on 0.0 to 1.0 scale. For example, a percentage score would be applied based on the percentage recovery of the core to the planned core length. Similarly, a percentage score would be applied based on percentage recovery of the data to the planned data length etc. A zero weighting would be applied to all non-applicable KPIs, i.e., if no activity was performed, weightage would be zero for the KPI related to the specific activity.

The new weightage method makes the KPIs more flexible to use in all situations and all types of wells from vertical to highly deviated or horizontal wells to extended reach well. The new scoring method captured all simple to complex wells.

6.7 Well Integrity KPI - Killer KPI

The Well Integrity was the main objective of all the completed wells, new drill wells or work-over wells. A well was considered not completed till it passed all the Well Integrity checks. Some of these checks were added to the Well Integrity KPIs to make sure these were captured while reporting KPI. Integral Wells were operating within design limits, their integrity was assured, and they did not have any known integrity issues or concerns, such as;

- An external leak from the tree or wellhead
- Tree and wellhead valves which fail to function or leak test
- DHSV system fails to function or leak test (passing)
- Tubing to the casing, or casing to casing communication
- Annuli in communication with the reservoir
- Un-bleedable annulus pressure

- Any well with tubing clearance or obstruction issues

In case any Well Integrity issue was observed on a well at its delivery, KPIs score for the complete well be considered '0' till the issue was fixed. The Well Integrity became a Killer KPI, which was introduced to make sure that delivered wells meet Well Integrity requirements.

6.8 Gain Analysis

Each KPI under New Well Quality KPIs was developed based upon S.M.A.R.T (Specific, Measurable, Achievable, Realistic and Time-bounded) criteria. The Well Quality KPIs at delivery supported by detailed guidelines were providing miscellaneous benefits to the organization. Below were some of the visible benefits achieved after implementing new Well Quality KPIs;

a) Versatile & Adaptable: Well Quality KPIs were flexible and applicable to all types of wells. So a simple excel sheet was used to cover all types of wells. Scoring guideline provides the set-by-step procedures for scoring each activity. Non-applicable activities were ignored from the calculation, which makes the Well Quality KPIs to be used on all types of wells.

b) Activity-based Valuation: KPIs were set for many different activities from spud to handover a well. Each KPI was scored based on the performance of the activity. So, KPI for each activity was tracked and monitored separately for performance enhancement by one specific team assigned for the activity.

c) Concentrated on Requirements: The major change observed related to the KPIs target setting was using the requirements as a baseline to score the KPIs instead of fixing scoring guidelines. It was one of the smart ways to accommodate the changing requirements from simple to complex wells.

d) Focused on the Integrity of a well: New Well Quality KPIs receive more attention in terms of Well Integrity. The Well Integrity became the main focus of the KPIs, and certain Well Integrity criteria were strictly considered to avoid full impact on overall Well Quality KPIs.

e) Technical Enhancement: The method to provide data and verification process supported by detailed guidelines were changing the team approach to solve issues and improve the activities. The Well Quality KPIs became a good source of technical enhancement for the engineers and coordinators who worked full or partially in KPIs preparation.

f) Self-Supported: As the roles and responsibilities of each person were clearly defined to prepare the Well Quality KPIs of a well, the KPIs reporting was carried out with minimum resources assigned for the KPIs preparation. As a well was completed, the assigned engineer prepares the KPIs and sends them to the focal point for consolidation. Later, KPIs were self-supported and extra technical resources were not required.

Well Delivery KPIs	Comments	KPI Responsibility	Score	Actual	Weightage	Total Achieved	Scoring Guideline
Program executed within planned limits with respect to; (including MOC)							
1) Drilling and Well Placement							
a) Landing point location (north/east coordinate and vertically in target reservoir) as per plan		OG/DCE	1.00		4.00	0.00	Yes/No, Yes=1, No=0
b) Total horizontal length in target layer achieved as per plan		OG/DCE	1.00		4.00	0.00	%
2) Running Casing and Cementing							
a) All casings successfully landed in planned formation (Landing points & sizes) as per plan		DCE/OG	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful cementing and testing as per plan		DCEFE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Casings are corrosion protected at surface (conductors, surface casing etc)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Liner hangers / packers are run, set and tested successfully		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
3) Completion and Stimulation							
a) Completion successfully run to target set depth within tolerance limits as per plan		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful completion equipment tests including, DHSV, wellhead tests,		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Enzyme/breaker treatment spotted		IDT/DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Stimulation program is executed (only with the rig) as per plan		DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
4) Wellbore Accessibility (actual results or model based on actual well path/actual completion design)							
a) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc		DCE/WI	1.00		2.00	0.00	%
b) Wireline Accessibility (Completion)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Coiled Tubing Accessibility		DEC/WW	1.00		2.00	0.00	%
5) Well Integrity							
a) Zonal Isolation successful		WI	1.00		6.00	0.00	Yes/No, Yes=1, No=0
b) Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure		WI	1.00		Killer KPI		Yes/No, Yes=1, No=0
6) Data Gathering and Evaluation							
a) Coring							
1. Core recovery (% Core recovery)		OG/RG	1.00		2.00	0.00	%
2. Core quality & usability (Mechanical stability of the core)		RG	1.00		2.00	0.00	%
b) LWD data (Recovery and Quality)							
1. Geo steering well log data (quality and frequency, sample/ft) - Realtime		OG	1.00		2.00	0.00	%
2. Reservoir Data (memory Data)		OG	1.00		2.00	0.00	%
c) Wireline logging data (Recovery and Quality)							
1. Cased Hole Data (Gyro, Corrosion, cement log..etc...)		WI/DCE	1.00		2.00	0.00	%
2. Open Hole Data (reservoir data)		OG/DCE	1.00		2.00	0.00	%
d) Post completion Data (Reservoir surveillance)		PE/DCE	1.00		2.00	0.00	Yes/No, OR, %
Well Delivery KPIs (Total Score) (2-4 weeks)		**0.00**			**50.00**	**0.00**	

Figure 24: Excel Sheet to calculate the Well Quality KPIs

Figure 23 shows the excel sheet used for the entire KPI structure to capture the weightage and score achieved against each KPI. The score for each KPI was calculated separately. It helps to evaluate the performance of a specific KPI for different wells to compare the individual performance of the KPI. For example, a score for coring sample recovery can be evaluated on all previous wells where coring was performed to check if there was any constant issue related to the coring sample, so performance can be improved using alternate solutions.

6.9 Performance Enhancement

New Well Quality KPIs bring the changes to the mindset from planning to executing operations. Performance enhancement on the drilling project contains many internal and external variables ranging from individual efforts to collective attempts. The Well Quality KPIs play one of its roles, too, to improve the overall project performance, especially KPIs measurement against the planned requirements helps to pick the best services and fit-for-purpose technologies for any drilling and completion activity. It proves it was a chain reaction that teams were considering requirements based on needs and eliminating extra requirements (wishes) from the drilling and completion programs. Drilling and Completion teams were looking for the best available technologies and fit-for-purpose approach to design and plan wells. Figure 27 shows the significant reduction in average well days since 2015, the year new Well Quality KPIs were implemented. Trend-line indicates the well day duration would keep improving till optimum days are achieved for a 25Kft well.

CHAPTER 7: Results Analysis

Besides all the improvements that were implemented and adapted for the project, the accurate interpretation of the results was very important. The challenge was the understanding of KPIs, analyses of various data and setting the right target to move forward step by step. The completion of a drilling well had two major variables to measure its performance; time to complete activities and length of the well. For example, the same activities could take different time to complete such as running a drilling pipe to a certain depth always would be different as that was a man-dependent activity and would show the different results at each run. Similarly, the long length of a well was required more time to complete such as running drill pipe for various lengths of well would results in different results. As all the drilling wells were not equal length. So, it was very important to capture the right performance of well, length should not be a variable as time was always considered as a benchmark to evaluate the performance. Authors played an extremely important role to capture, validate, calculate, present, analyze and benchmark the data of all the wells very carefully and diligently to avoid any mistrust on data and analysis. Many occasion teams challenged the author's analyses, but with consistently monitoring KPIs at the stringent principal, the author received many appreciations and supports from Senior Management for his work.

7.1 Setting Innovative Approach – "25Kft well in 90 days"

After spudding of the first project well, it became a common discussion of what target we could focus on as a baseline for the performance of a well. Multiple discussions occurred to measure actual performance, such as a 30% performance improvement over a three (3) year period, or a 10% reduction in the Well Duration per year. Many questions were raised including what type of wells, how to capture the reduction/improvement etc. What could be as a baseline? Each well was considered a different well as it had different measured depth. So, it was clear that some "normalization" was required to bring each well to the same reference scale to judge the performance of each well, each rig and each team.

7.1.1 Industry Practice

The approach "Days to drill 1000ft" was commonly used by directional drilling companies. However, completion days and running casing days were ignored entirely as only the days for Spud to TD (Total Depth) were considered in the calculation. In the absence of the right performance representation of project wells, shareholders were looking for a new approach to satisfy their quest for the project performance so that a good base can be set for performance enhancement.

7.1.2 A Novel Approach

The author adopted a novel approach to measure the performance of a well. The duration of the majority of the activities of a well was dependent on the depth of the well as all the projects well had a common configuration. Figure 3 in chapter 1 shows a standard well configuration. Considering the same well configuration for all the project wells, the duration to drill a standard well was selected as benchmarking. The question was what was the standard well depth? Figure 24 shows the normal distribution curve of project wells, where the mean depth 24,662ft was considered as base depth for the project wells. A roundup to 25,000ft was taken as a common well depth for a standard well.

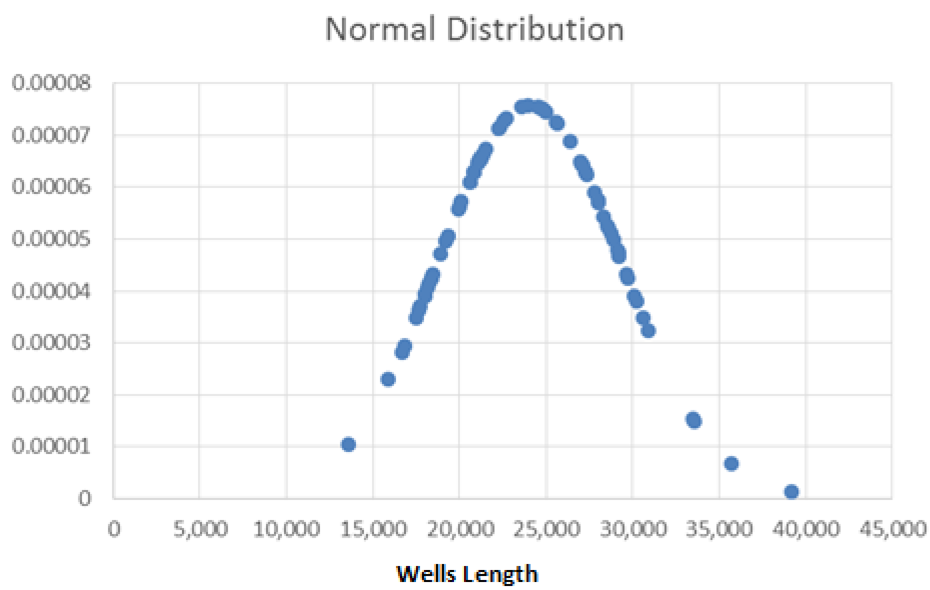

Figure 25: Normal distribution curve of future wells

Below was the initial formula for the Well duration calculation at 25kft scale;

Equation 8: Initial Formula Well Days Normalized at 25K ft

$$\text{Well days normalized at 25k ft} = \frac{\text{Actual well days including completion}}{\text{Total Net Footage}} \text{ X } 25{,}000$$

Each well was divided into following time categories;

1) Drill-on-Bottom Time: The time when only drilling was in progress i.e., drilling bit was touching the bottom during this time and drilling the formation. A pure drilling activity where only drilling was in progress.

2) Total Drilling Time: It was the time the first BHA was picked up until the well was ready to pick-up completion. It was actual total well duration excluding completion and rig move activities.

3) Flat Time: The time spent on all the activities to support the drilling. For example; Run-in-Hole, Pull-out-of-Hole, running casing, running wireline. The Flat time was a time when the bit was not drilling, but mandatory activities to support the further drilling. It was tracked and monitored in the 25Kft. Below was the formula used to calculate the Flat Time;

4)
$$\text{Flat Time} = \text{Total Drilling Time} - \text{Drilling on Bottom time}$$

Equation 9: Flat Time Calculation

6) Completion Time: The time dedicated to only completion activities until the rig was ready to move.

7) Rig Move Time: The time was moving from one location to another location.

Two major activities of a well, rig move and "in case of sidetrack", were the concerns in the normalized well calculation. The rig-move activity was considered non-drilling activity and depended on the distance between slots or distance between platforms and on move type. Some rig moves took 1 to 3 days, and some rig moves took more than 20 days. So, it was proposed not to consider the rig moves in the normalized calculation. Similarly, in the stuck situation due to any reason, it was difficult for a well to come back to a normal performance curve. So, it was proposed to use gross footage instead of net footage. Below was the final formula:

$$\text{Well days (25kft)} = \frac{\text{Actual well days including completion excluding rig move days}}{\text{Gross Total Footage}} \text{ X } 25{,}000$$

Equation 10: Final calculation for days for 25Kft well

7.1.3 The Concept

Figure 25 shows two different wells; Well A, a 28,421ft long well, drilled and completed in 126 Day and Well B, a 20,975ft long well, drilled and completed in 104 days. The question was raised which well was drilled and completed efficiently. If we compared the actual day, Well A could be considered inefficient well as it was drilled and completed in 126 days compared with Well B, which was drilled and completed in 104 days. But the issue was the length of both wells. The Well A was 28,421ft long and Well B was 20,975 ft. Was it fair to compare different lengths of wells on the same scale? As both wells had the same casing configuration, both wells were converted to the same length, 25,000ft and the result, the days, were compared. After converted to 25,000ft scale using equation 10, Well A would be drilled & completed in 111 days and Well B would be drilled & completed in 124 days. The new analysis confirmed that the Well A was more efficiently drilled well compare with the Well B.

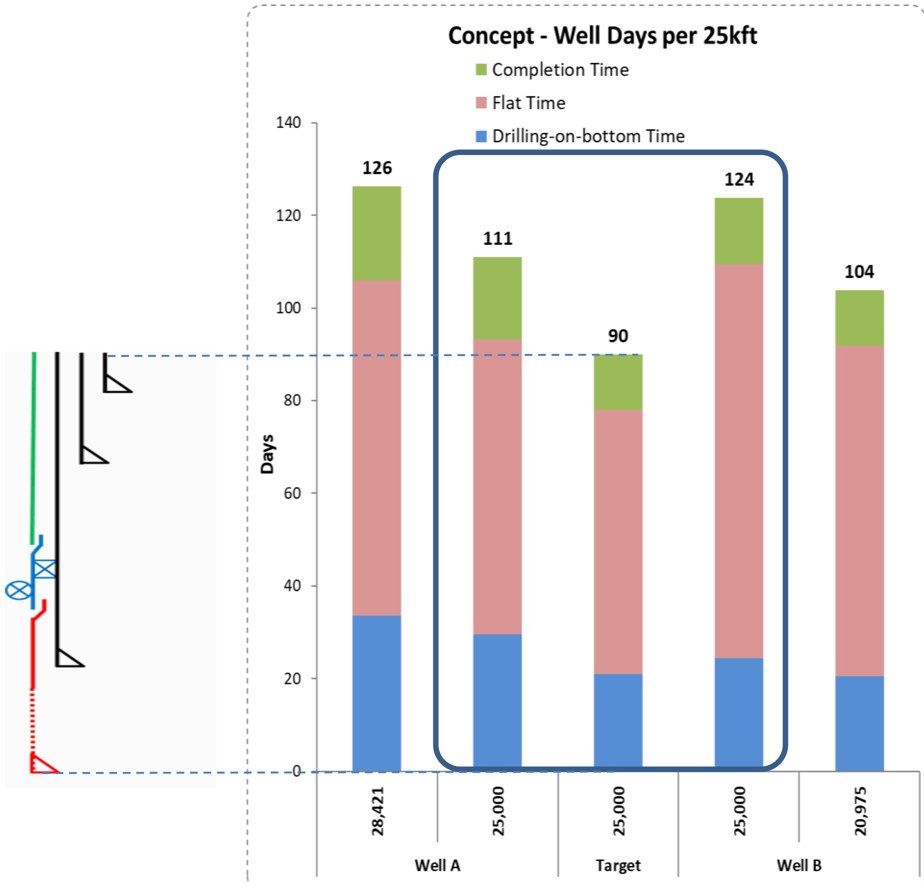

Figure 26: The Concept: Converting Well A and Well B to 25Kft

7.1.4 Target Setting

A similar concept was applied to all wells on the project. Based on performance improvement results from the wells drilled & completed in 2014 and 2015, a trend line was drawn. This trend line shows that at the end of 2016, a 25Kft well should be drilled and completed in 90days. The analysis was discussed with the shareholders who agreed to use this normalization method to set the target. After a discussion with the teams, the target was set to reduce the well days to 90 days on the 25kft scale by the end of 2016. Initially, the response to follow this new method was not fully understood, but after multiple reviews with shareholders and senior management, the concept got accepted and used to present the project performance regularly. Figure 26 shows the well drilled in 2014 and 2015 on a 25kft scale with the trend line. This figure was adjusted to fit on one page. However, it provided the idea of how the target was set. Both Wells, Well A and Well B, drilled and completed in 2015, were not meeting the criteria too. The target set was challenging but not impossible.

7.1.5 Performance Tracking

Performance Tracking and presenting into an attractive format is an art. With various analyses, the author found the best way to present the 25kft data was; well by well (Figure 26) and quarterly analysis (Figure 27). Well by Well calculation was computed using Equation 10, but for quarterly analysis, a different calculation was required. Equation 11 shows the formula for the quarterly analysis.

$$\text{Average Well days (25K ft)} = \frac{\text{Total actual well days for all Wells Completed in the Quarter}}{\text{Gross Total Footage drilled for all Wells Completed in the Quarter}} \text{ X } 25{,}000$$

Equation 11: Average Well Days (25Kft) - Quarterly

Calculating the average well days for the quarter helped to provide a bigger picture to understand the performance of the project after drilling & completing the wells.

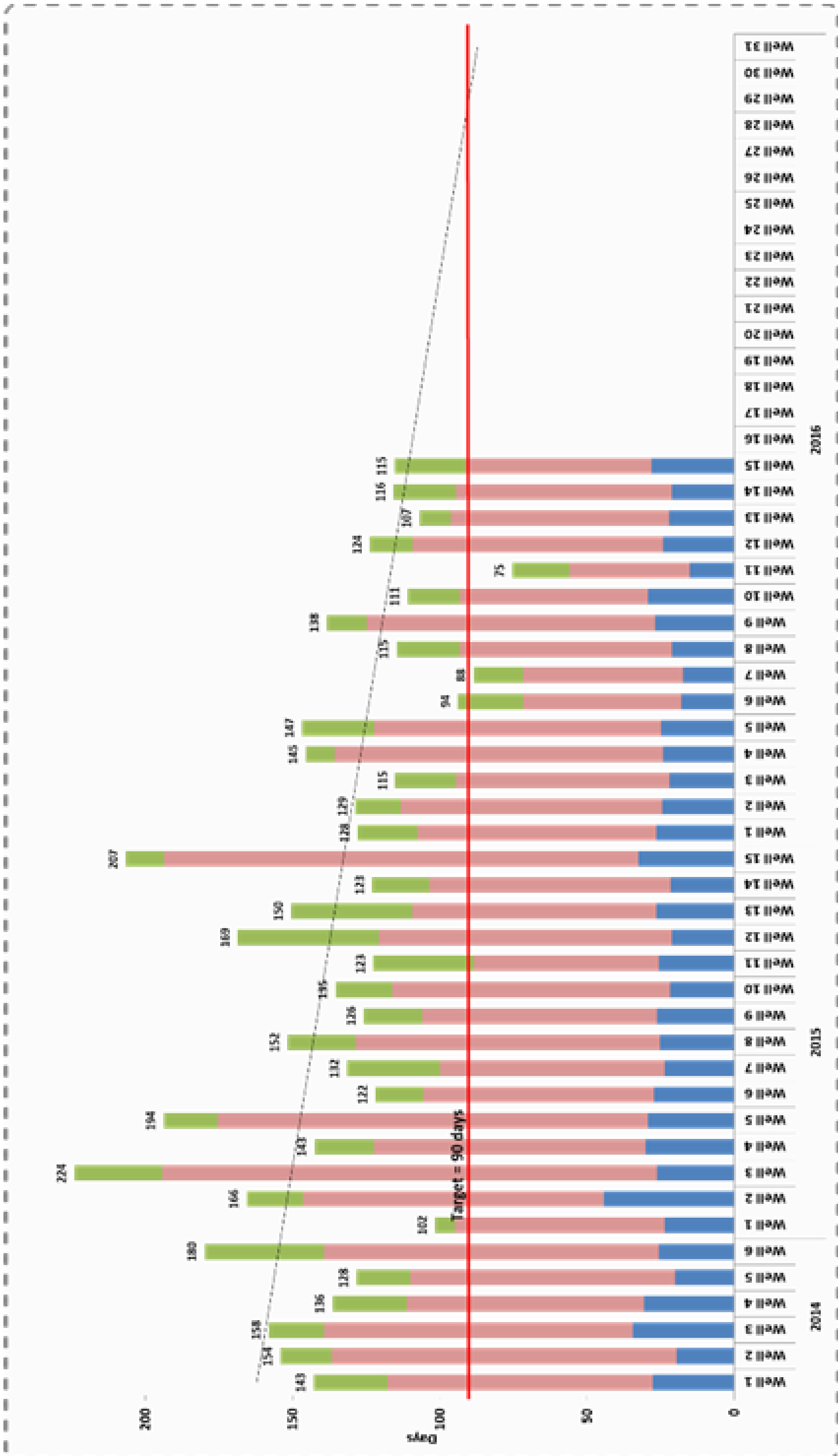

Figure 27: Well days 25kft with target and projection

Figure 27 shows the average well duration for 25kft well against each quarter from 2015 to 2017. The target to achieve 25kft well to be drilling and completed in 90 days was achieved in Q4 2016. It was further reduced to 70 days in Q4 2017. It was the marvellous achievement on the project after implementing the fit-for-purpose knowledge Management practices, commitment from the management dedication of the teams to implement initiatives either process-related or equipment improvement, etc.

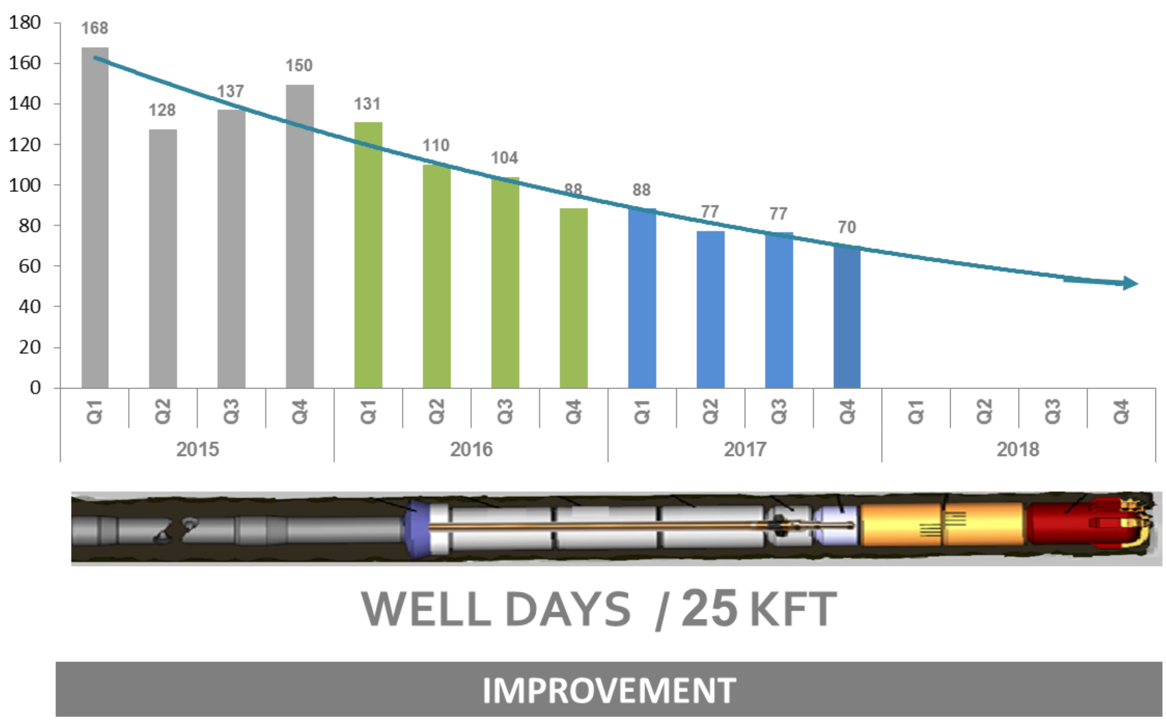

Figure 28: Well Days Reduction

7.2 Level 1, Level-2 and Level-3 KPIs Analysis

Data related to each management KPI from Level-1, level-2 and level-3 were analyzed monthly, quarterly and yearly and discussed with senior management and shareholders in various meetings. Below are some examples of the data analyses observing performance improvement. Each KPI analysis showed year to year performance enhancement.

7.2.1 % Well Delivered

Figure 28 shows the % Well Delivered (Level-1 and Level 2 KPI) overall for the company.

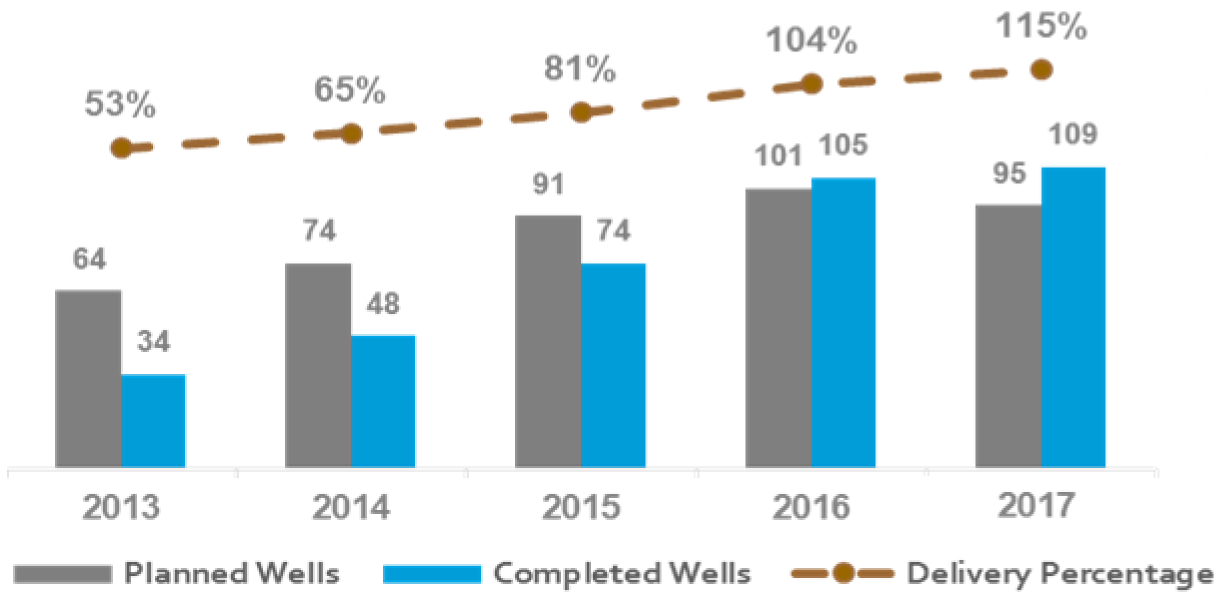

Figure 29: %Well Delivered Comparison (CEO, SVP)

Data Analysis shows that % Well Delivered was proven to be a good KPI for the team, management and shareholders, as it showed a strong sense of achievement. The above graph clearly shows that a continuous performance was increased in Well Delivery, as the teams were cleared on target and became focused on the planned wells to be delivered. % Well Delivered increased from 53% (2013) to 115% (2017). It was the greatest achievement of all the initiatives implemented for the project. As the rig count and performance were increased, the Planned wells were increasing. In 2017, planned well decreased due to a drop in rig count. Regardless the planned wells were increasing or decreasing, but the % of delivered well was continuously increasing.

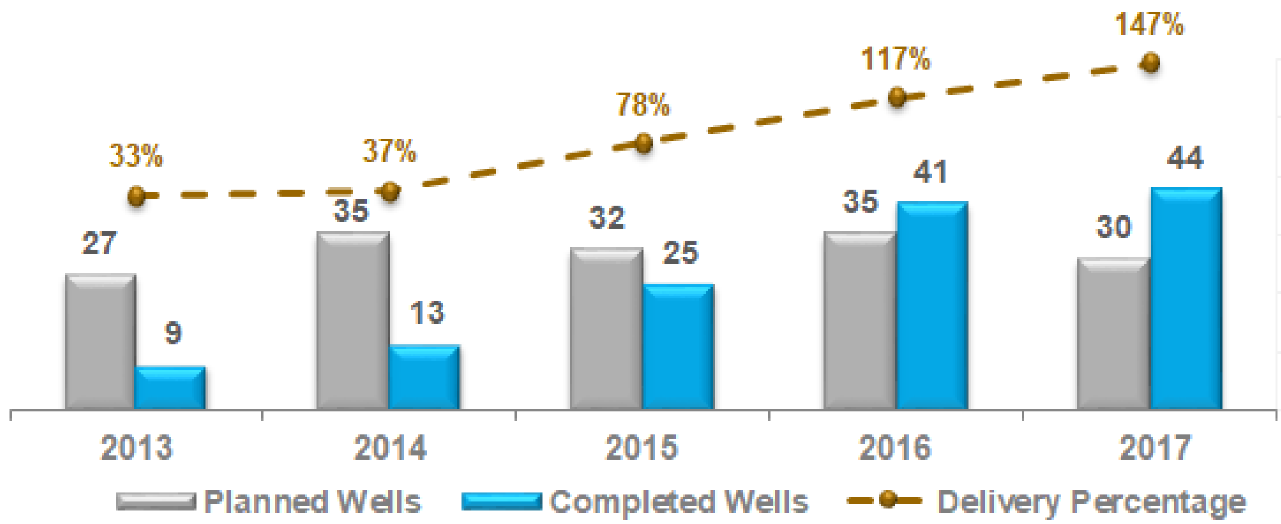

Figure 30: % Well Delivered – Project Wells (VP KPI)

Figure 29 shows the % well delivered for the UZ-750 project from 2013 to 2017. The major achievement in the Well Delivery score for the company was because of the UZ-750 project where % Well Delivered increased from 33% (2013) to 147% (2017).

Figure 30 shows the % of the well-delivered from another team (non-project wells), where the % well delivered was almost constant from 2014 to 2017, as the non-project teams were remained unchallenged and did not consider to implement any initiatives including KPIs. % Well Delivered was proven to be the best KPI for Level-1.

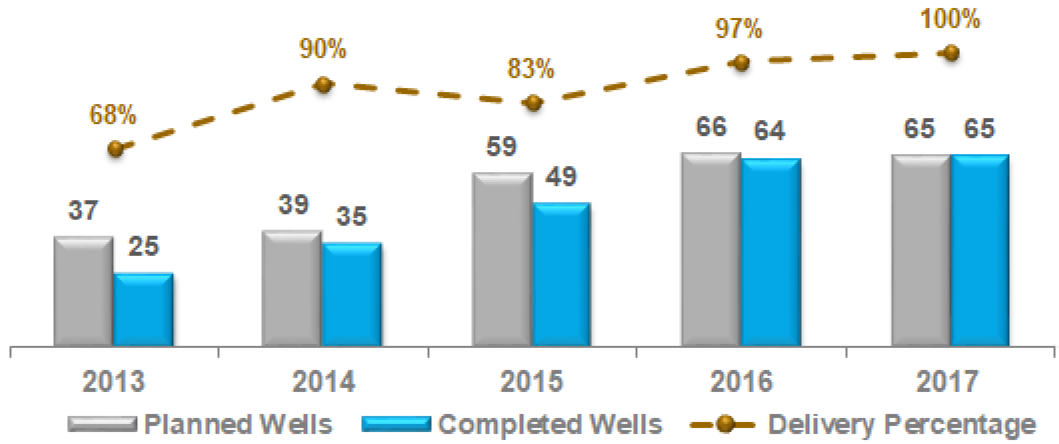

Figure 31: % Well Delivered Non-Project Wells (VP KPI)

The KPI received good attention from all levels as yearly goals very clear; Plan smartly and beat the target by implementing new initiatives.

7.2.2 Well Quality KPIs at Well Delivery

Figure 31 shows the yearly Well Quality KPI score from 2014 to 2017 overall for the company. The Well Quality KPIs represented the quality of the product, the delivered well. The highest KPI score, 98.8%, was achieved in 2016. After Implementation, initial a few years, the teams were learning from the KPI. Overall the quality score of the delivered wells was above 90%. The total score for the project wells for 2017 was 93.5%. Figure 32 shoes the Well Quality KPIs score distribution under all 6 categories for the project wells. Wellbore accessibility and Well Integrity were among the serious issue for the project wells. It was also noticed that the KPIs measurement on the UZ-750 project wells was strictly observed and followed under dedicated engineers. On non-project wells, the Well Quality KPIs were measured by an office admin. So the score calculation was not very precise and lack of engineering sense.

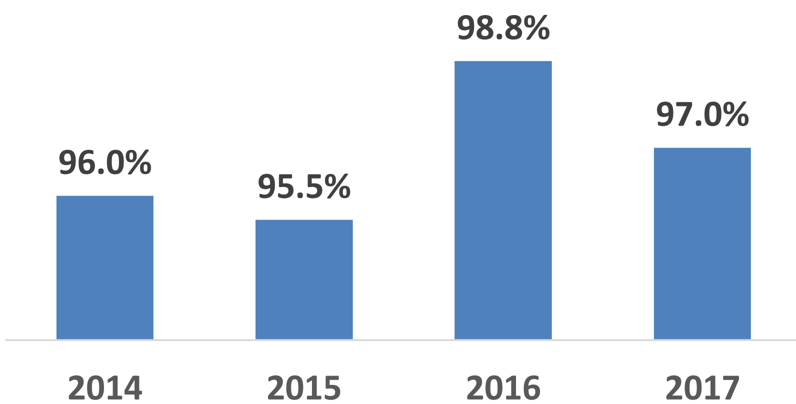

Figure 32: Overall - Well Quality Score

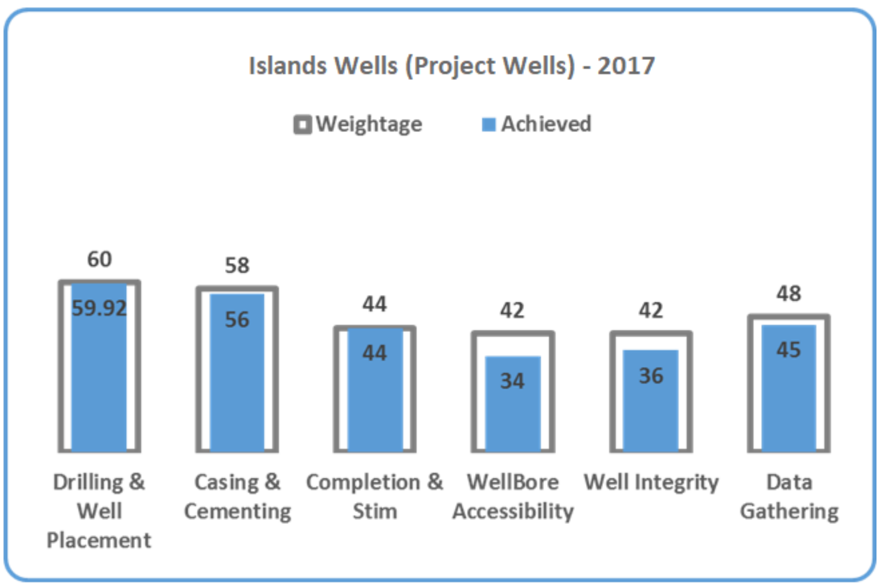

Figure 33: Well Quality (Delivery) Breakdown for UZ-750 Project Wells -2017

Later, it was recognized to unify the KPI process overall for the company. Besides the unification of the process, the need for the training & development of engineers was recognized to standardize the competency level among Engineers and other staff.

7.2.3 Drilling Efficiency (New)

Figure 33 shows the Drilling Efficiency (New) for 2016. Total Drilling Efficiency for the company was 106%. Drilling Efficiency for the project wells was 111%. Drilling Efficiency for the Re-entry well was 73%. The main reason was low drilling efficiency for re-entry wells the uncertainty in the well killing, pulling old completion, existing casing conditions and side-track options. A single under-performed well could have a high impact on the overall drilling efficiency of re-entry wells.

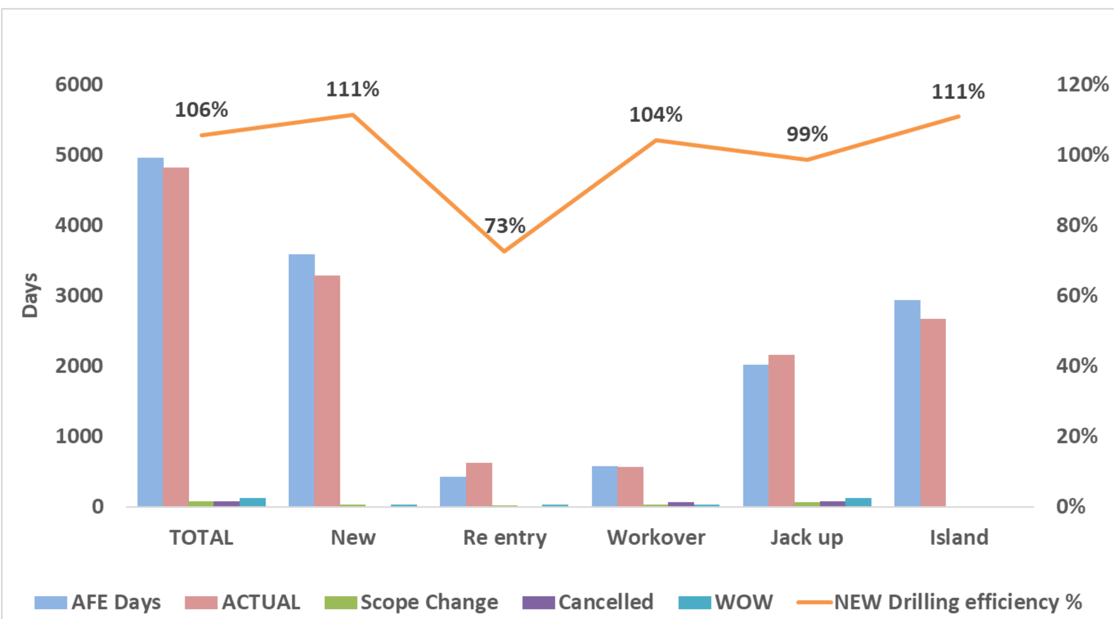

Figure 34: Drilling Efficiency (New) – 2016

Figure 34 shows drilling efficiency for the 2016 project wells. First 8 well of 2016 the Drilling Efficiency was 101% and the last 8 wells of 2016 the Drilling Efficiency was 133%. A significant improvement in the last part of the year was observed.

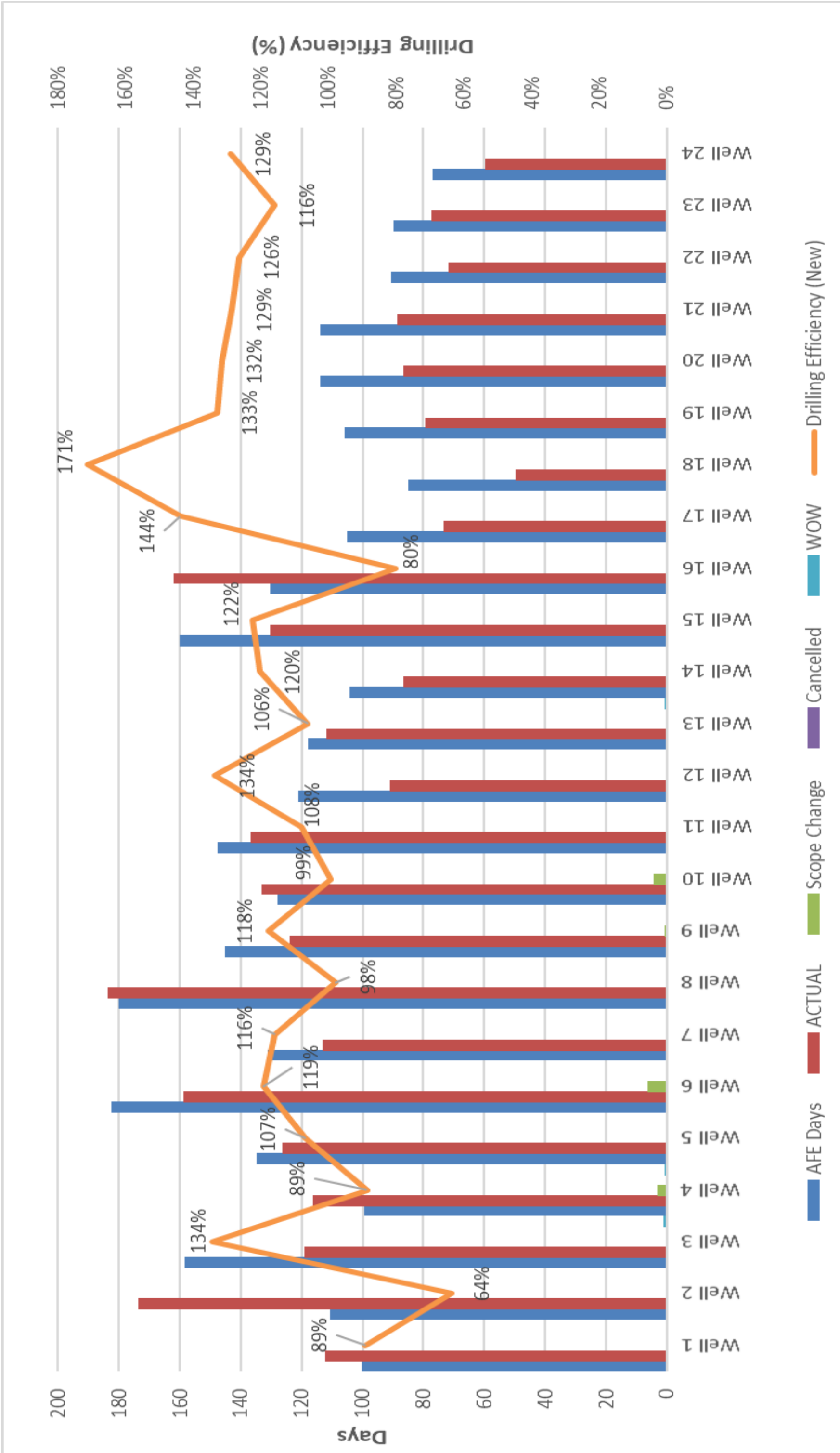

Figure 35: Drilling Efficiency of the project wells for 2016

Figure 35 shows the Drilling Efficiency (New) for all the Island rigs on the project for 2016. Drilling Efficiency on all the rigs was above 100% except Rig 3. Rig 3 experienced multiple types of equipment related and drilling tools related failures resulting in low drilling efficiency. The results calculated in the figure were based on the completed wells in 2016 regardless well was started in 2015 because it was practically impossible to calculate the Drilling Efficiency (DE) in the middle of a well. So, as a well got completed, DE was calculated.

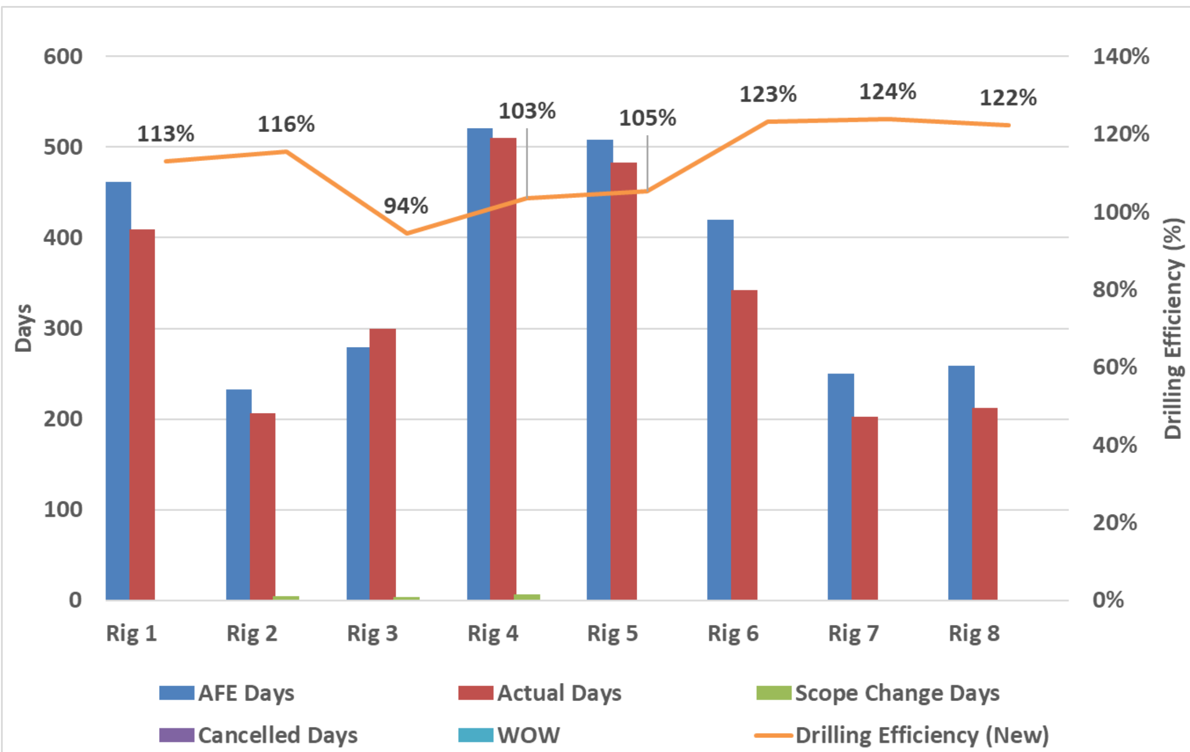

Figure 36: Drilling Efficiency (New) for Project Rigs

7.2.4 Rig Utilization

Figure 36 shows the rig utilization on the project wells based on equation 4 calculation for all rigs. Figure 36 shows the Rig utilization improved over time. Average rig utilization was

73.3% for 2016 for project rigs and 74.8% for 2017 for the project rigs.

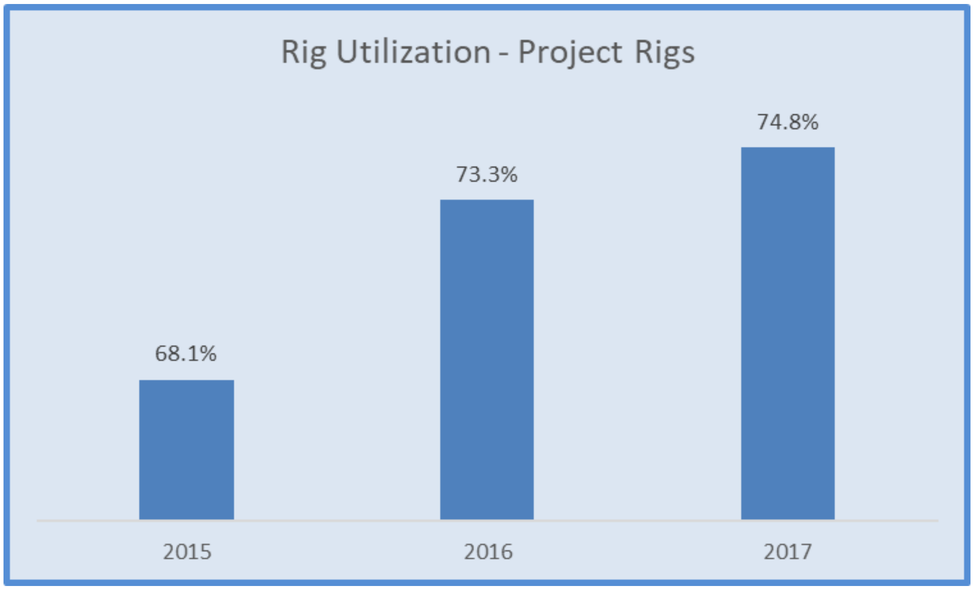

Figure 37: Rig Utilization for Project rigs

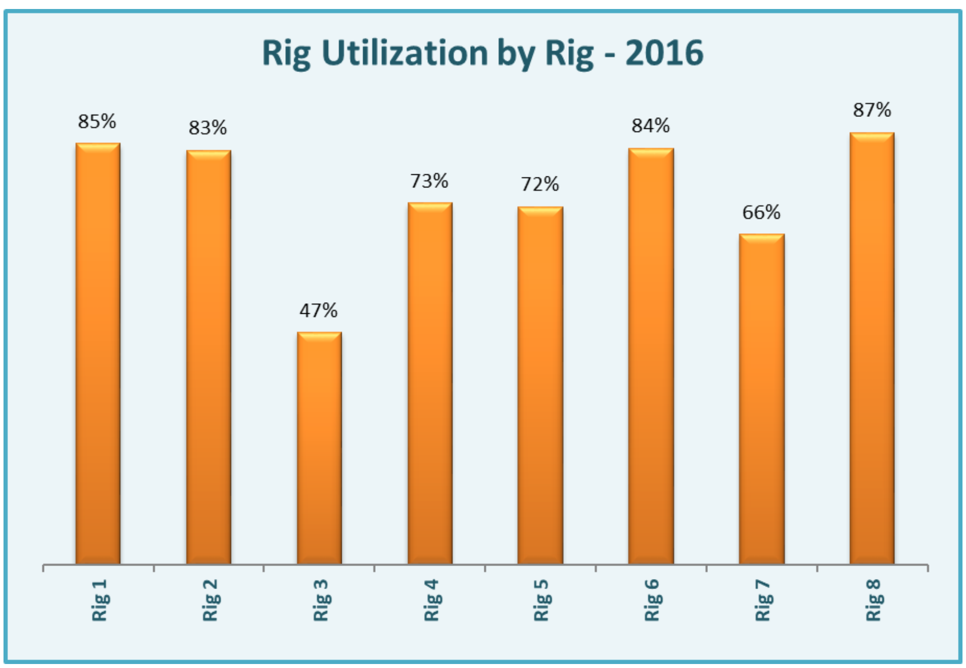

Figure 38: Rig Utilization by rig for 2016

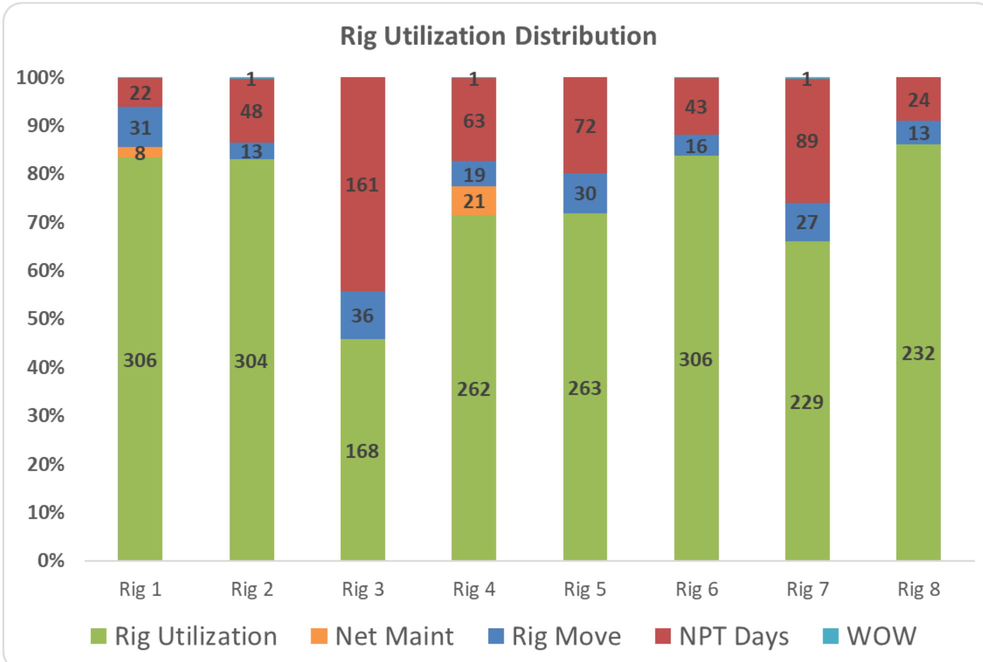

Figure 39: Rig Utilization - Breakdown

Figure 37 shows the rigs utilization for each rig for 2016. Rig 3 had 47% of the lowest rig utilization among all other rigs. Figure 38 shows a breakdown analysis to show the breakdown of the rig days for each rig. Rig 3 shows high NPT days compare to other rigs. High NPT on Rig 3 was the major contributor to low rig utilization. Rig Utilization became a very helpful KPI for the operations team to focus on each rig for higher productivity. The KPI also identified the teams who were working efficiently and the teams who needed management attention to make changes to improve team efficiency.

7.2.5 % NPT

This KPI, %NPT, was highly monitored and discussed every performance review meeting.

%NPT became the most important KPI and many analyses were conducted as the KPI had a direct and indirect relationship with all KPIs. A high NPT on a well-affected many KPIs such as Drilling Efficiency, Rig Utilization, and % Well Delivery. So management all every level was interested to learn more NPT to have better control over it. The author had done various analyses to have a better awareness of the issues and set detailed guidelines to capture accurate information. Detailed statistical analysis was done regularly to identify the critical issues related to the performance of different rigs. These activities were benchmarked easily to compare the progress over a period.

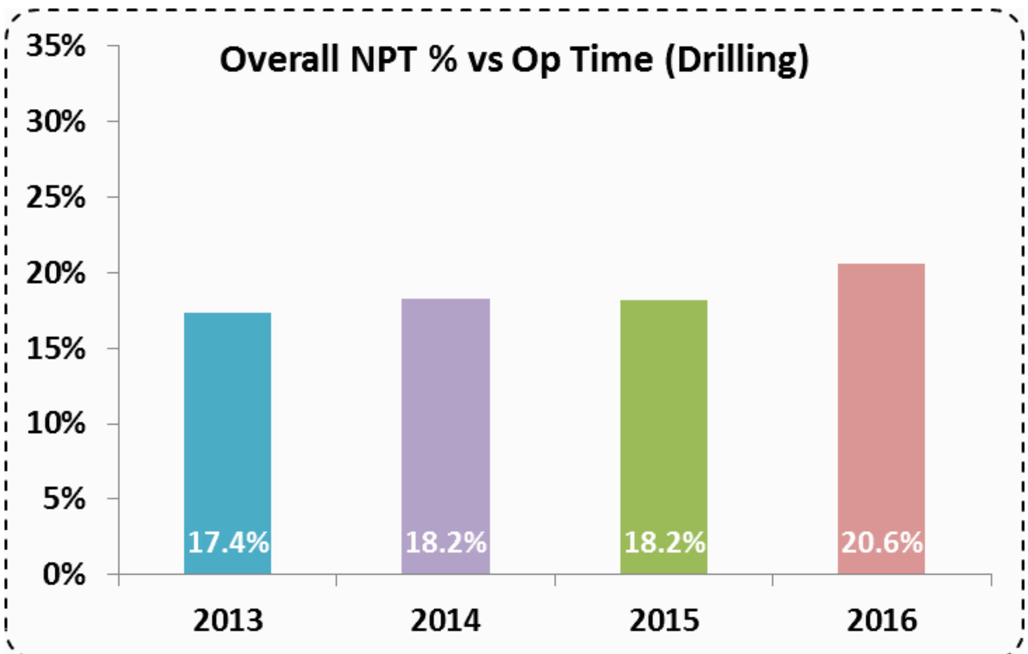

Figure 40: Overall NPT %

Figure 39 shows the overall NPT% of the project from 2013 to 2016. Figure 40 shows the overall NPT % based on fleet type, Island, and Jack-up. As Figure 39 shows, NPT% for drilling was consistent over four years, but Figure 40 shows that overall NPT% for the project was reducing over the same period. A significant and continuous NPT reduction over time was observed on the Island project. NPT was reduced from 29% of the total operating time in 2013 to 19% of the total operating time in 2016.

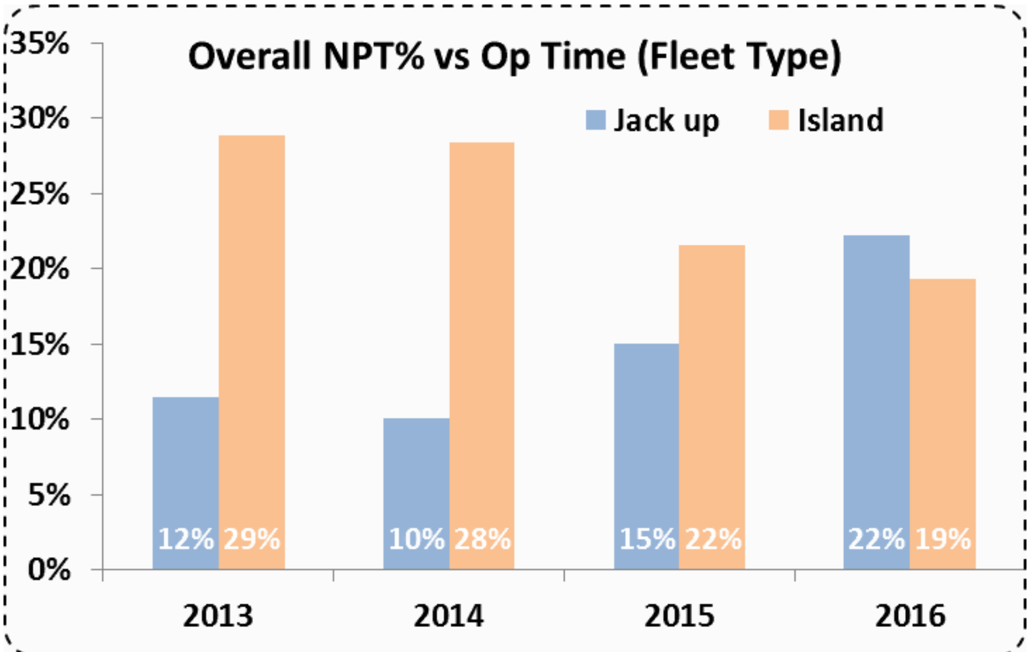

Figure 41: Overall NPT % (Fleet Type)

Figure 41 shows the NPT% for all the project rigs for 2016. Rig 3 had the highest NPT for 2016. 42% of the total operating time was lost time and rig was not productive for the duration. Due to high non-productive time, at Rig 3, the drilling efficiency and rig utilization were also low, which shows the direct relationship with NPT %. So it was concluded on many occasions if a good overall KPI score was required, then control the NPT.

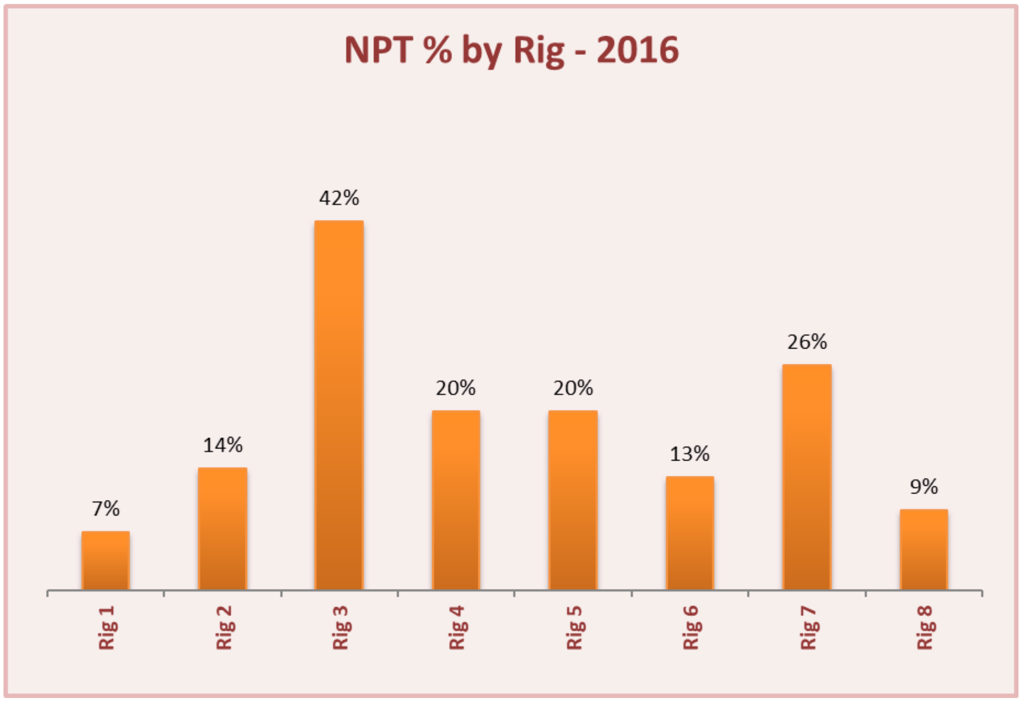

Figure 42: NPT% for Project Rigs for 2016

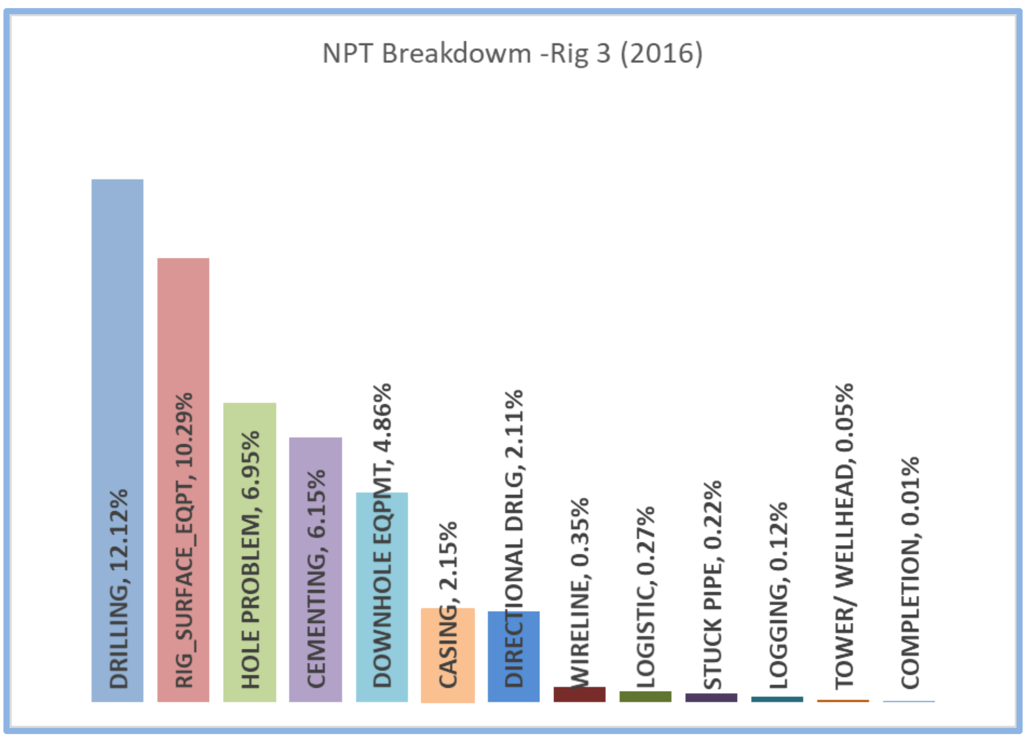

Figure 43: NPT Distribution – Rig 3 for 2016

Figure 42 shows the NPT break down on Rig 3 to identify the major areas of the failures. A further analysis was made using NPT / NCR investigation system to identify the root causes of the failures at Rig 3. Figure 43 shows the Root cause categories of the failures for Rig 3.

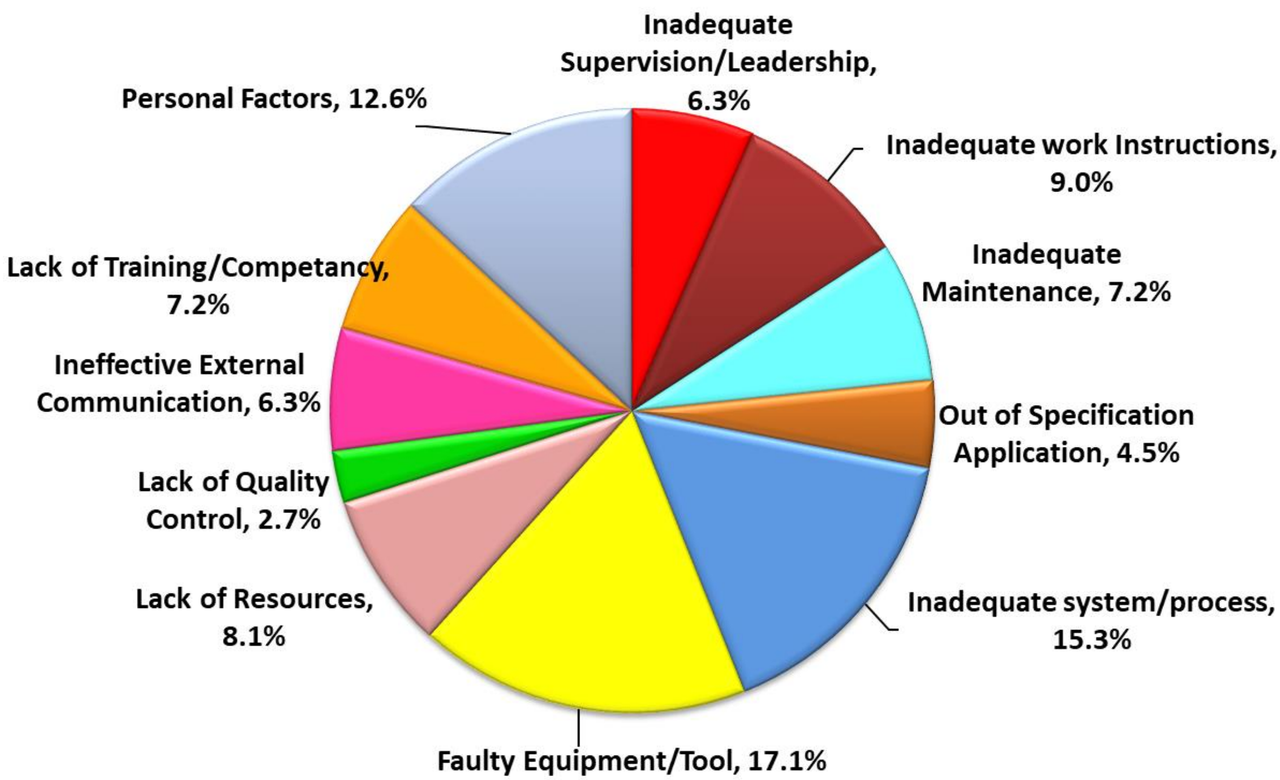

Figure 44: Root Cause Analysis for Rig 3 (2016)

With the implementation of new NPT coding, NCR/Investigation and guidelines to record NPT helped to have good data for better analysis and to develop long term actions to improve the performance of each rig and overall the project. A detailed NPT analysis shows that how we can use the conventional data in a modernized way to get maximum output for the decisions. A detailed 2016 NPT analysis is also discussed below confirming data availability for better analysis.

7.2.5.1 2016 NPT Analysis

NPT of 2016 was analyzed further to identify the areas to improve. Figure 44 and Figure 45 show the distribution of the NPT into different categories. Figure 44 shows the number of NPT days against each category. The analysis became very useful to calculate the cost impact due to certain failure category. The cost analysis helped to manage the resources accordingly to minimize the NPT. Rig daily rate depended on various factors. If we assumed $125K per day for a rig at the project, so only $41.6 Million were lost due to the Hole Problem. With the sum, 2-3 wells can be drilled extra. So cost analysis helped to get a better understanding of NPT.

Figure 45 shows the categories in % NPT to overall NPT. This highlights clearly to focus on high NPT areas. Areas for improvement were selected for further investigation and analysis for improvement. Three highlighted areas where the NPT % was very high, were;

- Hole Problems
- Rig Surface Equipment
- Logistics

A further detailed analysis was conducted in each category to narrow down the actual problem, so a further investigation could be conducted to apply accurate learning and to assign appropriate resources. Below data analyses confirmed the ability of the system and availability of data to breakdown the capture NPT categories in further sub-categories to fix the trouble areas.

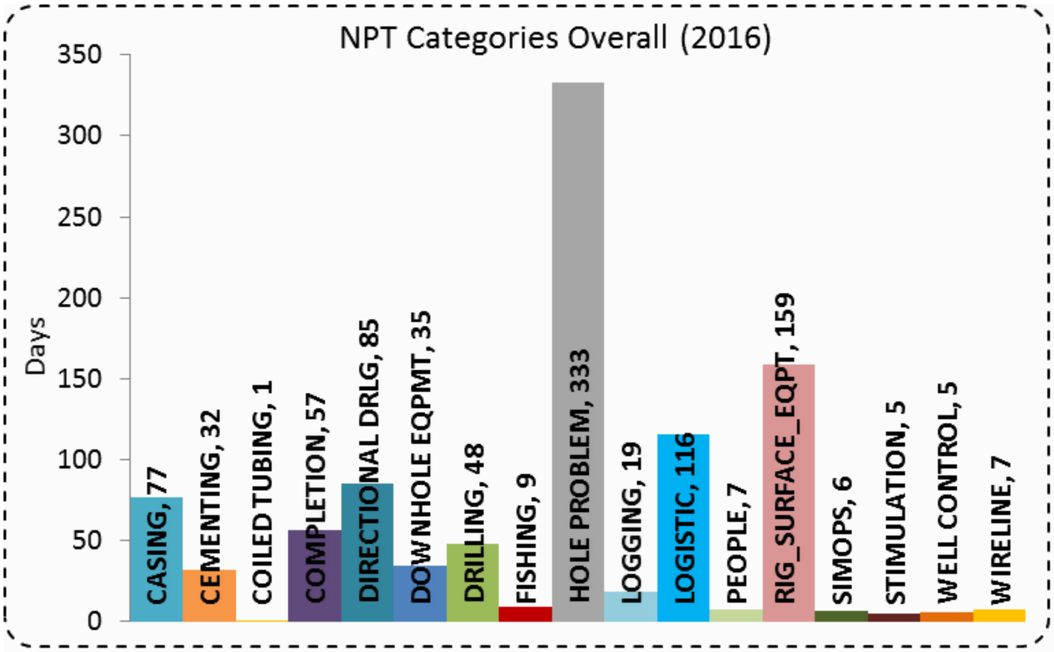

Figure 45: NPT Categories (Days) – 2016

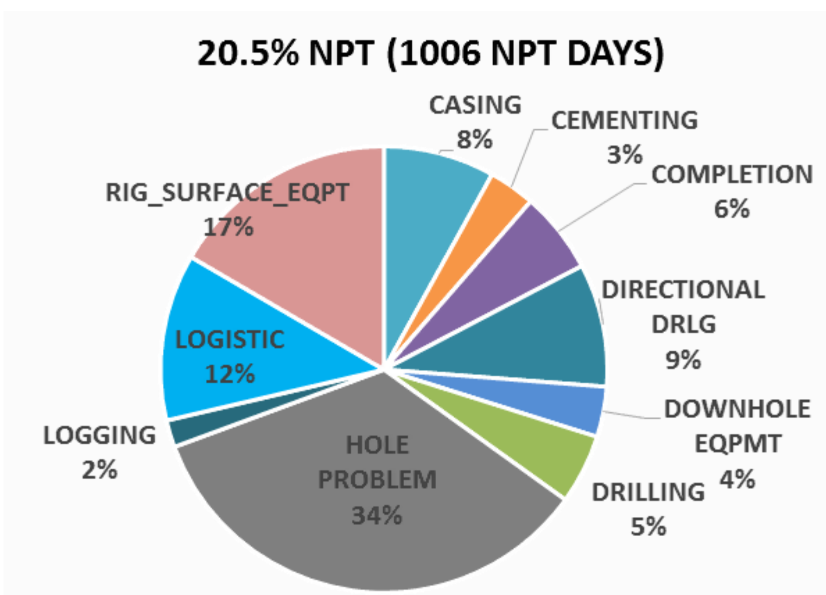

Figure 46: NPT distribution - % of NPT - 2016

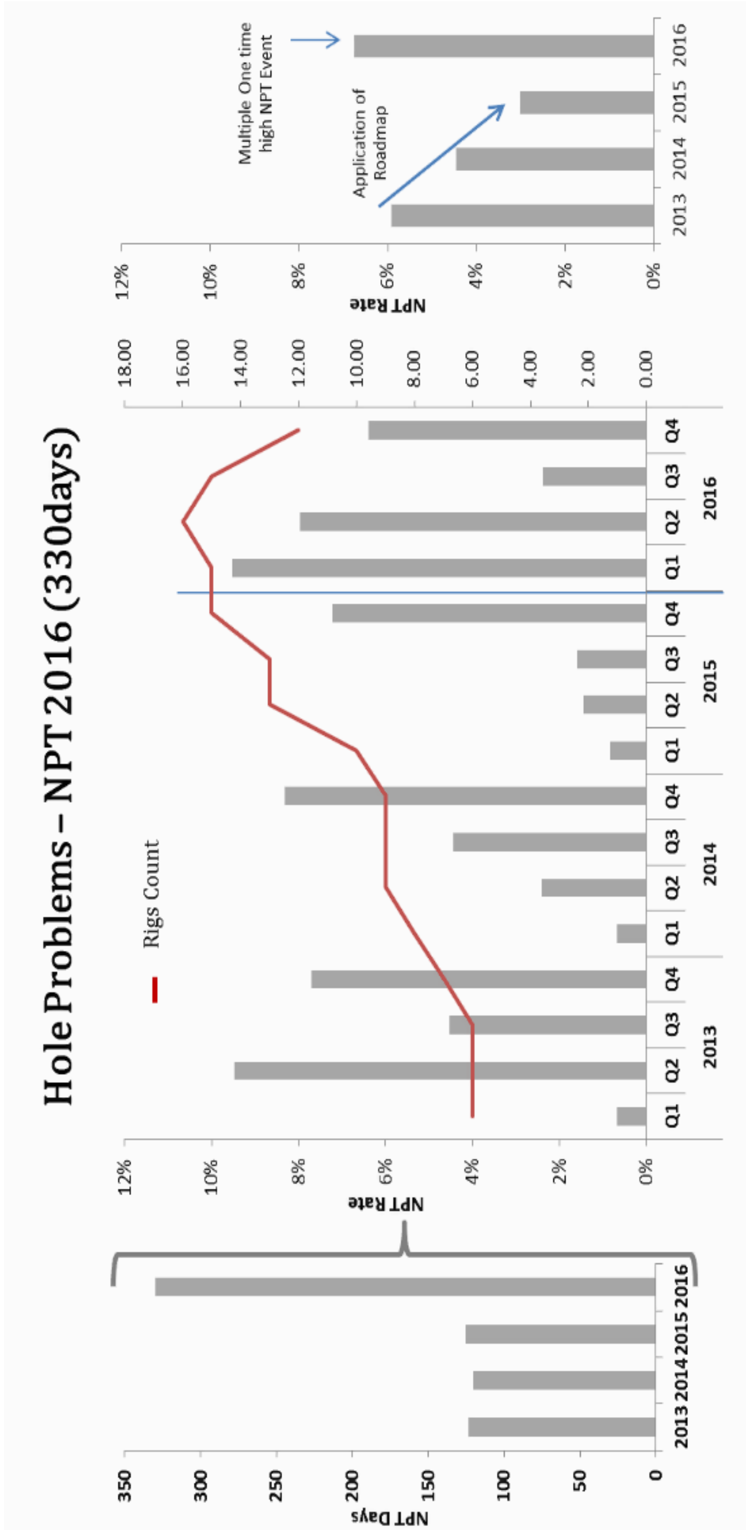

Figure 47: Analysis of Hole Problem NPT (Days & %)

7.2.5.2 Hole Problem NPT (2016) Analysis

Figure 46 shows a detailed analysis of Hole Problem NPT over a large-scale (yearly comparison) and small-scale (quarterly comparison) to observe the trend based on results of previous years and quarters to evaluate the change and analysis over a period. Figure 46 clearly shows that sudden, one-time events in 2016 had caused the Hole Problem NPT. Each one-time event was evaluated in detail. Figure 47 shows the further distribution of Hole Problem NPT into subcategories to get appropriate attention.

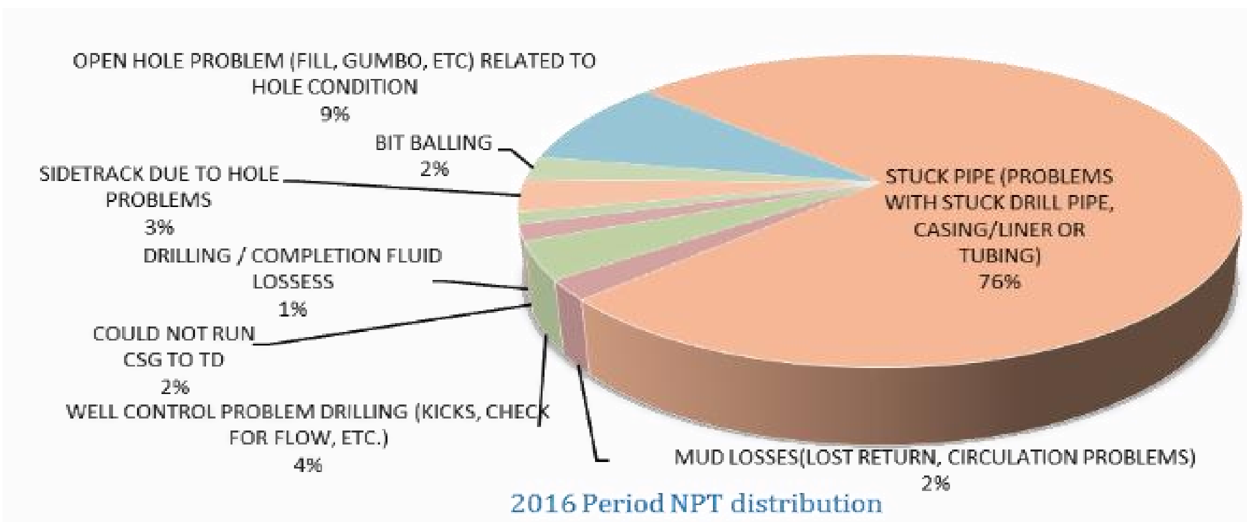

Figure 48: Hole Problem NPT breakdown - 2016

Figure 51 shows the stuck pipe event comprised 76% of the total Hole Problems reported for 2016. A task force was established to look into further detail and minimize the stuck pipe events and open Hole Problems related to the hole conditions. The taskforce came with some good recommendations with a technical enhancement for drilling such long wells. Kick-off point, Open Hole kick-off practices and inclination angle for sailing were improved.

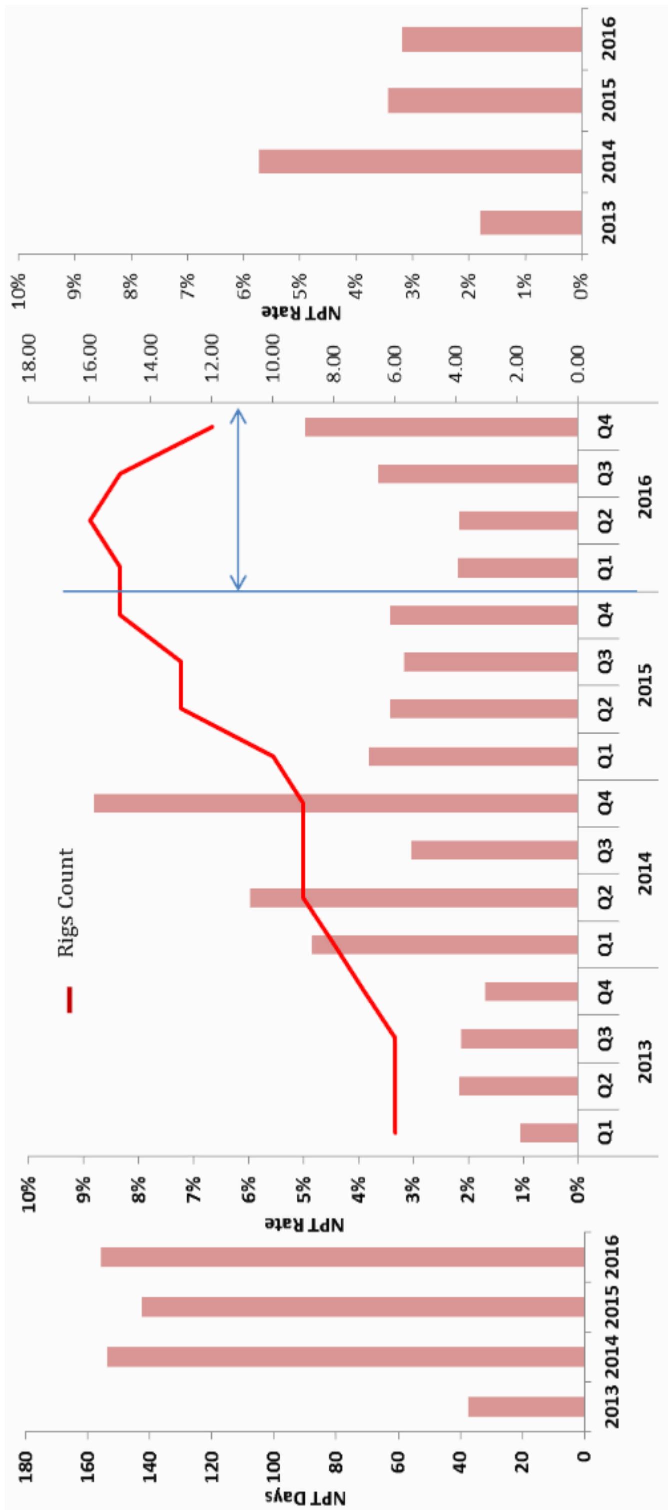

Figure 49: Analysis of Rig Surface Equipment NPT (Days & %)

7.2.5.3 Rig Surface Equipment NPT (2016) Analysis

Figure 48 shows a detailed analysis of Rig Surface Equipment NPT over a large- scale (yearly comparison) to small-scale (quarterly comparison) to observe the trend based on results of previous years and quarters and to evaluate the change and analysis for a period. Figure 48 clearly shows that the rig equipment related NPT had increased over the last three years. The further separate analysis shows NPT was not increased, except in the reporting. Before rig equipment, NPT was not monitored closely and not reported by teams in a timely fashion in the system. Figure 49 shows the further distribution of Hole Problem NPT into subcategories to get appropriate attention. 43% of the rig equipment failures were related to Top Drive. Many meetings between rig management and company management occurred to reduce the rig equipment NPTs, especially TOP drive failures. A significant drop in NPT was observed in early 2017, reducing the overall NPT % related to rig equipment to 1.3%.

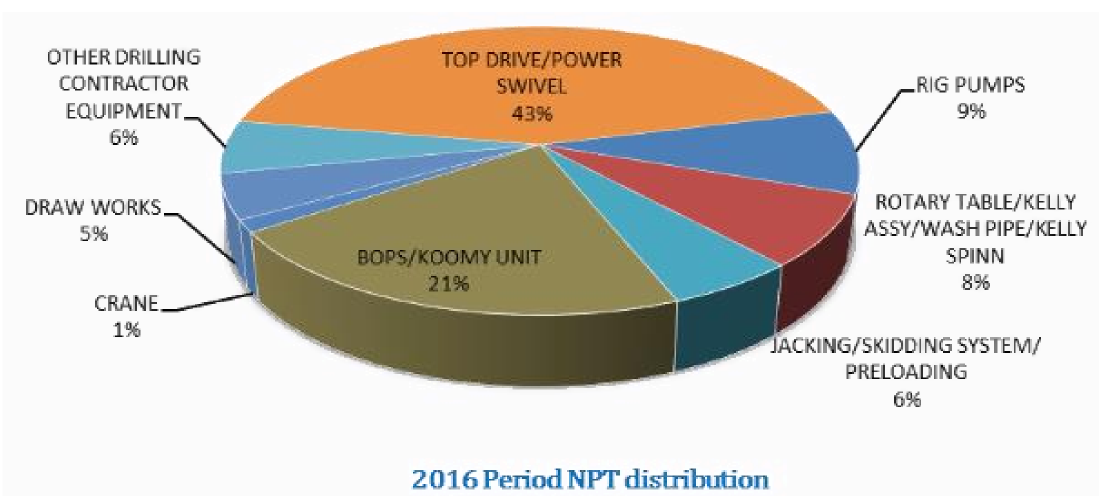

Figure 50: Rig Equipment NPT Breakdown - 2016

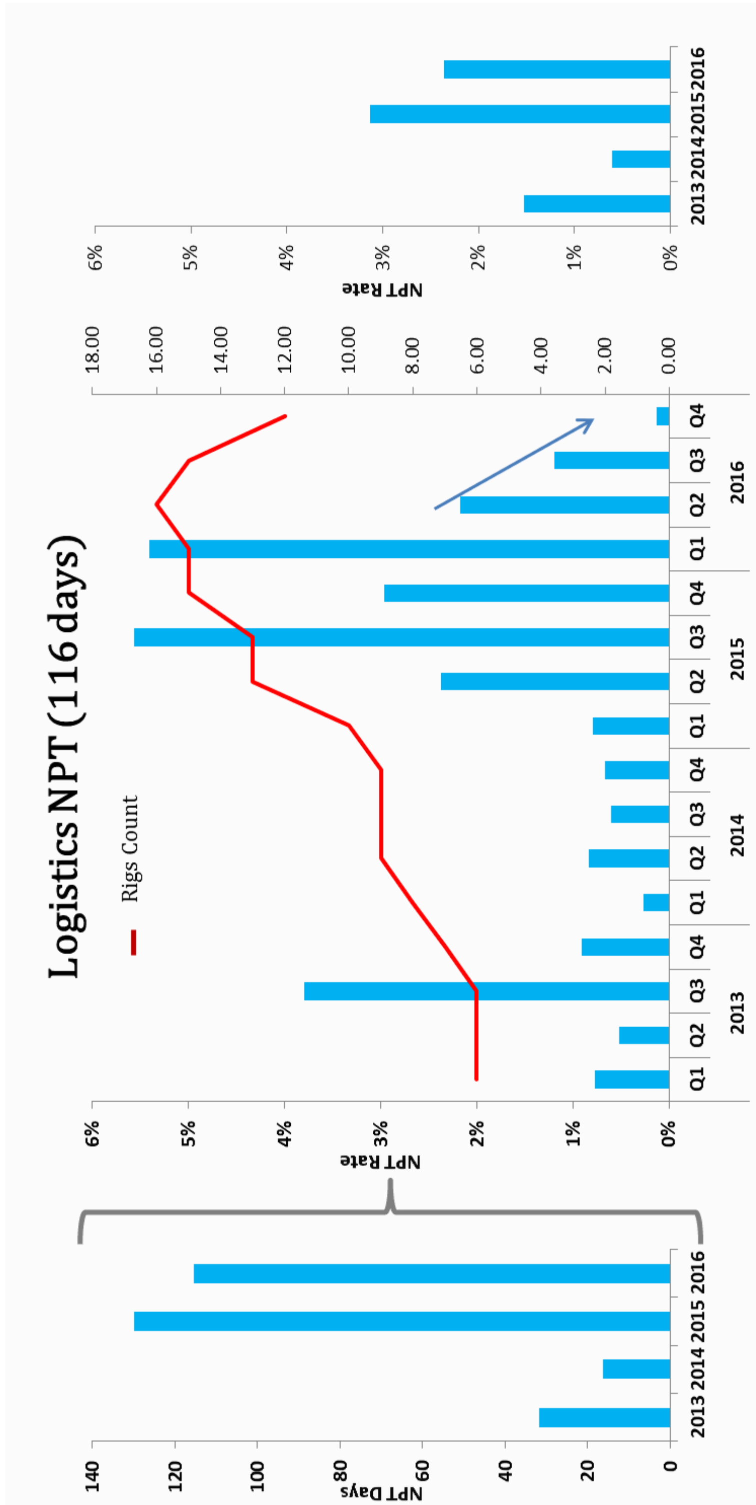

Figure 51: Analysis of Logistics NPT (Days & %)

7.2.5.4 Logistics NPT – 2016

Figure 50 shows a detailed analysis of Logistics NPT over a large- scale (yearly comparison) to small-scale (quarterly comparison) period to observe the trend based on results of previous years and quarters to evaluate the changes and analysis over time. With the increase of rig count, logistics NPT increased significantly. This raised serious concerns among the management of the company on logistics capacity. Figure 51 shows the distribution of Logistics NPT in further sub-categories. Supply boat management was pointed out as the highest NPT area to be fixed immediately. Shareholders formed a task force at the senior level to look into the logistics capacity and management skills and to identify the bottleneck in logistics management. Significant improvements were made in logistics in 2017 after making multiple organizational changes within the company and assigning increased resources to the logistics.

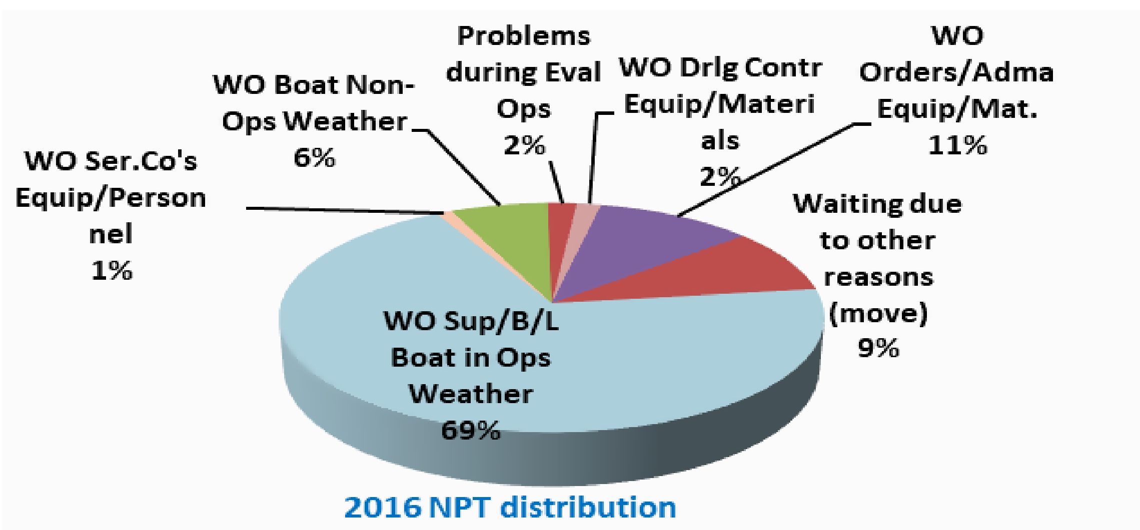

Figure 52: Logistics NPT Breakdown - 2016

7.2.6 FT/Day

FT/Day simply defined the total footage drilled in a day. Figure 52 shows the FT/Day for the project wells for over 3 years. FT/Day was increased by 94% in 2017 compared to FT/Day in 2015. It was a huge success story for the project. Continuous improvement over the years was an indication of the right approach taken at the start of the project.

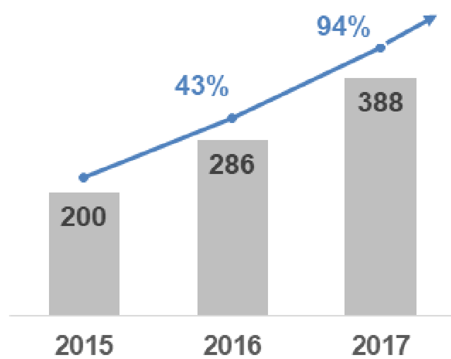

Figure 53: Average FT/Day for project wells over 3 years

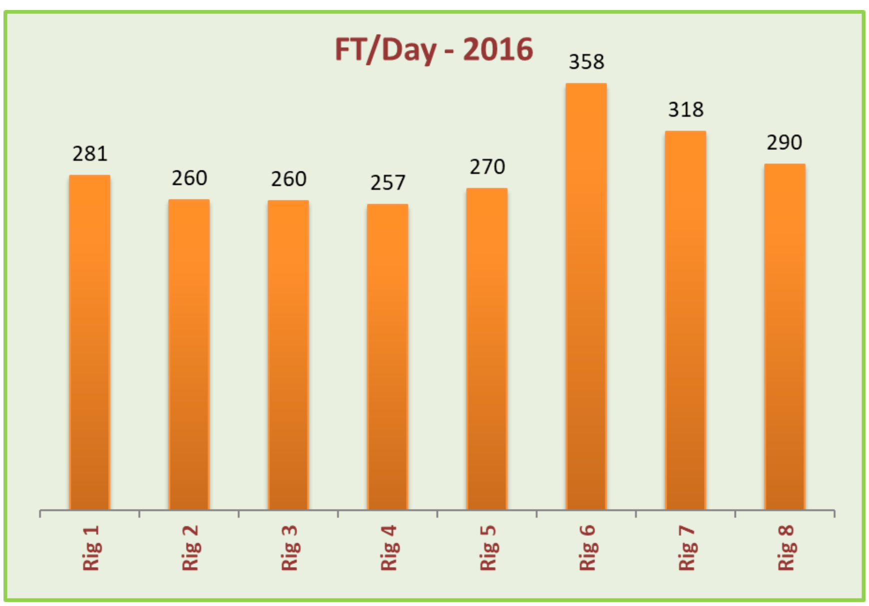

Figure 54: FT/DAY by Rig - 2016

Figure 53 shows the FT/Day for the project rigs for 2016. Rig 3 reported one of the lowest FT/Day for 2016. After implementing major changes and enhancement, Rig 3 showed high FT/Day in 2017. Figure 54 shows the FT/Day for the project rigs for 2017. Rig 3 became one of the most efficient rigs for 2017.

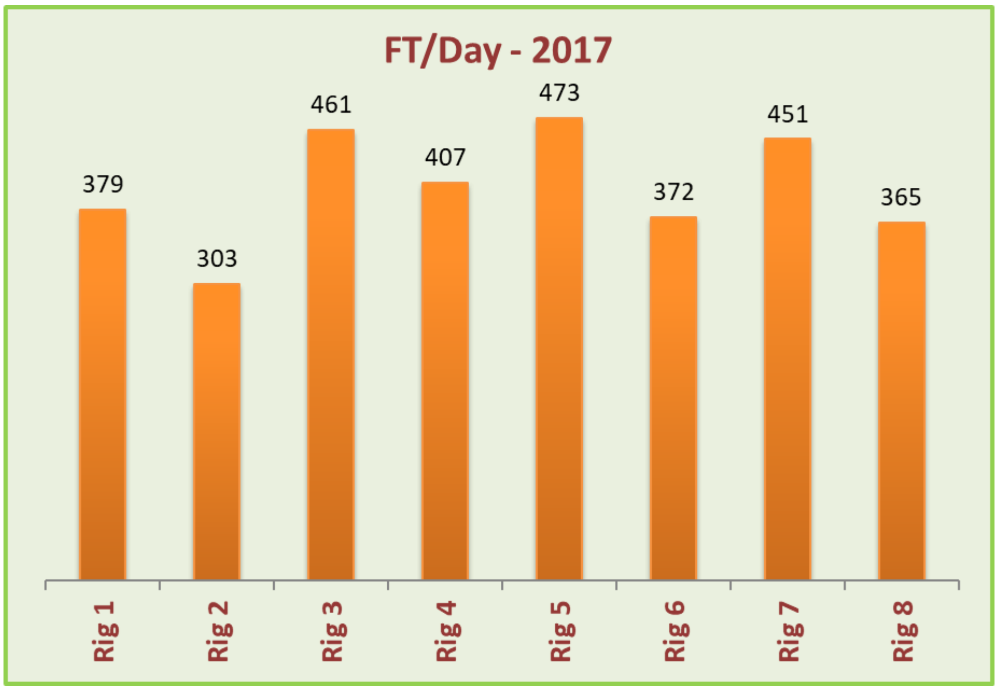

Figure 55: FT/DAY by Rig - 2017

7.2.7 Miscellaneous Data Analysis – NPT/NCR Investigation Request

Figure 55 shows the NPT/NCR Investigation requests were captured in the portal over 5 years period. NCR system was utilized very well. In 2016, an average of 40 NCR/NPT investigation requests per month was recorded, a 226% increment compared to 2012 where 12 NCR /NPT investigation requests were recorded per month.

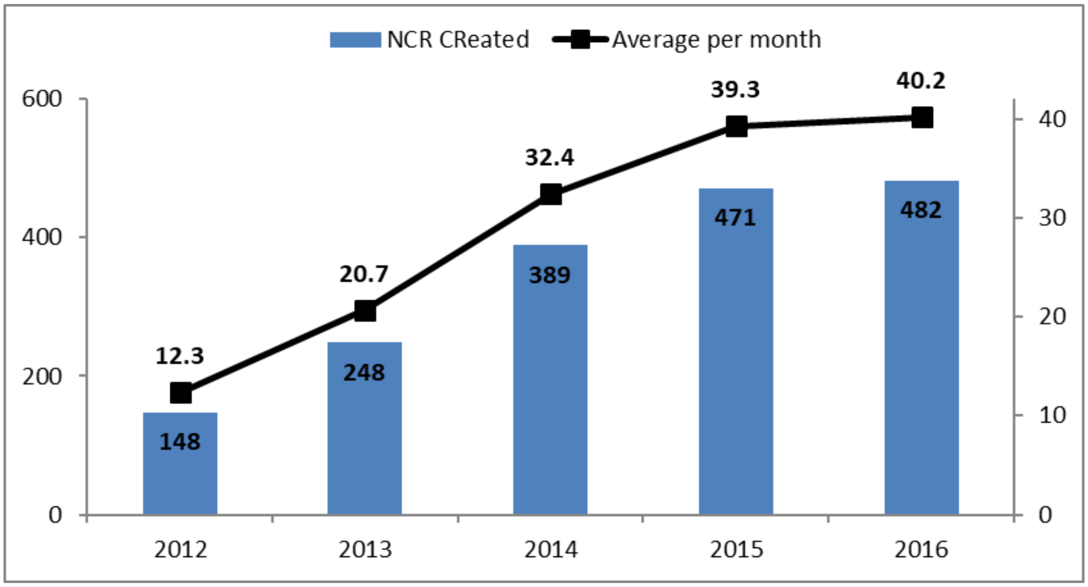

Figure 56: NCR report per year over 5 years period

NCR/NPT investigation request became one of the successful processes which were used very efficiently by the drilling teams. Approximately 1900 NCRs had been logged by May 2017.

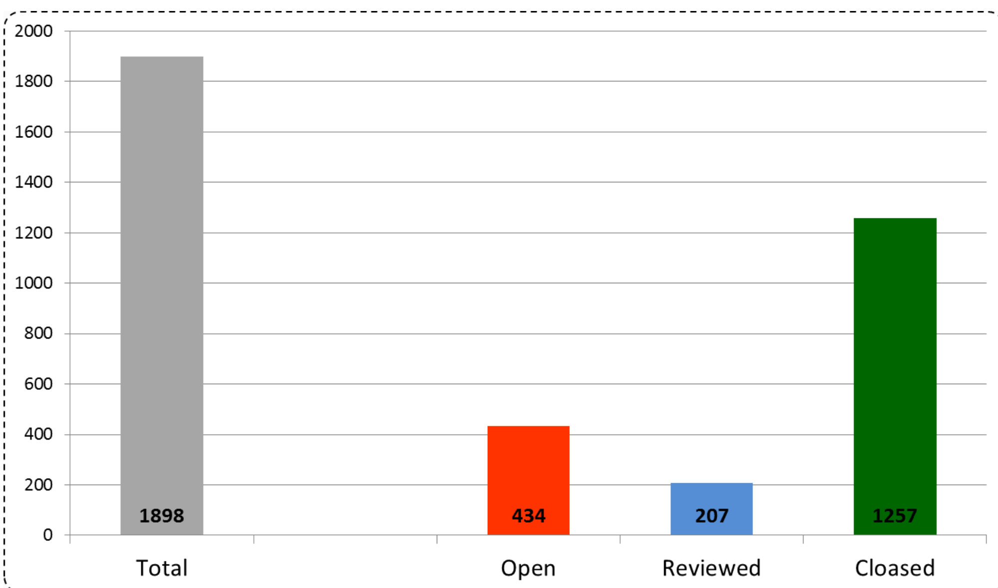

Figure 57: NCR Status (May 2017)

Figure 56 shows the current status of NCR and the number of counts. Figure 57 shows NCR utilization by fleet type. The Figure expresses the benefits of the NCR process on the Island project wells, where NPT significantly dropped from 29% of the operating time in 2013 to 19% of the operating time in 2016. Jack-up teams did not use the process as aggressively as Island teams did. A difference in overall efficiency was obvious. A significant and gradual impact was observed on the Non-Productive Time reduction over a four-year interval.

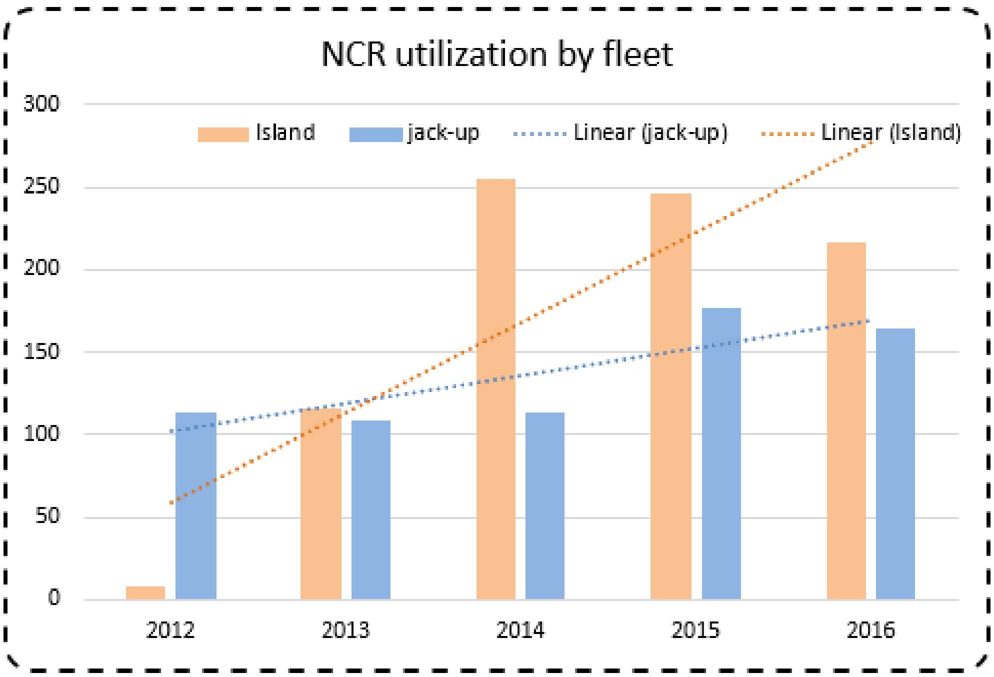

Figure 58: NCR utilization by Fleet type

CHAPTER 8: Conclusion and Way Forward

Based on the work accomplished, many conclusions and recommendations were observed. These conclusions and recommendations are discussed in this chapter. Later, some ideas are also proposed in the way forward section for the project and the company to achieve further performance enhancement on the project. Application of Artificial Intelligence and real-time performance monitoring will bring significant value for the project. With the availability of different Data applications across the company, Data Integrity became challenging. The solution to such Data Integrity issues is discussed in the way forward.

8.1 Conclusions and Recommendations

Below is the list of the conclusions and recommendations collected from the initiation to execution phases of the project. These conclusions and recommendations represent the useful learnings learned during the developing and implementing Knowledge Management practices and performance indicators for the project.

a) The need for Knowledge Management even at a limited level is a must for any project performance.

The information gathered through a Knowledge Management exercise became very useful for the project and converted the results into reduced well cost, reduced project cost and high-quality wells delivery. Depending on the resources, a comprehensive Knowledge Management System for a project may not be practically possible, however, any Knowledge

Management Practices at any level will convert the lessons learned into improvements resulting in cost and time saving with high-quality products. The need for Knowledge Management even at a limited level is a must for any project performance. A little but efficient Knowledge Management process will collect valuable information, which can be transformed into a future investment. This investment can bring considerable savings in the form of man-hours, optimized tools, etc., for other projects, not only to improve the quality of products but also to increase the chances to succeed.

b) Implement KPIs as early as possible to a Project, especially in an initiation stage remove the myths as soon as possible to avoid building resistance among teams.

Key Performance Indicators play a significant role in any project. These KPIs must be set as early as possible to be aligned with project goals such as cost, schedule, and quality, and to be measured against the approved plan. Each project may face some myths, which need to be overcome with effective project delivery tactics. While tracking the performance on the mega drilling project, the following two myths were observed and reversed with strong logical arguments and the appropriate support:

- Why are KPIs required for a new project, as the project is not fully established yet and KPIs are required only for the developed activities?

This myth was pushed back by consistently monitoring and reporting of project KPIs, regardless of resistance. Initially, the project KPIs such as "25kft well duration" was introduced for reporting purposes. Later it became part of the Level-1 milestone.

- Old KPIs cannot be challenged as experts made them and we have been tracking from many years

This myth was very challenging and can damage the project outcome easily, especially Quality. Many logical examples were used to convince management at every level by the different members. The Well Quality KPIs were an example that, initially, all parties refused to discuss, as KPIs were made by the experts a long time ago and were being used across all companies for a long time. This myth was overcome by the authority of the VP Drilling to used only for the project wells. After project teams were aligned, KPIs was applied slowly to other projects as well to other groups of companies.

So, the establishment of the KPIs done with the initiation of the project to align the teams at the beginning to avoid lingering the performance. The biggest fear among teams is what will be after the project is completed. This slows the performance of the project and motivations among workers. To finish a project on schedule, on cost with great quality, KPIs must be implemented at the initial stage of a project and must discuss and analyze in detail at every stage.

c) Define KPIs clearly at an early stage

During the initial stage of the project, it was quickly recognized that "Definition of each KPI" was extremely important to implement the KPIs effectively. Chapter 3 demonstrates this clearly in detail. The guidelines for lower-level KPIs helped to build the detailed KPIs structure, especially Level 2 and Level 3 KPIs. In the absence of basic definitions, the right

KPIs could not be developed and followed. Each time KPIs will be interpreted differently and calculation will become vague. As discussed in chapter 3, many NPT events were mixed with scope changes. So the definition of each KPIs with all assumptions must be discussed and documented at an early stage.

d) Data Integrity practices along with Competency are extremely important for consistency and reliability.

All KPIs depend on the data gathering and analytical tools used to measure the KPI. "Data Integrity" is the ultimate key to the success of a project. If the data is not captured according to the rule defined, all the analyses are useless, and the results will be considered vague. Strict rules and good control are required to make sure data is not altered for personal gain or incorrect reporting. A periodic auditing practice is a must to make sure data meet minimum requirements. In chapter 4, the guidelines for NPT and DDR were among the key documents which helped the project to abide by the rules and procedures. Later Data alteration became easy for correction and difficult for forging.

Competency in reporting data and KPIs is as equally important as Data Integrity. A little compromise in the selection of the right people for reporting and evaluating data can result in compromised KPIs reporting and incorrect judgment. Independent reporting is also a key to the project's success, as any influence may not present the data accurately. Early engagement of the stakeholders, such as service providers, together with strict adherence to the performance guidelines, were the key reasons for the project delivery on time.

e) Fit-for-Purpose KPIs always gets attentions

KPIs can be found from many sources such as previous projects, current projects from other parts of the world, etc. Service industry practices multiple types of KPIs for performance tracking. But "Fit-for-Purpose" KPIs are the core elements for the successful implementation of the performance criterion. In the absence of these elements, KPIs are considered as the filing of paperwork and do not represent the project performance accurately. Defining the Well Quality at the well delivery (chapter 6) is a good example where the conventional method showed an unrealistic approach and delayed KPIs had no input to the improvement process. KPI such as "25kft well duration" (chapter 7) is also a good example of the "Fit-for-Purpose" KPI which dedicated only to the project wells. This KPI got attention at every level and became a common KPI for the team to discuss and strive for success.

KPIs/Milestones must reflect the true representation of the project type, as using a standardized format may not get proper attention. So, setting the right KPIs with the right target provides an objective to the project and gets proper attention at all levels. Therefore, fit-for-purpose KPIs were always better than standardized KPIs.

A "Fit-for-Purpose" KPIs must cover all the characteristics of a project and involve each party for an effective contribution to the project performance, as the KPI coverage is the key to success by effectively involving all parties in the performance of the project.

8.2 Way Forward

With the development of extended reach drilling, the need for Artificial Intelligence is getting attention in the oil and gas sector. These extended reach wells are very long, and each activity can accumulate a large number of man-hours. For example, +300 connections are required to dismantle during Pull Out of Hole (POOH), and similarly, +300 connections are required to be made during Run in Hole (RIH), so +600 connections are required either to dismantle or to be made during a trip to 30,000ft. Each connection time varies from 3 minutes to 20 minutes, resulting in very long hours (from 30 hours to 60 hours for a trip). So, saving any 20-30 seconds per connection can bring significant savings.

8.2.1 Implementation of ILT (invisible lost time)

Many activities are causing extra working hours, such as BOP testing. A current project is about to launch to divide all rig site activities into smaller job packages and a benchmarking rule set to monitor the time lost due to poor operational practices or equipment reliability. Such time is referred to as Invisible Lost Time (ILT), as there is no clear start and end time to record the lost time. The ILT can only be measured against benchmarked activities based on the best composite value. Such practices are already available in the industry and are easily adaptable.

8.2.2 Introduction of AI (Artificial Intelligence)

With the development of computer-aided technologies, many operations on the rig-site can be operated by machines with the application of Artificial Intelligence, resulting in the saving of a huge sum from a well cost. Artificial Intelligence will bring consistency as well as accuracy in activities at rig-sites. The introduction of Artificial Intelligence will make extended reach drilling more economical in a low priced oil market and make it more feasible to explore deep reservoirs. Moreover, the replacement of many activities by machines for cost savings will reduce the human exposure to the high-risk areas, such as rig floors, and will reduce the safety incidents to a minimum level, which will be a significant improvement in rig operations. Where the rig cost is high, such as with deepwater activity, these technologies have already been implemented. Implementation of AI and Automation to such mega-projects can bring significant savings.

8.2.3 Introduction of SSPM (Strategic Partnership Performance Management)

In the oil and gas industry, especially with the significant drop in the oil prices since 2015, there is an emergent need for effective Strategic Suppliers Partnerships to improve efficiency and increase profitability. An application of a Strategic Supplier Partnership program (SSPM) in a drilling project has started to capture the value of partnership in the drilling services and to drive performance and process efficiency during the drilling operations. Besides having good monitoring of the suppliers' performance to ensure project deliverables, a further step, the Strategic Supplier Partnership program, was introduced to maximize the outcomes of the supplier's relationship. Both the operating company and the supplier collaborated to get the benefits from the effective resources optimization and processes enhancement such as invoices payment, equipment utilization, etc.

The program included a business process that starts with selecting the strategic supplier and defines relationship governance and develops metrics to measure, review, and improve performance. The program also involved developing KPIs at corporate and operational levels to measure the effectiveness of the strategic relationship. The synergy in various areas between the operator and its suppliers at both corporate and operational levels brought important discussion topics to light: improving the drilling performance metrics (the reduction of non-productive time (NPT) and optimizing well duration time), resolving payment claims, proposing technologies that enhance operational efficiency, and resolving issues at senior levels to address delayed payments, technology adaptation methods, procurement strategy, and employee training. The outcomes of the exercise show substantial improvement in some areas, such as NPT reduction, well duration time, and invoice cycle time. The improvements in the drilling performance metrics resulted in significant savings, compared to the conventional method of performance monitoring. Areas such as technology adaptation, procurement practices and employee development required more time to establish mutual understanding and remove all hindering factors to achieve the benefits. It is found that it is a great initiative taken by a National Oil & Gas Company that aims to align its practices with the best in class organizations.

8.2.4 Drilling Data Integrity; Current practices and Future needs (Rashid 2018)

The global industry is undergoing a revolution, the fourth Industrial Revolution, where cyber-physical systems connect the internet of things with each other and with humans in real-time. The question is, “Where are drilling data management practices heading in handling the data?" Drilling is the first and ultimate source of information for the oil and gas industry, from the surface to the deep reservoir.

Has the industry of drilling adopted contemporary practices? Drilling data integrity refers to the accuracy and consistency of drilling information inputs and is at least as important as the security of the data. Drilling data integrity should be the most critical activity in drilling a well. However, it has not received the same attention as other activities, such as directional drilling, have received. It is observed that with a lack of data integrity practices, data generated is unreliable, and the rate of failure continues to be high. The CAPEX assigned to data integrity is minimum to none. A revolutionary approach is required. Beginning from the data source, a strong data structure (flow), competency of data puncher and reliability of data entry systems, incorporating quality assurance and quality control tools (practices) is required. This data, of course, needs to be stored properly and be available for data analysis in the present and especially in the future.

The right investment in data integrity at the right time (which is now) could not only save millions in the future but also bring the industry close to the contemporary and revolutionary model. A massive paradigm shift is required to modernize the drilling industry as a pioneer data management organization with stringent data integrity practices. More and more checks with real investment in improving consistency and accuracy from real-time data transmission are required.

In Appendix H, a complex data flow model and data integrity practices discuss the need of the application of the 4th Industrial Revolution in connecting the Internet of Things using unified interface by having standardized vendor interfaces and the application of AI (Artificial Intelligence) to reduce not only data integrity issues, but also to enhance the fast execution of decision making data accurately and timely (Rashid 2018, np).

LETTER OF REFERENCE

ADNOC

06 March 2018

Letter of Reference

Faisal has been working in ADNOC Offshore since 2011 at various positions with Drilling Data and Performance Management Team. He has shown very high innovative skills in developing new procedures and processes to measure and improve overall Drilling Project Performance. He led many tasks such as development of Well Quality KPIs, Key Services KPIs, Performance bonus Incentive Scheme etc., on behalf of Drilling Engineering and Operations. He has contributed in the clarification and enhancement of existing practices such as operations codes, KPI calculation, NPT guidelines, scope change identification etc., His efforts have ensured that performance is measured and reflected properly, so teams can focus on right areas. His advisory role in development of L1, L2 and L3 KPIs has added tremendous value at every level. Knowledge Management Techniques introduced by him, such as NCR investigations, Bin-list etc., brought significant improvement to the service companies and engineering team performance. A new normalisation technique well days duration of 25kft well is highly accepted by all parties including shareholders. This normalisation technique became as a benchmark to challenge and motivate team to perform better.

Faisal's analytical ability is a great asset for the drilling team. His analysis on complex well situation are very helpful for team to understood true values attained for the project. Faisal's extraordinary work on Developing Well Quality KPIs and KPIs for key services was highly appreciated at ADNOC HQ and both were adopted as COP (code of practices) for ADNOC group companies.

Faisal has published two papers on NCR implementation and Well Quality KPIs. He has been participating in many knowledge sharing events including shareholders meetings on performance delivery and Drilling project KPIs.

ADNOC offshore fully supports Faisal's research in the Drilling Project Performance and academic pursuit toward a Master Degree in Oil & Gas by presenting his work as Master Dissertation at Memorial University, St. John's.

We wish Faisal a great success in his career by developing high value academic portfolio.

Regards

Mohamed Ishaq
Sr. Manager Drilling Business Support
Drilling, ADNOC Offshore

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أدنوك البحرية
ADNOC Offshore

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Appendices

APPENDIX A

Problem Events, NPT, Scope Change, and DDR Guidelines

GUIDELINES & APPROVAL PROCESS

Problem Events, NPT, Scope Change, DDR

Business Process Owner: DR-DCE, DR-DCO, DR-PBI

**The only official version of any DR-PBI Procedures or Guidelines is
That published by DR-PBI on the DR Portal in Intranet**

Approved by

29-6-14

DR-VP
John Jorden

Date Prepared/Last Revised June 2014

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Guidelines for Problem Events, NPT, Scope Change, DDR

	Name	Position	Signature & Date
Prepared by	Faisal Rashid	Manager DR-PBIPS	10-6-2014
Reviewed & endorsed	Rob Nisbet	DR-DCE Sr. Manager	10-6-14.
	Les Sept	DR-DCO Sr. Manager	19.6.2014
	Mohamed Ishaq	DR-PBI Sr. Manager	23.06.2014

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Guidelines for Problem Events, NPT, Scope Change

1. PURPOSE

The purpose of these Guidelines is to establish a unified methodology of recording Problem Events with and without nonproductive time and differentiating scope change activities from normal activities. It also provides the guidelines on DDR flow and approval process.

Ownership: DR-DCE Sr. Manager, DR-DCO Sr. Manager and DR-PBI Sr. Manager will be the Owner of these Guidelines and have the prime accountability for achieving their Purpose, their implementation and further development of the same

Responsibility: DR-DCO, DR-DCE, and DR-PBI are responsible for implementation of the Guidelines.

Stakeholders: Drilling,

Functional Support: will be provided by DR-PBIPS

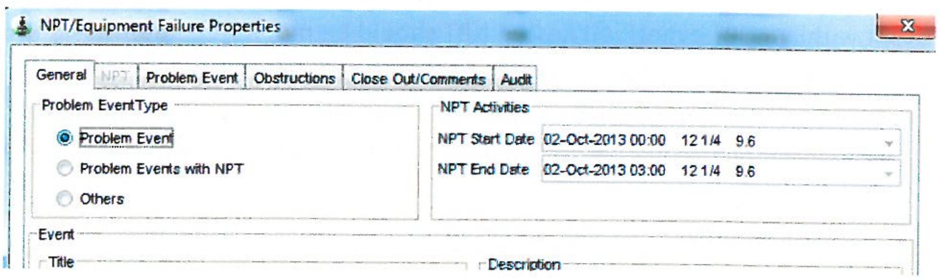
2. PROBLEM EVENTS

Problem events include all problems that occur during the reporting period. Problems should be reported as they occur and may overlap each other or be nested within other problems. There are two types of problem events;

- Problem events which do not affect the planned critical path activity such as:

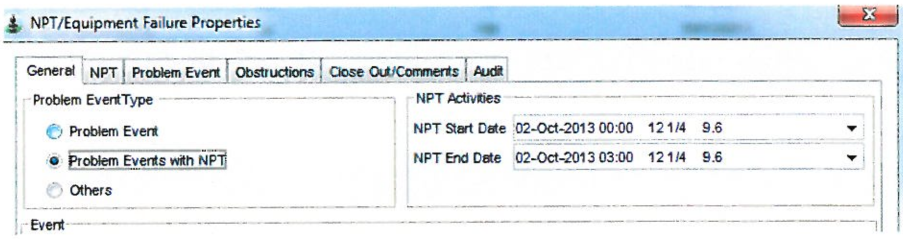
Mud pumps/fluids system repairs during wireline logging, crane repairs which do not effect drilling operations etc.

Note: Problem Events without NPT can be captured in openwells.



- Problem events which interrupt or delay the planned critical path activity – nonproductive time (NPT) such as:

Top drive system problem while drilling that stops/delays the operation, stuck pipe, string or BHA failure etc.



Note: Problem events must be created to record all problem events with or without NPT. A well will appear to be problem free unless Problem Events are reported.

Note: ZADCO NPT codes can be found in Appendix A.

3. NONPRODUCTIVE TIME

Nonproductive Time (NPT) is an Operating time required to recover from an event or Non-conformance. It is the time elapsed between the Non-conformance/failure events, and returning back to the same position before the event occurred or it is the time spending to recover from the consequences of the event or Non-conformance. NPT only includes time where operations could normally proceed e.g. waiting on weather is not included in NPT and should be monitored separately.

Operating Time:

Operating time for a rig is the period during which a rig is available to operate. Waiting on weather (WOW) and all the planned maintenance activities will be considered as non-operating time.

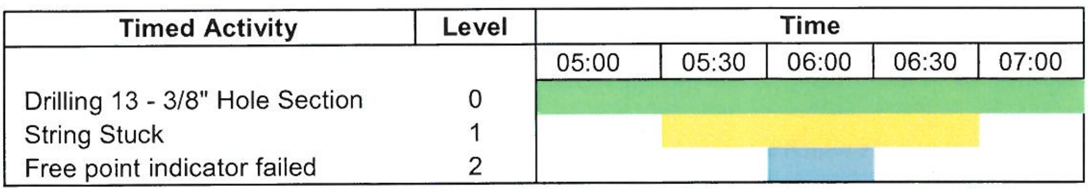
Hidden NPT:

Hidden NPT is an event which is difficult to track as NPT where start time and end time are not clearly defined such as operational difficulties cause slow casing run, or slow rig-up of equipment etc. Such event can be tracked through FTR (Flat Time reduction) process or by comparing operating efficiency for certain activities.

Note: An NCR (Non-Conformance report) to service provider is required for inefficient jobs/operations.

Nested NPT:

NPT Nesting occurs when a subsequent NPT event takes place during the completion of the primary event (i.e. a NPT event within a NPT event). All nested NPT should be monitored and tracked closely and should be entered in Openwells on a daily basis. For example, during a stuck pipe event, which is an NPT event, a free point indicator tool was failed, which caused additional NPT. Such NPT is a nested NPT and should be tracked as separate event and should be assigned to the service company who is running the FPI tool.



NPT Assignment and Approval:

After an NPT event, NPT will be assigned by the rig supervisor (as per DDR guidelines) to the vendor who is directly involved in the operations regardless if vendor is at fault or not. On a daily basis Well Engineer will approve the NPT data in openwell after review with management and lock the DDR. Once NPT is assigned to a vendor, it can only be changed to another vendor or ZADCO after a complete investigation by the vendor and review with management (NCR process).

Note: Management approval is required for assigning any NPT to ZADCO.

Shared NPT:

Shared NPT is the event, where two or more companies are involved directly in the NPT event. In case of shared NPT, NPT will be assigned to the major contributor. Rig supervisor will assign the NPT to the major contributor based on his judgment. Upon investigation and review, Drilling Management can reassign the NPT to different company.

NPT Investigation:

All the NPT investigation must be completed prior to the end of well review session.

- **Vendor NPT**: An NCR/NPT investigation request will be initiated by end user (Well Engineer, Cementing Engineer, Mud Engineer, Geologist, etc.) for all NPTs assigned to vendors regardless vendor is at fault or not.
- **ZADCO NPT**: Any NPT belong to ZADCO will be investigated by the Well Engineer and will be finalized prior to end of well review. All outstanding NPT investigation will be logged in Bin-List and investigation will be carried out by the assigned team.

Examples:

Below are some examples illustrating how to report the events.

- **Example 1 - MWD Failure**: While drilling ahead, the MWD fails. After consultation with management, the decision is made to continue drilling without the MWD and take surveys with single shots as required.

Is this an MWD problem?	YES – Report as problem event.
Is this MWD NPT?	NO – Since critical path activities are not impacted, this is not NPT (decision is to drill ahead).

- **Example 2 - Lost Circulation**

A. While drilling ahead, mud losses causes a suspension of drilling.

Is this a Lost Circulation problem?	YES – Report as problem.
Is this problem NPT?	YES – Since critical path activities are impacted.

Note: Start event at first sign of loss and end after circulation is established sufficiently to continue drilling.

B. Lost returns are experienced in an area where losses are common and planned for in the well program. The plan calls for treating the losses while drilling ahead.

Is this a Lost Circulation problem? YES – Report as problem.
Is this problem NPT? NO – Since critical path activities are not impacted, this is not NPT (decision was to drill ahead while treating losses).

C. Lost returns are experienced in an area where losses are common and planned for in the well program. The plan calls for treating the losses via the 'Fracture Closure Stress'– Technique

Is this a Lost Circulation problem? YES – Report as problem.
Is this problem NPT? NO – If the technique worked to cure the losses within the time estimated in the well program.
OR
YES – If the technique did not work to cure losses within the time estimated in the well program.

- **Example 3 – Well Killing/Well Flow**

A. While drilling ahead, a well flow causes a suspension of drilling. Well Killing operation starts to control the flow.

Is this a Well Flow problem? YES – Report as problem.
Is this problem NPT? YES – Since critical path activities are impacted.

Note: Start event at first sign of well flow and end after rig continues drilling.

B. Well flow is experienced in an area where it was expected and planned for in the well program. The plan calls for controlling the well flow while drilling ahead.

Is this a Well Flow problem? YES – Report as problem.
Is this problem NPT? NO – Since critical path activities are not impacted, this is not NPT (decision was to drill ahead and control well flow during drilling).

C. Well Flow is experienced in an area where it is expected and planned for in the well program. The plan calls for wait and increase the mud weight.

Is this a Well flow problem? YES – Report as problem.
Is this problem NPT? NO – If the increasing mud weight to control the well flow within the time estimated in the well program.
OR
YES – If the increasing mud weight does not work to control the well flow within the time estimated in the well program. (Mud weight has to increase more which was not planned)

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Note: If the Well flow is due to not shutting down the near-by injector wells. Such NPT should be tracked and reported in order to review with ZADCO production.

- **Example 4 - Rig Equipment:** On a rig with three mud pumps:

A. Mud pump # 3 fails when only two pumps are needed to continue drilling.

Is this a Mud pumps problem?	YES – Report as problem.
Is this problem NPT?	NO – Since critical path activities are not impacted, this is not NPT.

B. Mud pumps # 1 and # 2 fail and two pumps are needed to continue drilling.

Is this a Mud pumps problem?	YES – Report as problem.
Is this problem NPT?	YES – Since drilling cannot continue.

- **Example 5 - Wireline Failure**: Fail to set Bridge plug by Wireline. Bridge plug was set later by Drill pipe

Is this a wireline problem?	YES – Report as problem event.
Is this problem NPT?	YES – Since operation was planned to set the BP with wireline. An extra operation was added due to failure.

Note: Start event at rigging up setting tool till POOH DP to surface

- **Example 6 – Stuck pipe:** While POOH, drill string got stuck. After 1 hour work on stuck point, string got free.

Is this a stuck pipe problem?	YES – Report as problem event.
Is this problem NPT?	YES – Since critical path activities are impacted.

- **Example 7 – Redrill a well:** Well # 1 (Well # FD001) from Slot #1 is drilling 12 ¼" section and string got stuck at section TD. Decision was made to abandon the well to surface and redrill the Well # FD001 from slot # 2 with different well number Well # 2. (Well number is assigned to slot. Each slot keeps the well number).

Is this a stuck pipe problem?	YES – Report as problem event.
Is this problem NPT?	YES – Since critical path activities are impacted.
How the NPT should be assigned?	Since KPIs are completed well based, all the NPT will be assigned to the Well # FD001 (Well # 2) from the stuck point till the new 12 ¼" section TD including rig move.

Rig Repair/Upgrade:

- If a rig goes under repair during any well phase, such time to repair the rig will be considered as non-productive time (NPT).

- If a rig goes under maintenance/upgrade with mutual agreement between ZADCO and contractor, maintenance/upgrade will be considered as planned maintenance.

- **Example 8 – Rig Repair**: High erratic torques experienced while drilling. Top drive lubricator pump found not working. Drill string recovered to surface for top drive fault finding. Gearbox was found damaged.

Is this a Top Drive problem?	YES – Report as problem event.
Is this problem NPT?	YES – Since critical path activities are impacted. (Since drilling cannot continue)

Planned activities during an NPT event:

NPT events may be interrupted to account for certain planned activities.

- **Example 9: BOP Testing:** While waiting on equipment (an NPT event) to continue the drilling operation, a decision is made to perform a BOP test, which soon is due.

How should this be coded?	Since a BOP test is a planned critical path activity, the time spent for the BOP test should "interrupt" (close out) the wait NPT. If the waiting continues to impact drilling progress after the BOP test is completed, the NPT event should be reinitiated (open new wait NPT).

Note: This results in more than one NPT event for the same problem. However, the amount of NPT will reflect only lost critical path time.

Planned & Unplanned wait

- Planned wait includes any critical path wait activity which has been built into the well plan such as:
  - Waiting on cement, safety meetings, JSA's, etc.
- Unplanned wait includes any critical path wait activity that has not been built into the well plan, and in almost all cases should trigger the creation of an NPT event such as:
  - Rig repair, waiting on weather, logistics, waiting on orders, labor strike, etc.

- **Example 9 – unplanned wait**: Rig # 1 counters severe losses and is shortage of OBM. Rig # 2 has OBM mud for its use, but equipped well to prepare required OBM quickly. In order to reduce the NPT time at Rig # 1, OBM was mobilized from Rig # 2. Now Rig # 2 waits in order to have OBM ready for its own operations.

How should this be coded?	Since critical path activities are impacted at Rig # 2. This unplanned wait should be treated as an NPT event.
Is this unplanned wait NPT?	YES – Since critical path activities are impacted. (Since drilling cannot continue)

4. SCOPE CHANGE

A scope change is a change in the planned operations. It is an additional requirement during a well phase. It is very important to record the scope change events clearly in order to calculate Drilling & Completion efficiency accurately.

- Any additional activity, which was not planned in original AFE during WDP and was required due to change in requirements or due to operational issues (not NPT events), is a scope change.

Note: Any delay due to scope change will not be considered as NPT event, as it is known that change in plan (scope change) will cause extra delay due to mobilization of equipment or people. It will be considered as part of scope change and no NPT will be assigned on waiting for equipment or people for such events. **Any NPT event during scope change will be considered as NPT event. (Scope change NPT)**

Scope Change Requirements:
A scope change must be supported by an **approved MOC** or approved program.

- **Example 10:** An extra log run, which is required at a certain depth to have more information about formation (a scope change event). To run the log, a different tool is required, which is not available at the rigsite. Well operation is stopped and rig is waiting for the tool.

How should this be coded?	Since it is an additional requirement and should be reported as Scope change.
Is this event NPT?	No – Since Rig is waiting for the equipment which was not planned and this extra activity is not result of an NPT event.

- **Example 11:** Due to consequences of an NPT event, an extra log run is required. Tool is not available at rigsite and rig has to wait for the tool.

How should this be coded?	Since, it is an additional requirement due to consequences of an NPT event. Extra log run will be part the same NPT event.
Is this event NPT?	Yes – Since Rig is waiting for the equipment due to an NPT event as this extra activity is the result of an NPT event. Rig wait time will be part of the same NPT.

- **Example 12:** During finalizing well program, an extra core run (3rd run) was added. But original AFE have only 2 core runs planned.

How should this be coded?	Since, it is not part of original AFE. This event should be recorded as Scope Change.
Is an MOC required for this event?	No – Since well program is approved by management and additional run is part of the final well program, so no MOC is required.

Cancelled Operation:
If an activity, which was planned in original AFE, is cancelled, then days and the cost assigned to the cancelled activity should be removed from KPIs calculation (Drilling Efficiency, Well Cost KPIs etc)

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5. DDR (DAILY DRILLING REPORT) FLOW AND APPROVAL PROCESS

A standardize DDR report showing time related entries each day from midnight (previous day) to midnight (current day). Operation after midnight (OAMN) to 6:00am will be entered the DDR.

Initial Set-up:
An initial set-up is done for each well at start of well with following information;

- Planned TD & TVD,
- Planned AFE cost with AFE info
- Planned Hole Sections
- Drilling Complexity Index (DCI) & Well Complexity Index (WCI)
- Slot information
- Well Information
- Pre Spud Cost Completeness, if any
- Spud date

Initial Set-up will be prepared by System Analyst (PBI) in Openwells with the help of Well Engineer and Rig Supervisor.

Daily Required Information:
Following information is entered at daily basis at the rig site.

- Daily Operation Information (Operations Summary)
- Performance Limiter
- Time log entries (Duration, Depths, Phase, code, Type, Operation Description)
- NPT information (Duration, NPT code, Description, Company, NCR#,)
- Daily cost breakdown (Cost Summary)
- Daily personnel information (People count & Key people)
- Safety information including stop cards & JSA
- Fluid checks, Mud and Cement information
- Bit & BHA information
- Well bore information & sections including directional survey data
- Mud pumps information
- Support vessels
- BOP and Well information

Key Performance Indicators:
Following DDR KPIs will be reported at regular interval (weekly and monthly);

- ***DDR closure rate per rig/well***: This KPIs will check how many DDR were Approved / locked on time. Each DDR should be locked daily basis prior to issue new DDR.
- ***% of open DDR per well***: This KPIs will mention the number of the DDRs open (not locked) at weekly, monthly basis and at end of well review.
- ***% of the missing data per well:*** This KPIs will monitor the % of the missing data per well at end of well review
- ***% of DDRs is unlocked for correction***: This KPI will monitor the changes made to DDR after locking the DDR.

(Note: minimum data required sheet, wellbore schematic, casing drawing and completion diagram from openwells can be used for comparison, if required)

Below are the DDR steps with activity details and responsible party for each step.

STEPS	ACTIVITY		RESPONSIBLE
Data Entry	**Data is entered in Openwells** All data as listed above will be entered at rigsite every day before 06:30am. Rig supervisor is responsible for data entry. Note: For quantitative analysis, a pop-up message is set-up for Rig Supervisors to check the missing data.	(Daily)	Rig Supervisor (DR-DCO)
Distribution	**DDR will be generated in required format and will be distributed as per distribution list** Report is generated for each rig of previous day activities based on data entered and will be distributed by 07:00am each day to the approved distribution list by system Analyst	(Daily)	System Analyst (DR-PBI)
Data Assurance	**Each Data Entry will be checked for accuracy and missing information** Well Engineer will check at daily basis each data entry in Openwells for accuracy and will make sure that no necessary data is missing. If any data entry is missing or need more information, He will inform the rig supervisor. Note: For quantitative analysis, a pop-up message is set-up for engineers to check the missing data.	(Daily)	Well Engineer (DR-DCE)
Missing Data Input & Data Correction	**Missing Data is entered and corrected** Rig Supervisor will add the missing data and will correct the data at daily basis, if any, as per Well Engineer's request. Note: If the missing data is not entered timely or data is not corrected timely as per Engineer's request, Well Engineer can raise the issue to Rigs Operations Manager or higher level	(Daily)	Rig Supervisor (DR-DCO)
Data Validation & Approval	**Each Data Entry will be validated for accuracy and approved** After all necessary information entered the DDR, Well Engineer will validate each data entered in Openwells for accuracy and approve the DDR.	(Daily)	Well Engineer (DR-DCE)
Locking	**Each DDR will be locked in Openwells** Once DDR is filled with required information, DDR will be locked by Well Engineer after approval to avoid any changes to the DDR. Note: Each DDR should be locked before the New DDR is issued. It is part of DDR KPIs.	(Daily)	Well Engineer (DR-DCE)
DDR Analysis (KPI Reporting)	**DDR data is checked and Analysis for KPIs** System Analyst will run queries to analyze DDR data, will prepare KPIs reports and will distribute at a regular intervals (monthly and weekly basis).	(Weekly)	System Analyst (DR-PBI)

Changes in DDR:

Once a DDR is locked, it will be opened only by system analyst (DR-PBI) based on below criteria;

1) If changes to the data do not affect the KPIs, data can be changed or corrected after approval from either Rig Operations Manager or Engineering Manager.
2) If changes to the data affect the KPIs, the following approval authorities are required;
   a) If the changes to the data affect the L1 KPIs after reported to Corporate Planning, VP-DR approval is required for all changes. (Note: Level 1 KPIs includes Drilling Efficiency, Well Cost and Well Delivery KPIs. If more information is required on L1 KPIs, consult DR-PBIPS.)
   b) If the changes to the data do not affect the L1 KPIs, but it does affect others previous reviewed KPIs, Senior Engineering Managers approval is required.

Note: All the changes request will be monitored by System Analyst/Performance Analyst (DR-PBI). Any report can be prepared and shared to management upon request, such as NPT weekly or monthly report.

6. APPENDIX # A

ZADCO Problem Events/ NPT Codes

No.	TYPE	CODE	DESCRIPTION
0	**ADMA/ZADCO**		**ADMA/ZADCO LOST TIME**
	ADMA	1	ADMA LOST TIME
	ADMA	100	ADMA WAITING ON..
	ZADCO	2	ZADCO LOST TIME
	ZADCO	200	ZADCO WAITING ON..
1	**CASING**		**CASING LOST TIME**
	CASING	1.1	CREW/POWER TONG/JAM UNIT/ELEVATOR/SLIPS/CASING FULL UP PKR
	CASING	1.2	LINER HANGER/LINER SETTING TOOLS
	CASING	1.3	DV TOOL/DV PACKER/FLOATING EQPT/EXPANDABLE CASING
	CASING	1.4	CASING CRACK/ CASING PARTED/ CASING COLAPSED
	CASING	1.5	OTHER CASING TOOLS
2	**CEMENTING**		**CEMENTING LOST TIME**
	CEMENTING	2.1	CEMENTING UNIT/RCM/CEMENTING SYSTEM/CIRCULATING SWEDGE/CEMENTING HEAD
	CEMENTING	2.2	CEMENTING/SQUEEZING/MATERIAL/SERVICES
	CEMENTING	2.3	DRY TESTING SERVICES(CREW/TOOLS)/HANDLING EQUIPMENT
	CEMENTING	2.4	RETRIEVABLE PACKER
	CEMENTING	2.5	CEMENT RETAINER/BRIDGE PLUG/SETTING TOOL
3	**DRILLING**		**DRILLING LOST TIME**
	DRILLING	3.1	STABILIZERS
	DRILLING	3.2	SHOCK SUBS
	DRILLING	3.3	JARS
	DRILLING	3.4	POWER TONG/DP'S HANDLING EQUIP/HWDP/DC/DP'S EG:WASHOUT,TWISTOFF
	DRILLING	3.5	BIT CONE/BIT NOZZLE/BIT BREAKER/BIT PLUG
	DRILLING	3.6	HOLE OPENER/UNDER REAMER
4	**DIRECTIONAL DRLG**		**DIRECTIONAL DRILLING LOST TIME**
	DIRECTIONAL DRLG	4.1	DIRECTIONAL TOOL/OPERATOR
	DIRECTIONAL DRLG	4.2	STEERING TOOL/BENT HOUSING/ORIENTING SUB/SES
	DIRECTIONAL DRLG	4.3	SINGLE SHOT GYRO SURVEYS
	DIRECTIONAL DRLG	4.4	MULTI SHOT GYRO SURVEY
	DIRECTIONAL DRLG	4.5	MAGNETIC SINGLE SHOT SURVEYS
	DIRECTIONAL DRLG	4.6	MAGNETIC MULTI SHOTSURVEYS
	DIRECTIONAL DRLG	4.7	KICK OFF DOWN HOLE MOTOR
	DIRECTIONAL DRLG	4.8	STEERABLE DRILLING MOTOR/BHA/OPERATOR
	DIRECTIONAL DRLG	4.9	MWD
	DIRECTIONAL DRLG	4.11	LWD
	DIRECTIONAL DRLG	4.12	OTHER SURVEY TOOLS
	DIRECTIONAL DRLG	4.13	WHIP/PACK/ANCHORSTOCK/RETRIEVABLE TOOLS
5	**DOWNHOLE EQPMT**		**DOWNHOLE EQUIPMEN LOST TIME**
	DOWNHOLE EQPMT	5.1	TURBINE OPERATOR
	DOWNHOLE EQPMT	5.2	PDC/DIAMOND BIT
6	**FISHING**		**FISHING LOST TIME**
	FISHING	6.1	OVERSHOT/GRAPPLE/GUIDE/SPEAR
	FISHING	6.2	BUMPER SUB/JAR
	FISHING	6.3	MILLING TOOL
	FISHING	6.4	WASH OVER SHOE
	FISHING	6.5	DIE COLLAR/GUIDE
	FISHING	6.6	TAPER TAP
	FISHING	6.7	OTHER FISHING TOOL
7	**COMPLETION**		**COMPLETION LOST TIME**
	COMPLETION	7.1	STIMULATION PACKAGE, STRING, SERVICES (see code 18)
	COMPLETION	7.2	COILED TUBING PACKAGE (see code 19)
	COMPLETION	7.3	DST TOOL PACKAGE
	COMPLETION	7.4	TESTING EQUIPMENT/BURNER BOOM/COMPRESSOR
	COMPLETION	7.5	WELLHEAD/XMASS TREE/VALVES/CHOKE MANIFOLD
	COMPLETION	7.6	TUBING HANGER

No.	TYPE	CODE	DESCRIPTION
	COMPLETION	7.7	DOWN HOLE EQUIPT/SSV/CONTROL LINE/SSD
	COMPLETION	7.8	SEAL ASSY
	COMPLETION	7.9	PERMANENT PACKER
	COMPLETION	7.11	DUAL HYDRAULIC PACKER
	COMPLETION	7.12	SINGLE HYDRAULIC PACKER
	COMPLETION	7.13	EXPANSION JOINT
	COMPLETION	7.14	BLAST JOINT
	COMPLETION	7.15	FLOW COUPLING
	COMPLETION	7.16	NIPPLE
	COMPLETION	7.17	WIRELINE ENTRY GUIDE
	COMPLETION	7.18	TAIL PIPE
	COMPLETION	7.19	CREW/POWER TONG/JAM UNIT/COMPUTER
	COMPLETION	7.21	DUAL HANDLING EQUIPMENT
	COMPLETION	7.22	SNUBBING UNIT
	COMPLETION	7.23	WIRELINE(SLICKLINE) TOOLS AND PLUGS
	COMPLETION	7.24	OTHERS COMPLETION EQPT
8	**CORING**		**CORING LOST TIME**
	CORING	8.1	CORE BARREL
	CORING	8.2	CORE HEADS
9	**MUDLOGGING**		**MUDLOGGING LOST TIME**
	MUDLOGGING	9.1	MUD LOGGING SERVICES
10	**WIRELINE**		**WIRELINE LOST TIME**
	WIRELINE	10.1	WIRELINE CABLE
	WIRELINE	10.2	WIRELINE PLUGS
	WIRELINE	10.3	WIRELINE DEPTH COUNTER
	WIRELINE	10.4	WIRELINE UNIT
	WIRELINE	10.5	OTHER WIRELINE EQPTS
11	**RIG_SURFACE_EQPT**		**RIG_SURFACE_EQPT LOST TIME**
	RIG_SURFACE_EQPT	11.1	TOP DRIVE/POWER SWIVEL
	RIG_SURFACE_EQPT	11.2	RIG PUMPS
	RIG_SURFACE_EQPT	11.3	ROTARY TABLE/KELLY ASSY/WASH PIPE/KELLY SPINN
	RIG_SURFACE_EQPT	11.4	GENERATOR/SCR/DC/ELECT.POWER, VFD
	RIG_SURFACE_EQPT	11.5	ENGINES
	RIG_SURFACE_EQPT	11.6	JACKING/SKIDDING SYSTEM/ PRELOADING
	RIG_SURFACE_EQPT	11.7	BOPs/KOOMY UNIT
	RIG_SURFACE_EQPT	11.8	CRANE
	RIG_SURFACE_EQPT	11.9	TRIP TANK
	RIG_SURFACE_EQPT	11.11	MUD PIT / KILL LINE/ CHOCKE LINE
	RIG_SURFACE_EQPT	11.12	DEGASER
	RIG_SURFACE_EQPT	11.13	DESANDER/ DESILTER/ CENTRIFUGE
	RIG_SURFACE_EQPT	11.14	SHALE SHAKER
	RIG_SURFACE_EQPT	11.15	DRAW WORKS
	RIG_SURFACE_EQPT	11.16	STAND PIPE/CHOKE MANIFOLD
	RIG_SURFACE_EQPT	11.17	BELL NIPLLE/RISER
	RIG_SURFACE_EQPT	11.18	SPUD CAN INSPECTION
	RIG_SURFACE_EQPT	11.19	OTHER DRILLING CONTRACTOR EQUIPMENT
12	**LOGISTIC**		**LOGISTIC LOST TIME**
	LOGISTIC	12.1	TUG BOATS/OFFLOADING/ACID BOAT
	LOGISTIC	12.2	DELAY OF SUPPLY BOATS
	LOGISTIC	12.3	CUTTING MOORING ROPE
	LOGISTIC	12.4	HITTING THE WELL HEAD/JACKER/SEA LINE/OIL LINE
	LOGISTIC	12.5	OTHERS
13	**LOGGING**		**LOGGING LOST TIME**
	LOGGING	13.1	STANDARD LOGGING TOOLS FOR CASED HOLE LOGS
	LOGGING	13.2	STANDARD LOGGING TOOLS FOR OPEN HOLE LOGS
	LOGGING	13.3	CABLE/DRUM OF LOGGING UNIT
	LOGGING	13.4	COMPUTER/PERFORATING TOOLS/CHEMICAL CUTTER/PUNCHER
	LOGGING	13.5	RFT/PLT/PRODUCTION LOGGING
	LOGGING	13.6	PERMENENT PACKER/BRIDGE PLUG/SETTING TOOL/CEMENT RETAINER
	LOGGING	13.7	OTHERS LOGGING TOOLS
14	**SAFETY**		**SAFETY LOST TIME**
	SAFETY	14.1	AIR LOOP SYSTEM
	SAFETY	14.2	OTHER SAFETY EQUIPMENT

No.	TYPE	CODE	DESCRIPTION
15	**WELL HEAD JACKET**		**WELL HEAD JACKET LOST TIME**
	WELL HEAD JACKET	15.1	DELAY TOWER PREPARATION
	WELL HEAD JACKET	15.2	OTHER TOWER EQUIPMENT
16	**RIG COMMUNICATION EQUIPMENT**		**RIG COMMUNICATION EQUIPMENT LOST TIME**
	RIG COMMUNICATION EQUIPMENT	16.1	TELEPHONE
	RIG COMMUNICATION EQUIPMENT	16.2	RADIO
	RIG COMMUNICATION EQUIPMENT	16.3	COMPUTER
	RIG COMMUNICATION EQUIPMENT	16.4	EMAIL
	RIG COMMUNICATION EQUIPMENT	16.5	FAX

Addinoal NPT Codes			
No.	**TYPE**	**CODE**	**DESCRIPTION**
17	**HOLE PROBLEM**		**HOLE PROBLEM LOST TIME**
	HOLE PROBLEM	17.1	OPEN HOLE PROBLEM (TIGHT, FILL, GUMBO, ETC.) (PROBLEMS RELATED TO HOLE CONDITION)
	HOLE PROBLEM	17.2	STUCK PIPE (PROBLEMS WITH STUCK DRILL PIPE, CASING / LINER OR TUBING)
	HOLE PROBLEM	17.3	MUD / FLUIDS PROBLEM (DRILLING OR COMPLETION FLUID PROBLEMS)
	HOLE PROBLEM	17.4	MUD LOSSES (LOST RETURN, CIRCULATION PROBLEMS)
	HOLE PROBLEM	17.5	WELL CONTROL PROBLEM DRILLING (KICKS, CHECK FOR FLOW, ETC.)
	HOLE PROBLEM	17.6	WELL CONTROL PROBLEM COMPLETION (RESERVOIR PRESSURE, ETC.)
	HOLE PROBLEM	17.7	CASED HOLE PROBLEM (FILL OR OBSTRUCTION IN CASING / TUBING)
18	**STIMULATION**		**STIMULATION LOST TIME**
	STIMULATION	18.1	STIMULATION PACKAGE(ACID PUMP, LINES), STRING, SERVICES
	STIMULATION	18.2	ACID BOAT
19	**COILED TUBING**		**COILED TUBING LOST TIME**
	COILED TUBING	19.1	COILED TUBING PACKAGE (CT REEL, POWER PACK, INJECTOR HEAD)
	COILED TUBING	19.2	NITROGEN UNIT

- Code 17 has been created to cover the NPT related to Hole Problems issue, as it's showing all this type of problem was previously captured under code 2 ZADCO, not allowing further analysis for specific type of problem.
- Code 18 has been created to cover the NPT related to stimulation services, this code has replaced the previous code 7.1
- Code 19 has been created to cover the NPT related to Coiled Tubing services, this code has replaced the previous code 7.2

** Stimulation and Coiled tubing NPT has been separated from Completion due to side effect of raising the completion NPT while this NPT is related to barge stimulation operation.

APPENDIX B

ADNOC Drilling COP 3ch4 Standard Codes and Definitions

Abu Dhabi National Oil Company

E&P DIRECTORATE

DRILLING CODE OF PRACTICE

VOLUME 3: WELL REPORTING AND CODING

CODE OF PRACTICE ON DRILLING AND WELL ACTIVITIES

DRILLING – COP 3- 4 STANDARD CODES AND DEFINITIONS

Table of Content

1. INTRODUCTION

ADNOC has chosen to use a common reporting system for all operations under the ADNOC umbrella. The purpose is to have a system whereby ADNOC can analyze and monitor all operations within the Company.

The benefits of using standards detailed codes are:

- ✓ Achieve consistency in planning and data recorded
- ✓ Development of reporting standards
- ✓ Improve performance through more detailed Reporting and Data Analysis
- ✓ Achieve consistent benchmarking of KPIs throughout all OPCOs
- ✓ Easy mobilization of employees across OPCOs

The aim of this chapter is to provide all OPCO's personnel both office based and at the rig site with a simple guide to the coding structure, their descriptions and their definitions in support of the planning and executing of the well.

This Document was devised following the OpenWells®/EDM structure. Eventual adaptation to a different system is not ruled out, thus the general principles remain.

2. STRUCTURE OF CODING SYSTEM

The fundamental principal of improvement relies on the measurement and comparison of variables (or KPIs). The key factor for measuring and improving performance is achieving consistency of the data recorded, which is accomplished by the use of standard codes and definitions for Objective with main operation. Non Productive Time can easily be monitored as long as the coding structure is being used correctly and consistently.

The report objectives and codes are split as follows:

1. Main Event and Objective of the Event
2. Stages of the Operation
3. Operational Activity Main Level and Sub Levels
4. Operational type including Non Productive Time
5. Non Productive Time Category and Sub-categories

3. MAIN EVENT / OBJECTIVE OF THE EVENT

This code gives the main objective with the activity whether it is a new development or exploration well or a work over activity. The event may match AFE or budget for the event, it may be one event for as full well or a well split into for example: move, drilling, well testing and abandonment.

One of the following definitions shall be chosen, (see example at the end of this chapter)

MAJOR RIG MOVE (MOV)
The event begins when the rig is moving from island to island / field to field or is released from the island for maintenance. Separate AFE will be issued for this. For small rig moves i.e. Well to well or row to row or if a separate AFE is not created for it then this event will not be selected.

- *MOVE INTO CONCESSION*
- *MOVE OUT OF CONCESSION*
- *MOVE WITHIN CONCESSION*

CONSTRUCTION (CON)
The construction event commences with site preparation or restoration.

- *SITE CONSTRUCTION*
- *SITE RECLAMATION*

PRE-EXECUTION (PRE)
The pre-execution event commences once the rig is under contract and includes all repair work in connection with casing and wellhead, drill string, completion string, formation evaluation equipment and surface/subsea equipment all done prior to wellbore/drilling.

- *RIG MAINTENANCE*
- *RIG UPGRADES*
- *COMMISSIONING*

EXPLORATION DRILLING (EDR)
This event is selected for the wells to be drilled for exploration purposes.
It includes the time of rig move, drilling, casing, cementing & evaluation operations.
This event will be selected when a separate AFE for drilling only is available.

- *ORIGINAL DRILL DEVIATED*
- *ORIGINAL DRILL HORIZONTAL*
- *ORIGINAL DRILL SLIMHOLE*
- *ORIGINAL DRILL VERTICAL*

EXPLORATION DRILLING AND COMPLETION (EDC)
This event is selected for the wells to be drilled & completed for exploration purposes.
It includes the time to rig move, drilling, casing, cementing, completion & evaluation operations. The completion phase starts after the drilling phase and the last casing / liner tested/dry tested, cleaned to planned td, all logging has been run and communication test has been performed. Evaluation begins with stimulation, production testing and logging operations.

This event will be selected when a combined AFE for drilling, testing & completion is available.

- *ORIGINAL DRILL & COMPLETE DEVIATED*
- *ORIGINAL DRILL & COMPLETE HORIZONTAL*
- *ORIGINAL DRILL & COMPLETE SLIMHOLE*
- *ORIGINAL DRILL & COMPLETE VERTICAL*

EXPLORATION COMPLETION (ECM)

This event includes making up/testing/running/landing/pulling of the completion string /tailpipe and/or production tubing. Includes setting and testing of production packer(s) run in conjunction with the string.

This event should be considered only when a separate AFE for completion is available.

- *ORIGINAL COMPLETION CASED HOLE*
- *ORIGINAL COMPLETION COMBINED OPEN HOLE / CASED HOLE*
- *ORIGINAL COMPLETION OPEN HOLE*

DEVELOPMENT DRILLING (DRL)

This event is selected for the wells to be drilled for development purposes.

It includes the time of rig move, drilling, casing, cementing & evaluation operations.

This event will be selected when a separate AFE for drilling only is available.

- *ORIGINAL DRILL DIRECTIONAL*
- *ORIGINAL DRILL HORIZONTAL*
- *ORIGINAL DRILL MULTILATERAL*
- *ORIGINAL DRILL SLIMHOLE*
- *ORIGINAL DRILL VERTICAL*
- *DEEPEN DIRECTIONAL*
- *DEEPEN HORIZONTAL*
- *DEEPEN MULTILATERAL*
- *DEEPEN SLIMHOLE*
- *DEEPEN VERTICAL*

DEVELOPMENT DRILLING AND COMPLETION (DDC)

This event is selected for the wells to be drilled & Completed for development purposes.

It includes the time to Rig Move, drilling, casing, cementing, completion & evaluation operations. The completion phase starts after the drilling phase and the last casing / liner tested/dry tested, cleaned to planned TD, all logging has been run and communication test has been performed. Evaluation begins with stimulation, production testing and logging operations.

This event will be selected when a combined AFE for drilling, testing & completion is available.

- *NEW SINGLE LATERAL DUAL PRODUCER*
- *NEW SINGLE LATERAL SINGLE INJECTOR*
- *NEW SINGLE LATERAL SINGLE PRODUCER*
- *NEW SINGLE WAG INJECTOR*
- *NEW DUAL LATERAL DUAL PRODUCER*
- *NEW SINGLE LATERAL SINGLE ES PRODUCER*
- *NEW MULTI LATERAL SINGLE PRODUCER*
- *NEW MULTI LATERAL DUAL PRODUCER*
- *NEW MULTI LATERAL SINGLE INJECTOR*

- *NEW MULTI LATERAL DUAL INJECTOR*
- *NEW WATER DISPOSAL*
- *NEW WATER INJECTOR*
- *NEW SINGLE LATERAL OBSERVER*
- *NEW CUTTING DISPOSAL*
- *NEW SINGLE OIL PRODUCER*
- *NEW SINGLE GAS PRODUCER*
- *NEW DUAL OIL PRODUCER*
- *NEW DUAL WATER INJECTOR*
- *NEW SINGLE WAG INJECTOR*
- *NEW DUAL WAG INJECTOR*
- *NEW SINGLE GAS INJECTOR*
- *NEW DUAL GAS INJECTOR*
- *NEW OBSERVER WELL*
- *NEW WATER SUPPLY*

RE-ENTRY DRILLING AND COMPLETION (RDC)

This event is selected for the wells to be drilled & Completed for re-entry purposes.
It includes the time to Rig Move, Pre-drilling operation, drilling, casing, cementing, completion & evaluation operations. The completion phase starts after the drilling phase and the last casing / liner tested/dry tested, cleaned to planned TD, all logging has been run and communication test has been performed. Evaluation begins with stimulation, production testing and logging operations.
This event will be selected when a combined AFE for drilling, testing & completion is available.

- *RE ENTRY MULTI LATERAL SINGLE PRODUCER*
- *RE ENTRY MULTI LATERAL DUAL PRODUCER*
- *RE ENTRY MULTI LATERAL SINGLE INJECTOR*
- *RE ENTRY MULTI LATERAL DUAL INJECTOR*
- *RE ENTRY WATER DISPOSAL*
- *RE ENTRY WATER INJECTOR*
- *RE-ENTRY SINGLE LATERAL DUAL INJECTOR*
- *RE-ENTRY DUAL LATERAL DUAL INJECTOR*
- *RE-ENTRY SINGLE LATERAL DUAL PRODUCER*
- *RE-ENTRY SINGLE LATERAL SINGLE PRODUCER*
- *RE-ENTRY SINGLE LATERAL SINGLE INJECTOR*
- *RE-ENTRY DUAL LATERAL DUAL PRODUCER*
- *RE- ENTRY SINGLE OIL PRODUCER*
- *RE- ENTRY SINGLE GAS PRODUCER*
- *RE- ENTRY DUAL OIL PRODUCER*
- *RE- ENTRY DUAL WATER INJECTOR*
- *RE- ENTRY SINGLE WAG INJECTOR*
- *RE- ENTRY DUAL WAG INJECTOR*
- *RE- ENTRY SINGLE GAS INJECTOR*
- *RE- ENTRY DUAL GAS INJECTOR*

DEVELOPMENT COMPLETION (COM)

This event includes making up/testing/running/landing/pulling of the completion string /tailpipe and/or production tubing. Includes setting and testing of production packer(s) run in conjunction with the string.

This event should be considered only when a separate AFE for completion is available

- *BEAM PUMP*
- *CASED HOLE*
- *CUTTINGS DISPOSAL*
- *ELECTRICAL SUBMERSIBLE PUMP*
- *GAS INJECTOR*
- *GAS LIFT*
- *MULTILATERAL PRODUCER*
- *MULTILATERAL INJECTOR*
- *OBSERVATION*
- *OPEN HOLE*
- *PROGRESSIVE CAVITY PUMP*
- *SINGLE LATERAL PRODUCER*
- *SINGLE LATERAL INJECTOR*
- *STEAM INJECTOR*
- *WAG INJECTOR*
- *WATER DISPOSAL*
- *WATER INJECTOR*
- *NEW SINGLE OIL PRODUCER*
- *NEW SINGLE GAS PRODUCER*
- *NEW DUAL OIL PRODUCER*
- *NEW DUAL WATER INJECTOR*
- *NEW SINGLE WAG INJECTOR*
- *NEW DUAL WAG INJECTOR*
- *NEW SINGLE GAS INJECTOR*
- *NEW DUAL GAS INJECTOR*

RECOMPLETION (REC)

The event defines the activities of changing the completion to enhance the well's productivity.

- *ADD NEW PAY ZONE*
- *BEAM PUMP*
- *CASED HOLE*
- *CUTTINGS DISPOSAL*
- *DUAL LATERAL PRODUCER*
- *ELECTRICAL SUBMERSIBLE PUMP*
- *GAS INJECTOR*
- *GAS LIFT*
- *MULTILATERAL PRODUCER*
- *MULTILATERAL INJECTOR*
- *OBSERVATION*
- *OPEN HOLE*
- *PROGRESSIVE CAVITY PUMP*

- *SINGLE LATERAL PRODUCER*
- *SINGLE LATERAL INJECTOR*
- *STEAM INJECTOR*
- *WAG INJECTOR*
- *WATER DISPOSAL*
- *WATER INJECTOR*
- *WATER DISPOSAL.*
- *RE- ENTRY SINGLE OIL PRODUCER*
- *RE- ENTRY SINGLE GAS PRODUCER*
- *RE- ENTRY DUAL OIL PRODUCER*
- *RE- ENTRY DUAL WATER INJECTOR*
- *RE- ENTRY SINGLE WAG INJECTOR*
- *RE- ENTRY DUAL WAG INJECTOR*
- *RE- ENTRY SINGLE GAS INJECTOR*
- *RE- ENTRY DUAL GAS INJECTOR*

WELL ENHANCEMENT/ STIMULATION (ENH)
The event encompasses all activities for enhancing flow from reservoir to wellbore.

- *ACID FRAC – ACID*
- *ACID FRAC - CO2*
- *ACID FRAC - N2ACID FRAC – OTHER*
- *ACID JOB - BRIDGE PLUG / PACKER*
- *ACID JOB – BULLHEAD*
- *ACID JOB - COIL TUBING*
- *ACID JOB – OTHER*
- *ACID JOB - PERFORATION CLEANING*
- *ACID JOB - STRADDLE PACKER*
- *ACID JOB - WITH DIVERTER*
- *ADD PERFS (SAME ZONE)*
- *CONFORM - CHEMICAL - PERM BLOCKER*
- *CONFORM - CHEMICAL - REL PERM BLOCKER*
- *CONFORM - CHEMICAL - VOID SPC FILL*
- *CONFORM - CEMENT - DVOID SPC FILL*
- *CONFORM - CEMENT - NEAR WB SQZ*
- *CONFORM – COMBINATION*
- *CONFORM - MECHANICAL – LINER*
- *CONFORM - MECHANICAL – PACKER*
- *CONFORM - MECHANICAL - PLUGBACK/FILL*
- *CONFORM – OTHER*
- *FRAC – UNPROPPED*
- *LOGGING*
- *PLUG BACK*
- *SAND FRAC - CO2*
- *SAND FRAC – GEL*
- *SAND FRAC - N2*
- *SAND FRAC – OIL*
- *SAND FRAC – OTHER*

- *SAND FRAC - RESIN COATED*
- *UNDERREAM OPENHOLE*

WELL CONVERSION (CNV)

This event will be selected when a well is decided to be converted from one well type to another.

- *CONVERT TO DISPOSAL*
- *CONVERT TO OBSERVATION*
- *CONVERT TO SUPPLY WELL*
- *INJECTOR TO PRODUCER*
- *PRODUCER TO INJECTOR*
- *RETURN TO INJECTOR*
- *RETURN TO PRODUCER*

ARTIFICIAL LIFT REVISION (ALR)

This event is selected for conversion of well to artificial lift.

- *CONVERT TO ELECTRICAL SUBMERSIBLE PUMP*
- *CONVERT TO FLOW*
- *CONVERT TO GAS LIFT*
- *CONVERT TO HYDRAULIC LIFT*
- *CONVERT TO PLUNGER LIFT*
- *CONVERT TO PROGRESSIVE CAVITY PUMP*
- *CONVERT TO SUCKER ROD PUMP*

SURFACE EQUIP REVISION (SEQ)

The event defines the revision or re-configuration of surface equipment.

- *BEAM UNIT DOWNSIZE*
- *BEAM UNIT UPSIZE*
- *STROKE LENGTH DECREASE*
- *STROKE LENGTH INCREASE*
- *STROKE PER MINUTE DECREASE*
- *STROKE PER MINUTE INCREASE*

WELL MAINT – RIGLESS (WMN)

All barge and rigless related activities will be considered under this event.

- *ACID DUMP*
- *CASING INTEGRITY TEST*
- *CHANGE GAS LIFT VALVE*
- *CONDENSATE JOB*
- *DIAGNOSTIC*
- *DOGGR SURVEY*
- *FISHING HOT OIL TREATMENT*
- *HOT WATER TREATMENT*
- *OTHER ACTIVITIES*
- *PARAFFIN REMOVAL*
- *PLANNED CHEMICAL TREATMENT*
- *POLISHED ROD FAILURE*
- *SCALE REMOVAL*

- *SLIDING SLEEVE*
- *SPECIAL CHEMICAL TREATMENT SWAB*
- *TREE REPAIR / REPLACE*
- *UNLOAD WELL WITH COIL TUBING*
- *WELLBORE CLEANOUT - COIL TUBING*
- *WIRELINE - BHP/T SURVEYS*
- *WIRELINE – CAMERA*
- *WIRELINE – LOGGING*
- *WIRELINE - MECHANICAL SERVICES*
- *WIRELINE – PROFILES*
- *WR-SCSSV INSTALL / REPAIR.*
- *WELL P&A OPERATION*
- *PRODUCTIVITY TESTING*
- *LDT– LONG DURATION TEST*
- *STIMULATION OPERATION*
- *ACCESSIBILITY OPERATION*

WELL MAINT – RIG (WMR)

Well maintenance and workover activities conducted by rig will be under this event.

- *CASING DAMAGE*
- *CASING PRESSURE*
- *CHANGE PUMP DEPTH*
- *ELECTRICAL SUBMERSIBLE PUMP DOWNSIZE*
- *ELECTRICAL SUBMERSIBLE PUMP FAILURE*
- *ELECTRICAL SUBMERSIBLE PUMP UPSIZE*
- *FISHING*
- *GAS LIFT DESIGN CHANGE*
- *GAS LIFT EQUIPMENT FAILURE*
- *HYDRAULIC PUMP FAILURE*
- *LOGGING - CASED HOLE*
- *LOGGING - INJECTION SURVEY*
- *LOGGING - PRESSURE SURVEY*
- *LOGGING - PRODUCTION SURVEY*
- *LONG STROKE OTHER ACTIVITIES*
- *PERF WASH*
- *PLUNGER LIFT EQUIP FAILURE*
- *POLISHED ROD FAILURE*
- *PREPARATION FOR STEAM*
- *PROG CAVITY PUMP FAILURE*
- *REGULATORY TEST FAILURE*
- *RETURN TO PRODUCTION AFTER STEAM*
- *ROD FAILURE (PART)*
- *ROD PUMP DOWNSIZE*
- *ROD PUMP FAILURE*
- *ROD PUMP UPSIZE*
- *SALVAGE EQUIPMENT*
- *SAND CONTROL - GRAVEL PACK*

- *SAND CONTROL – SCREENLESS*
- *SAND CONTROL - SLOTTED LINER*
- *SAND CONTROL - WIREWRAP SCREEN*
- *SPECIALIZED EQUIPMENT*
- *SWAB*
- *TUBING ANCHOR FAILURE*
- *TUBING CHANGE*
- *TUBING FAILURE (LEAK) UNSEAT PUMP – FLUSH*
- *WELLBORE CLEANOUT*
- *WELLHEAD REPAIR/CHANGE*
- *CHANGE/ADD PAY ZONE*
- *WELL P&A OPERATION*

WELL TESTING (WTS)

Total time spent on drill stem tests, DST, including perforating, flow testing, shut in/build up periods, squeezing, wireline work, sampling and any abandonment work specifically required by the drill stem test. This event will be selected when a separate AFE for well testing is issued.

- *CLEAN-UP*
- *DRILL STEM TEST*

ABANDONMENT (ABD)

This phase includes time associated with either permanent or temporary abandonment of the well. This can be applied to abandonment of the complete wellbore or just a segment of the wellbore. This phase starts when a drillstring is started in the hole to commence abandonment operations (to set open hole plug, ezsv, or cibp). This phase concludes when the drilling unit demobilization procedures are started.

- *SUSPEND*
- *ABANDONMENT*

MAJOR RIG REPAIR (MRR)

Time spent on repairing the drilling rig and its associated equipment, third party equipment also included. Includes rig move out of location.

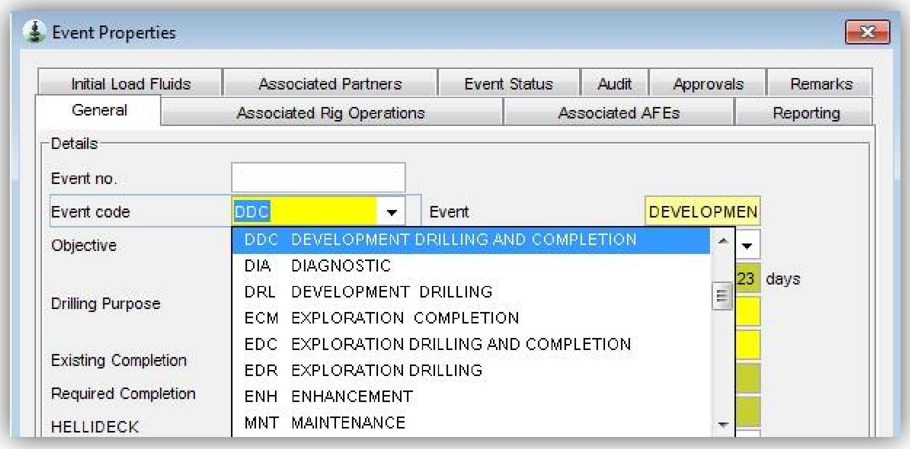
- *MAJOR RIG MAINTENANCE*
- *RIG UPGRADES*

RELIEF WELL (RLF)

Time spent in drilling a relief well to intersect an uncontrolled well.

- *RELIEF WELL*

Example of events in OpenWells®



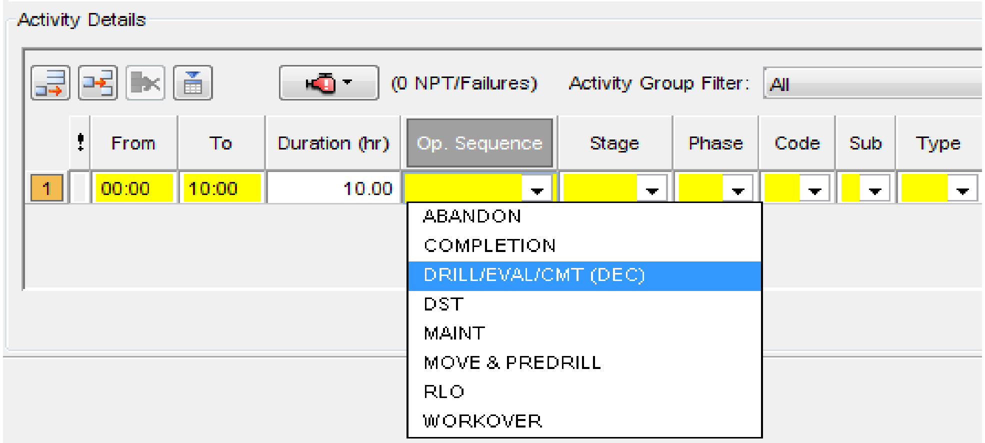
4. OPERATION SEQUENCE, STAGE AND PHASE

The Operation Sequence will indicate the ongoing main activity, this field is not mandatory, but may be used by the OPCO's as shown below.
The Stage will indicate the ongoing activity or section, (see example at the end of this chapter), this field is mandatory.
Phase may be used to describe the hole sizes to be drilled as per the well program / AFE (36", 26", 22", 18 ½", 17 ½", 16", 12 ¼", 8 ½", 6" etc.).

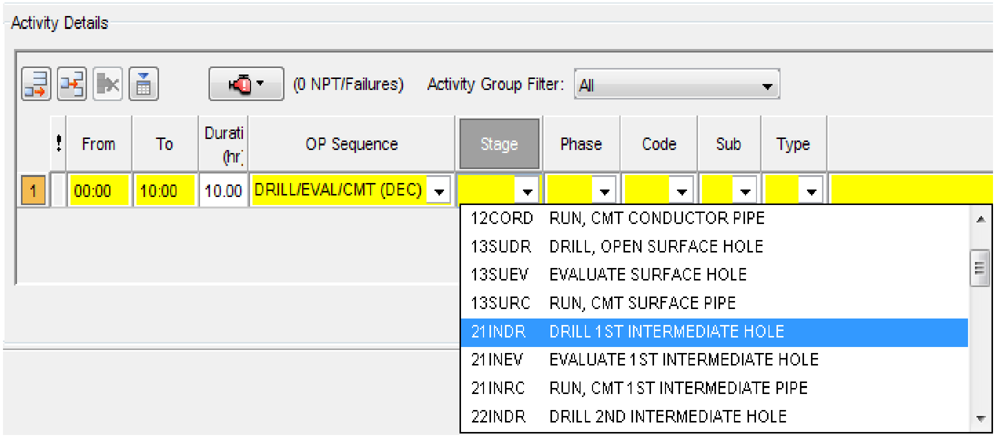
OP Sequence	Stage	Stage Description
MOVE & PREDRILL	00MRMI	Major Rig Move Bw/In Field
	00PSCD	Preset Conductor
	01MIRU	Move In, Mob, Rigup
MAINT	02MAIN	Rig Maintenance
MOVE & PREDRILL	05BOPT	Nipple Up and Test BOP
	06PRES	Pre-Spud
	07PRWO	Pre-Workover
	08RECM	Recover Old Completion
	09PRED	Pre-Drill (only for entry Sidetracks)
DRILL / CMT / EVAL (DCE)	11STDR	Jet, Drill, Open Structural Hole
	11STRC	Run, Cmt Structural Pipe
	12CODR	Drill, Open Conductor Hole
	12CORD	Run, Cmt Conductor Pipe
	13SUDR	Drill, Open Surface Hole
	13SUEV	Evaluate Surface Hole
	13SURC	Run, Cmt Surface Pipe
	21INDR	Drill 1st Intermediate Hole
	21INEV	Evaluate 1st Intermediate Hole
	21INRC	Run, Cmt 1st Intermediate Pipe
	22INDR	Drill 2nd Intermediate Hole
	22INEV	Evaluate 2nd Intermediate Hole
	22INRC	Run, Cmt 2nd Intermediate Pipe
	23INDR	Drill 3rd Intermediate Hole
	23INEV	Evaluate 3rd Intermediate Hole

	23INRC	Run, Cmt 3rd Intermediate Pipe
	30PILO	Drill / Evaluate / Abandon Pilot Hole
	31PRDR	Drill 1st Production Hole
	31PREV	Evaluate 1st Production Hole
	31PRRC	Run, Cmt 1st Production Pipe
	32PRDR	Drill 2nd Production Hole
	32PREV	Evaluate 2nd Production Hole
	32PRRC	Run, Cmt 2nd Production Pipe
	33PRDR	Drill 3rd Production Hole
	33PREV	Evaluate 3rd Production Hole
	33PRRC	Run, Cmt 3rd Production Pipe
	34PRDR	Drill 4th Production Hole
	34PREV	Evaluate 4th Production Hole
	34PRRC	Run, Cmt 4th Production Pipe
DST	41PCOP	Pre- DST Operations
	42PCTC	Prod Testing - Cased Hole (DST)
	42PCTO	Prod Testing - Open Hole (DST)
WO	45WOVR	Work-Over Operations
COMP	50CMPL	Completion Operations
	51 STIM	Stimulation
	55POST	Post-Completion Operations
ABND	61ABND	Abandonment Operations
	62SUSP	Suspending Operations
MOVE & PREDRILL	81DMOB	Rig Down, Demob, Move
	82MRMO	Major Rig Move Out Field
RLO	90 RLOP	Rigless Operations

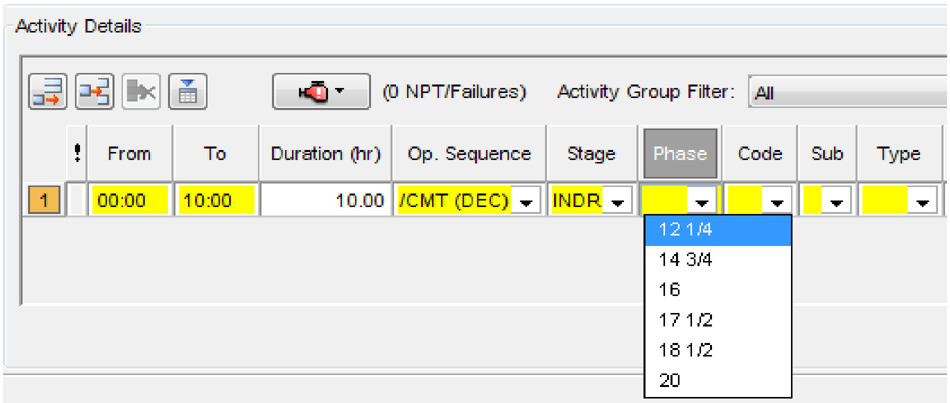
Example of OP Sequence in OpenWells®



Example of Stage in OpenWells®



Example of Operations Phase in OpenWells®

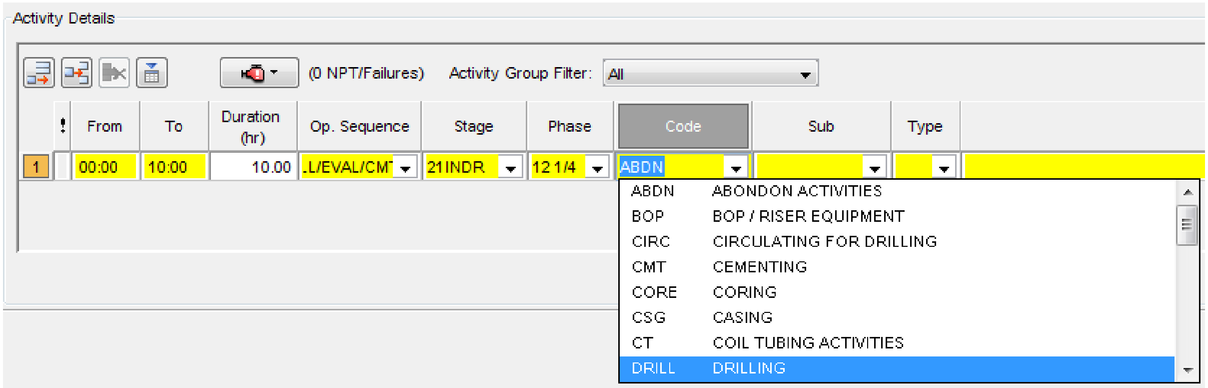


Note: For Stage (Start & End) Definitions please refer to the Appendix.

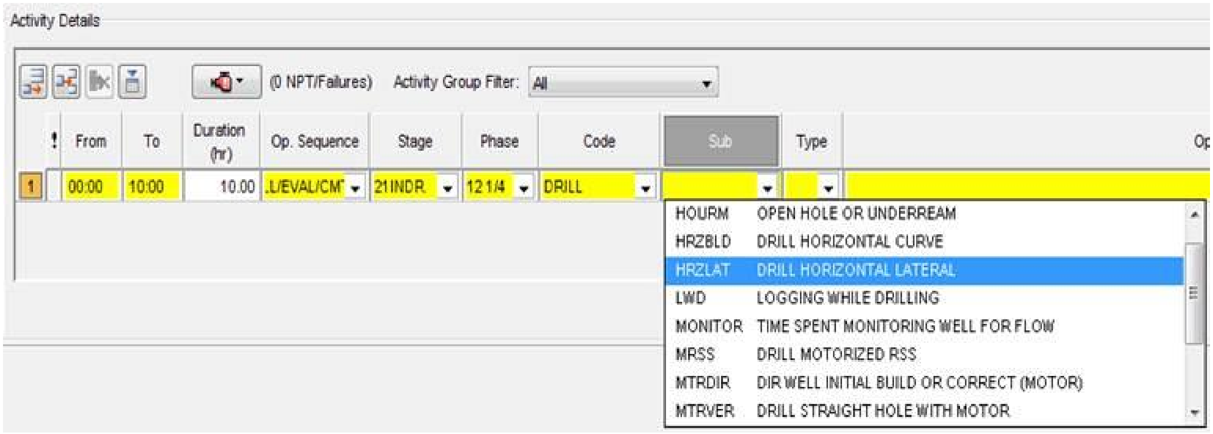
5. OPERATIONAL CODES AND SUB-CODES

This is the library of third tier of phase codes with description of related activities that these codes encompass as they relate to the activities of the Well Phase and Phase codes. The description also highlights criteria and description for when a code should start and stop.

Example of Operations Code in OpenWells®



Example of Operations Sub Code in OpenWells®



CODE [DESCRIPTION]	SUBCODE	SUBCODE DESCRIPTION
ABDN [Abandon activities] → → Time starts when the last regular operation finishes and kill string or cement string is picked up & run and the well is secures by Suspension tree or cap. → In case of suspension, this code includes time spent after the last test or regular operation before suspending the well is completed. This includes time spent to plug back the hole, using cement plugs or Bridge plugs.	PLUGABN	Plug - Abandon
	BULLHD	Bullhead
	SETPKR	Set Packer
	SUSCAP	Securing the well with flanges and Suspension cap
	PULCSG	Remove casing as part of abandonment
BOP [BOP / Riser Equipment] → Includes all well control equipment work including MPD / UBD equipment, including BOP drills → All rig time spent reconfiguring BOP stack → All rig time spent testing BOP equipment → Used for BOP maintenance	CHRAMS	Change rams/other BOP work
	HUBOP	Hang BOP
	RDBOP	RD BOP
	RUBOP	RU BOP - Initial RU
	RUUBD	RU Underbalance BOP Equipment
	RD UBD	RD Underbalance BOP Equipment
	TSTBOP	Test BOP
	BOPJET	BOP Jet
	BOPDRILL	BOP Drill
	DIVRTR	Diverter
	RISER	Run/Pull Riser
CSG [Casing] → Includes rigging up / down of casing equipment, running casing / liner and trips done in conjunction with casing / liner operations. →Time spent for rigging up to run casing/liner, until casing is on bottom ready to be cemented. →Includes circulating with casing in the hole. → Includes POOH with liner setting tool after liner cementing	CORUN	Clean Out Run
	CSGPAT	Run Casing Patch
	LNRTOP	Liner Top Operations
	PIPE	Pressure Test Casing/Liner/Tubing
	POHLST	POH Casing/Liner Landing String
	PULCSG	POH with Casing/Liner
	RIGUP	RU Casing Equip.
	RIGDN	RD Casing Equip.
	RUNCSG	Run Casing/Liner
	TIEBAC	Run Tieback
	RLNRPKR	Run/Set Liner Top Packer
	SCRAPER	Scraper Run
	SLNRHGR	Set Liner Hanger
	RULINES	RU/Pressure Test Surface Lines
	CIRCCSG	Circulating with casing in hole

	RNUBD	Run/Pull Tie Back
	OTHR	Other operation -not in list
CMT [Cementing] Time from R/U cement lines until casing/liner is cemented and cement lines are R/D. → Includes top up cement jobs. → Includes circulation through DV prior cementing second stage and clean out drill pipes after liner cement job. → Includes time spent to cement tie back liner. → Includes reinforce the formation due to low LOT/FIT. (Subcode : REM)	PRIM	Primary Cementing
	PLUG	Plug - Kickoff, etc.
	REM	Remedial / squeeze
	RIGUP	RU Surface or DH Equipment
	RIGDN	RD Surface or DH Equipment
	STAGEC	DV Tool Stage Cementing
	TIEBAK	Tie-Back Cementing
	WOC	WOC
	TOPUP	Top up cementing jobs
	CNCMT	Circulate for Cementing
CIRC [Circulating for Drilling] → Time from interruption of drilling to condition mud or displace hole with new mud until drilling starts. → Circulation for mud-conditioning during normal drilling operations → Time from picking up the bit from bottom, conditioning the hole before survey and surveying, until drilling restarts.	CHOVR	Change Over Wellbore Fluid
	CFSAMP	Circulate For Samples
	CNDFLD	Condition Fluid
	BRINE	Circulate brine
	CNDHOL	Condition Hole
	CNHP	Circulate for Tight Spot/Hole Problem
	MIXBLD	Mix Mud / Build Volume / Ship Fluid
	RCIRC	Reverse circulate
	BRCIRC	Break Circulation
	BTMUP	Circulate Bottoms Up
	CIRCOUT	Circulate Out Wellbore/Fill
CORE [Coring] Cutting of core, tripping and circulating	CUTCOR	Cut core
	CIRCOR	Circulate for Coring
	PULDCOR	Pick up/Lay Down Coring Assembly
	RNCOR	Run Coring Assembly
	PUCOR	Pull Coring Assembly
DRLOUT [Drill Out] → Includes drilling out shoe track, stage tools, drilling new formation for LOT / FIT and performing FIT / LOT	DOCMT	Test CSG. Drill CMT, Floats, landing Collar & Form for FIT
	DOTB	Drill Out Tie-Back/ Stage Tool/Pack off Bushing
	FST	Run FIT/LOT/SBT/WIBT

DRILL [Drilling] → Starts when start drilling. Ends with all tripping → Includes hole opening and under reaming. → Includes connection time. → Includes logging while drilling. → Includes side tracking for re-entry to drill new → In case of excess time in connection operation, due to hole condition or stuck pipe problem, Use codes REAM, STKP etc.	HOURM	Open Hole or Underream
	HRZBLD	Drill Horizontal Curve
	HRZLAT	Drill Horizontal Lateral
	MRSS	Drill Motorized RSS
	MTRDIR	Dir well initial build or correct (motor)
	MTRVER	Drill straight hole with motor
	LWD	Logging While Drilling
	ROTDIR	Rotary - Directional Hole
	ROTVER	Rotary - Vertical Hole
	RSS	Drill with Rotary Steerable
	RWD	Ream While Drilling
	MONITOR	Time spent monitoring well for flow
	DRUBD	UBD Drilling
	OTHR	Other operation -not in list
FISH [Fishing] → Fishing for lost equipment, bits, cones, junk etc. → Includes fishing for drill pipe if not caused by stuck pipe (if caused by stuck pipe then use STKP code). → Include wireline runs for fishing. → Includes all tripping and making up of BHA	BIT	Bit cones
	DRLSTR	Drill string failure (not stuck pipe)
	OTH	Other - junk, dropped tools, other
	STRPOV	Wireline
	TRIPFSH	Tripping for Fishing
	MUBDFSH	MU/Break Down Fishing BHA
	CIRC	Circulate & Spot Fluid (diff sticking)
	CLNJUNK	Clean Junk Off Bottom
	CUTPIPE	Cut Tubing/Casing
	FPBO	Free-point or Backoff
	MILL	Milling
	RIMPBLK	Run Impression Block
	WASHOV	Washing Over
	WLSPEAR	Run Wireline Spear
	WORKJAR	Latch/Work/Jar the Fish/Stuck Pipe
LOCMOV [Location / Move] All activities in conjunction with the moving of the unit → Includes time to off load/ back load equipment. → Includes time at end of well from release of rig to commencement of skidding over another well or into move position. → Includes time spent in preparing rig to start work	LOCPRP	Location Preparation
	MOVE	Move
	RD	Rig Down
	RU	Rig Up

->Standby during Rig Move	WODL	Wait on Day light
	PMAIN	Planned Maintenance
	SAFMEET	Safety Meeting
	SITESU	Site Survey
	ANCH	Anchor (Moor)
	CLNLOC	Clean Location
	LOADUNLD	Unload/Load Equipment
	NDLOC	NDC - Location Preparation
	NDRMT	NDC - Rig Maintenance
	NDRMR	NDC - Rig Move Resources
	NDTRA	NDC - Traffic Coordination
	OPHSE	OPERATOR - HSE
	OPLOC	OPERATOR - Location Preparation
	OPBPC	OPERATOR - BP Change
	OPAHO	OPERATOR - Asset Handover
	OPWOW	OPERATOR - Waiting on Weather
	OPFMJ	OPERATOR - Force Majeure
	OPMRP	OPERATOR - Move Road Preparation
	OPFCD	OPERATOR - FCD Endorsement
	OPCCP	OPERATOR - NOC-CICPA
	OPERD	OPERATOR - NOC-Etihad Rail
	OPDOT	OPERATOR - NOC-Dept. of Transport
	OPADCC	OPERATOR - NOC-ADCC/Transco
	OPLTR	OPERATOR - Late Request
	OPMMR	OPERATOR - Marine Move Resources
	SKID	Skid Rig
LOG [Logging] Wireline logging including logging performed on pipe. Time from commencement of rigging up to log until logging equipment are completely rigged down at the end of logging program. → Includes any necessary conditioning trip conducted during logging operations. → Includes intermediate and final multi-shot gyro surveys if deployed by e-line. → Includes TLC and LWD logging. → Includes repeated logging section and LWD in wipe mode.	CHLOG	Cased Hole Wireline Logs
	TPLOG	Trip for Logging
	SHILT	Shallow Hole Test
	PTSEQ	Surface Equipment Pressure Test
	CIRLOG	Circulate for Logging
	DPLOG	Open Hole Drillpipe Conveyed Logs

	MADPASS	Measurement After Drilling
	OHLOG	Open Hole Wireline Logs
	RIGUD	RU/RD Equipment
	W/LOG	Wipe Log
	WLWRK	Other wireline work (perf, etc)
	TCLOG	Tubing Conveyed Logging
	VLOG	Video Logging
	PERF	Perforating / Re-perforating
	PRLOG	Production Logs
	BHPS	Bottom Hole Pressure Survey
	BHSA	Bottom Hole Sampling
	CMT	Cement Evaluation
LCIRC [Lost circulation] Activities due to lost circulation and when drilling is interrupted to seal off loss zones → Starts when remedial action is required. Includes time to cure losses or flow with LCM, squeeze cement and or setting bridge plug. Includes all tripping time until losses cured or well flow stopped. →End with killing the well or until resuming normal operations.	HEAL	Wait on hole to heal
	LCM	Circulate LCM
	PLUG	Set Cmt or other LCM plug
	LOSS	Lost Circulation
	LCMT	Losses during cement operations
	LFRA	Losses due to fracture/fault
	LSKILL	Losses during Well Killing
	LDEP	Losses due to pressure depletion
OTHR [Other activities] Other or Miscellaneous operations.	OTHER	All other operations
REAM [Ream Hole] Time from the start of reaming and/or washing down until able to carry straight trip in or out under normal drag/ slack-off. → Does not include underreaming.	BKRM	Backream Out Of Hole
	PRRM	Precautionary ream/ wash
	RMTGT	Ream tight or undergauge hole
REDRL [Redrill Preparations (Side tracks only)] → Includes cutting and retrieving casing and milling section or window. → To be used for Sidetracks and Slot Recovery operations only	CLNWEL	Clean-out well for redrill
	CUTPUL	Cut and Pull Casing
	KOP	Set KO plug (was initially CUTSCT)
	RIGUD	RU/RD Equipment
	TRIPPRE	Trip for Sidetrack Preparation
	MILWIN	Mill Window
	WSKWIN	Set whipstock
	WSKREC	Whipstock recover

RIGMT [Rig repairs] Rig maintenance, repair and upgrade → Unplanned repair interrupts normal operations to repair and test rig components or any surface drilling equipment. → Planned repair/maintenance includes weekly monthly maintenance programs or if rig is released to contractor for Proof Load Test, certify BOP's trolley, water leg inspection rig class certification etc. .	REP	Repair rig equip (Unplanned)
	RIGUPG	Rig Modification / Upgrade (RIAP)
	SRVRIG	Normal rig maintenance
	CLNPIT	Clean Pits
	CLNRIG	Clean Rig
	CUTDLIN	Slip and Cut Drilling Line
	SERVRIG	Service Rig and Equipment (planned)
SAFE [Safety activities] Time of interruptions in regular operations for carrying out bi-weekly drills, safety meetings, and audits. → Includes pre-job and toolbox meetings. → Includes workshops, meetings. → Includes Audits and incident investigations. → Includes Time Out for safety	INCINV	Incident Investigation
	SM	Safety Meeting
	DRILL	Safety Drills (H2S, Fire, Evacuation, WC, etc)
	PJSM	Pre-job Safety Meeting
	RUDEQ	RU/RD Safety Equipment
	SAFASSM	Safety Assessment
STKP [Stuck pipe] Work conducted to freeing stuck pipe and recover stuck pipe by fishing.	FISHSP	Recover stuck pipe by fishing
	STKDS	Spot fluid/ jar/ back-off
	WRKPIP	Jarring Pipe
	TRIPSTKP	Tripping during Stuck Pipe
	WSOP	Work on Stuck Pipe
SRFEQ [Surface Equipment] → Rigging up or down of equipment other than rig owners, and repair of same. Not covered by other specific operation codes.	REPR	Repairs (other than rig)
	RIGUP	RU/RD equip on rig floor
	CIRHEAD	Circulating Head
	DSEQ	Drillstring/Tubular Handling Equip
	ELEC	Electrical
	PTSTEQ	Pressure Test Equip
	PWRSWIV	Power Swivel
	RIGFLR	Rig Floor
	RODEQP	Rod Handling Equip
	SCEQ	Service Company Equip
	PRODOP	Production Ops
	CL	Control lines
	TPP	Tanks/Pits/Pumps
SURV [Survey directional] Time from picking up the bit from bottom, conditioning the hole before survey and surveying, until drilling restarts.	GMS	Multishot on wire/slickline incl RU/RD
	GYRO	Gyro Survey

→ Includes survey before spud in and after drilling the 36"hole. → Includes multi/single shot gyro survey for nudging and kick off operations. → Includes MWD record for tie in survey or tie in gamma ray logging for previous drilled section. → Includes Intermediate and final gyro surveys if deployed by drill pipes → Excluding LWD.	INCL	Single survey on slickline incl RU/RD
	GSS	Gyro Single Shot
	MDMS	Magnetic Directional Multishot
	MDSS	Magnetic Directional Single Shot
TRIP [Tripping (Drilling Only)] Time from pulling off bottom until a new Bit/BHA is on bottom and a new operation is due to commence. → Includes making up the new bit. → Includes making up and laying down the bottom hole assembly. →Excludes trip for coring, logging or other special operations → Includes any short trip or round trip done due to failure or washout → Includes trip for reaming and washing → Excludes time to pull and clear plugged bit → Excludes pulling out downhole equipment	PUBHA	Make up /Pickup BHA
	LYDNBHA	Lay down BHA
	CMT	Trip cementing tools
	COND	Trip to clean hole or condition mud
	DRILL	Trip for bit or BHA, log/csg point, or TD
	LDNDP	Lay down Drilling String
	PUDP	Pick Up Drill String
	PMPOT	Pump out
	RMHO	Trip reamer or hole opener
	STRP	Short Trip
	WIPER	Wiper trip (not to surface)
	WSHO	Trip for washout
WAIT [Waiting time] All waiting time except waiting on cement	WOD	Waiting On Daylight
	WOLOC	Waiting on Location Access
	SBOATO	Waiting On Supply Boat (Operational Weather)
	SBOATN	Waiting On Supply Boat (Non Operational Weather)
	ABOATO	Waiting on Acid Boat (Operational Weather)
	ABOATN	Waiting On Acid Boat (Non Operational Weather)
	TBOATO	Waiting on Tug boat (Operational Weather)
	TBOATN	Waiting on Tug boat (Non Operational Weather)
	TOWER	Waiting on Tower Preparations
	SIMOPS	Waiting on SIMOPS
	CRANE	Waiting on Crane (high winds)
	ORDERS	Waiting on Orders
	WOW	Waiting on Weather
	PERSON	Waiting on Personnel
	DIVG	Diving / ROV / Camera
	SDFACMT	Shutdown for Facility Maintenance./Ops.

	RIGPSDN	Planned Rig shutdown
	RIGUPSDN	Unplanned Rig shutdown
	WOEQC	Waiting On Equipment
WLCNTL [Well Conrol] Work conducted as result of a kick or to control well flowing → Includes Well Control during Drilling, Evaluation, WO, → Includes Well Control drills	CRCCND	Shut in / Circulate Out Kick / Cond Mud
	NOCIRC	Well Control Ops w/o Circulating
	STRIP	Stripping Pipe In/Out
	WCDRL	Well Control during Drilling
	WCTRIP	Well Control during Tripping
	WCCIR	Well Control with Circulation
	WCFW	Flow Well
	WCOW	Observe Well
	WCEVL	Well Control during Evaluation
WLHD [Well Head] Work on wellhead / wearbushing	RWH	RU/RD Wellhead
	TSTWH	Test Wellhead
	RWB	Run / Pull Wearbushing
CT [Coil Tubing activities] All coil tubing operations → Includes coil tubing operations to clean sediments → Includes coiled tubing for diesel or Nitrogen lift. → Includes only Coil Tubing R/U and R/D for Well Stimulation, other stimulation operations will be under ST code	CHEM	Special Chemical Treatment
	CI	Corrosion Inhibitor
	DISPL	Displacement
	MILL	Milling
	MUBDDEQ	MU/BD Down Hole EQ
	N2KO	N2Kick Off
	OTHER	Special CT Operations
	PLUG	Plug setting / retrival
	PTSTEQ	Pressure Test Equipment
	RUDSEQ	RU/RD Surface Equipment
	SCALE	Scale Removal
	STIM	Stimulation (R/U R/D for Stimulation only)
	WBCO	Wellbore Clean Out
	MUCWJ	CT Lift Frame/ Flowhead
CM [Completion] Time spent to prepare, run, land and test a new completion. → Includes time to run and set dual or single hydraulic packers. → Includes dummy seal or smart tool run. → Includes any clean out trips prior to run completion. → Includes displacing well fluid with inhibited brine and observing well. → Includes completion tests during running completion.	IRAEQ	Install/Remove Associated Equip
	IRPOC	Install/Remove POC
	IRSU	Install/Remove Surface Unit
	MUBDCM	MU/Breakdown Completion Equip

→ Includes time to check injectivity prior to N/U X-mass tree. → Includes N/U, N/D, Xmas Tree	SPACE	Space Out
	STROUT	Strip Out Tubing/Rods
	TRIPROD	Run/Pull Rods
	RIGUP	RU Completion Running Equipment
	RIGDN	RD Completion Running Equipment
	CIRCM	Circulation with Completion
	RUNTBG	Run Tubing
	PULLTRIPTBG	Pull Tubing
	TRIP	Tripping
	DISPL	Displace well
	MONITOR	Monitor and observe well
	COMPTST	Completion tests
	TRIPESP	Run/Pull ESP Completion
	TRIPICD	Run/Pull ICD Completion
	CORUN	Clean Out Run
	DUMMY	Gauge or Dummy run
	TUBHGR	Tubing Hanger
	STAB	Stab / Sting
	PACKER	Set/Unset packer
	MLFISHPK	Mill/Fish Packer
	SCRAPER	SCRAPER RUN
	TSTXMASS	Test Xmass Tee
	TREEND	Tree Nipple Up / Down
	OTHR	Other operation -not in list
GPFP [Gravel/Frac Pack] Pick up and run Gravel assembly, pump gravel and mini & main frac pack, and rig down equipment.	MUBDDEQ	MU/Breakdown DH Equip
	PMPGRAV	Pump Gravel
	PMPPFP	Pump Frac
	RUDSEQ	RU/RD Surface Equipment
	TRIP	Tripping
IE [Injection Equipment] All activities related to Injection (excluding Well Testing)	MUBDDEQ	MU/Breakdown DH Equip
	INJ	Perform injection test
	TRIPIE	Tripping for Injection Equipment
PF [Perforating] Time required to perforate the well → Includes time to make up/lay down guns, firing heads, trip and get on depth	CIRC	Circulating
	LOG	Correlation Log

	MUBDDEQ	MU/Breakdown DH Equip
	RUDSEQ	RU/RD Surface Equipment
	SETPKR	Set Packer/Tools
	SHTDRP	Shoot and Drop
	TRIP	Tripping TCP Guns
PT [Pressure Test] Pressure testing to determine the maximum pressures that may be safely applied without the risk to formation. This code to be used if no relevant Pressure testing code is available.	BPV	Back Pressure Valve
	COMPSTR	Completion
	DHSV	Downhole Safety Valve
	LOTFIT	Leak Off Test / Formation Integrity Test
	MUBDDEQ	MU/Breakdown DH Equip
	PIPE	Casing/Liner/Tubing
	RUDSEQ	RU/RD Surface Equipment
	SURLINEQ	Surface Lines / Equipment
	TRIPPT	Tripping for PT
	CTPT	Coil Tubing Pressure Test
	WLPLUG	Wireline Plug
ST [Stimulation] Time spent to stimulate the well by acidizing or any other mean, either through the completion or via production test string or DST string. → Includes spotting acid using coiled tubing from rig up to rig down. → Includes time spent to check injectivity prior to acidize by bullheading or through coiled tubing. → Includes test of flow lines and acid lines. → Includes spotting and circulating out Enzyme	ACID	Acidizing
	CHEMTRT	Chemical Treatment
	DIVERT	Diverting Agent
	EMUL	Emulsified Acid
	FRAC	Fracturing
	HOTOIL	Hot Oil Treatment
	MUBDDEQ	MU/Breakdown DH Equip
	N2ACID	Nitrified Acid
	N2LIFT	Nitrogen Lift
	PERFWASH	Perforations Wash
	PTSTEQ	Pressure Test Equipment
	REVOUT	Reverse Out Sand
	RUDSEQ	RU/RD Surface Equipment
	SPOT	Spot & Circulate
	TRIP	Tripping
	XLINK	Cross Link
RW [Routine Work (Downhole Maint)] All work related to wellbore cleaning techniques and operations →Includes remove all mud residue and other debris that can damage completion → Includes tools designed for scraping and brushing the inside of ID casings	CALEQP	Measure/Caliper Equipment
	FILLTBG	Fill Tubing
	JB	Junk Basket Run on Pipe

and liners in preparation for packer setting or pulling → Includes operations to ensure zonal isolation	PKRPLUG	Run/Pull Packer, Bridge Plug, Other
	PULD	Pick Up / Lay Down Workstring
	SCRAPER	Bit & Scraper Run
	SDN	Shutdown for Night
	SURGTOOL	Surge Tool Run
	TBGBAIL	Bail Sand with Tubing
	TRIP	Tripping
	ZPERF	Perforation for Zonal Communication
	SPOT	Spotting Hi-Vis mud, heal pill , LCM or acid
	OTHR	Other operation -not in list
TS [Well Testing activities] Times spent to flow the well through separator or carry out pilot injection test → Includes additional perforations/operations. → Includes any operation to terminate ongoing test for next test. → Includes production logging (PLT) and pressure gradient survey. → Includes Drill Stem Tests (DST). → Includes RIH/POOH production/injection/DST test string. → Includes initial flow, PBU or PFO operations during the test	CU	Clean up
	FIRETCP	Fire Tubing Conveyed Perforating Guns
	FLDLEVL	Fluid Level
	FLOWPD	Flow Period
	IFTEST	Inflow Test (IF / WSO)
	INJTEST	Injection Test
	MPFM	Multi-Phase Flow Meter
	MRT	Multi Rate Testing
	MUBDDTL	MU/Breakdown DH Tools
	MUBDSEQ	MU/Breakdown Surface Equip
	OHTEST	Open Hole Testing
	PRBUILD	Pressure Build Up
	PACKER	Set Packer
	PTSTEQ	Pressure Test Equipment
	RULINES	Rig Up/Test Flow & Kill Lines
	SRT	Step Rate Testing
	PDST	Well testing (DST)
	TRIP	Tripping
	FLOWBH	Press Survey - Flowing BH
	FLOWBU	Press Survey - Flowing Buildup
	FLOWGRD	Press Survey - Flowing Gradient
	STATBH	Press Survey - Static BH
WL [Slick line activities] All Wireline operation in Drilling or Completion beginning with rig up of	BHP	Run/Set/Retrieve Downhole Gauges

Wireline Unit to laydown of BHA → Includes Gauge run, Packer run, replace GLV, tag, downhole samples → Excludes Wireline Fishing, logging and pressure test(w/l plug).	BLKPLUG	Run/Pull Blanking Plug
	CUTSCAL	Cut Scale
	DHSV	Run/Pull Downhole Safety Valve
	DUMPBLR	Run Dump Bailer
	GAUGRNG	Gauge Ring
	GLVAVL	Gas Lift Valve Changes
	ISOSLV	Run/Pull Isolation Sleeve
	MEMPL	Memory Production Logging
	MUBDDEQ	MU/Breakdown DH Equip
	PTSTEQ	Pressure Test Equipment
	RUDSEQ	RU/RD Surface Equipment
	RUNPKRA	Run Packer Assembly
	RUNPLUG	Run/Set Cmt Retainer/Bridge Plug
	SAMPL	Downhole Sampling
	SANDBLR	Run Sand Bailer
	SLSLEEV	Open/Close Sliding Sleeve
	SPVALV	Run/Pull Side Pocket Valves
	SWAB	Swabbing
	TAG	Check PBTD/ECOD or Tag for Fill

6. OPERATION TYPE INCLUDING NPT

The operation type indicates whether this is preplanned activities or activities that have been subject to a scope change with a corresponding Management of Change process. It will also differentiate between productive and non-productive activities.

OPERATION TYPE

CODE	Description
N	Program Work / Normal Operations
L	Program Work Non Productive Time / Lost Time
SN	Scope Change - Normal Operations
SL	Scope Change - Non Productive Time / Lost Time

Program Work:
Time Summary activities that follow those steps outlined in the work program that we started operations with at the beginning.

Program Work Non Productive Time:
NPT is any unexpected occurrence caused by either operating equipment failure or an event such as stuck-pipe or waiting on weather. It is categorized as either lost time, which is avoidable - or down time, which is unavoidable.
NPT is also known as trouble time, and commonly used as a measure of efficiency of operations.
Lost time is generally defined as unproductive/unplanned extra time. These problems are avoidable and self-inflicted, i.e. faulty hardware, equipment failures, incorrect actions, procedures, planning, instructions, negligence, incidents, accidents, etc. All time spent on associated operations to remedy these problems (e.g. extra trips, fishing, circulating, sidetracking, etc.) is included.
NPT duration is the time between the non-conformance/failure event and returning to the same point in the well before the event occurred. NPT also includes time where operations cannot proceed as normal, e.g. waiting on weather, this is included in NPT but shall be monitored separately. Time spent to perform a planned critical path activity during an NPT event may be subtracted from the NPT duration. For example, if a decision is made to perform a BOP test while waiting on equipment to continue drilling, this time should be deducted from the total NPT duration.

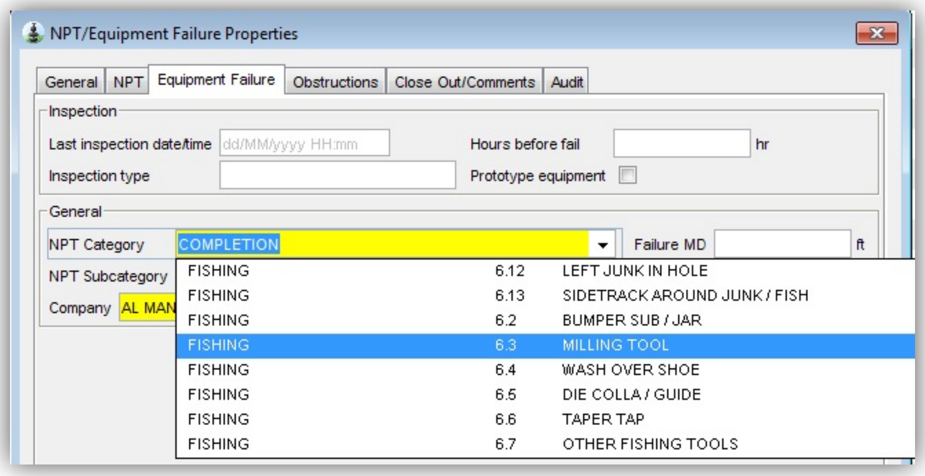
Scope Change Work:
A scope change is a change in the planned operations. It is an additional requirement during a well phase. It is very important to record the scope change events clearly in order to calculate Drilling & Completions efficiency accurately.
Any additional activity ,which was not planned in original AFE during WDP (Well Delivery Process) and was required due to change in requirements or due to operational issues (not NPT events), is a scope change.
Scope change should be accompanied with an approved MOC, Approved Program / Procedure.

Scope Change Non Productive Time

Any NPT event during scope change will be considered as NPT event (Scope Change NPT).

7. NPT Category / Subcategory and Definitions

Example of NPT Category in OpenWells@



NPT CATEGORY/ NPT FAILURE DESCRIPTION	NPT Code	SUBCATEGORY
LOST TIME Lost time is generally defined as unproductive/unplanned extra time. These problems are avoidable and self-inflicted, i.e. faulty hardware, equipment failures, incorrect actions, procedures, planning, instructions, negligence, incidents, accidents, etc. All time spent on associated operations to remedy these problems (e.g. extra trips, fishing, circulating, sidetracking, etc.) is included	1 (ADMA) 2 (ZADCO)	LOST TIME
WAITING ON Meetings or training for general purpose that shuts the rig down. Not for JSAs, pre-job safety meetings or HES investigations. Waiting on daylight to move the rig. Activity suspended due to waiting on personnel. Operations suspended due to labor industrial disputes or local community problems. Activities suspended because of unforeseeable bad weather conditions.	100 101 102	WAITING ON WEATHER WAIT ON PERSONNEL MEETING AND TRAINING
SIMOPS Different activities by Rig and Tower occurring close enough to each other that there is a risk of interference, clashing, or risk transfer.	201	SIMOPS

WO INSTRUCTION/PAPERWORK Waiting on Instruction and Paperwork	202	WO INSTRUCTIONS/PAPERWORK
	203.1	WAITING ON SQM TEAM
	203.2	WAITING ON SE TEAM
	203.3	WAITING ON NEB TEAM
	203.4	WAITING ON BU TEAM
	203.5	WAITING ON BAB TEAM
	203.6	WAITING ON GAS TEAM
	203.7	WAITING ON ASR TEAM
	203.8	WAITING ON EXPL/UFR TEAM
	203.9	WAITING ON CICPA
CASING - Problems with the casing itself like crossed threads, failure / leak during a pressure test, etc and which may require remedial work.	1.1	CREW/POWER TONG/JAM UNIT/ELEVATOR/SLIPS/FILL UP PKR
	1.2	LINER HANGER SETTING TOOLS
	1.3	DV TOOL& PACKER/FLOATING EQPT/EXPANDABLE
	1.4	CASING CRACK/ PARTED/ COLLAPSED
	1.5	OTHER CASING TOOLS
	1.6	CASING LEAK
	1.7	CASING PATCH
	1.8	DRESSED DV EQUIPMENT
	1.9	AUTO FILL CIRCULATING HEAD
	1.10	JUNK IN HOLE
	1.11	DROPPED CASING/OBJECT
	1.12	NEGLIGENCE
CEMENTING - Any time associated with remedial cementing job performed during the Drilling phase; not associated with bond log indicating cement integrity failure (i.e., wet shoe). - Time spent fixing a cemented-up drillstring during liner or stab-in cementing jobs, until back on normal operations. - Problems with equipment like liner hanger, top packer, inflatable packer, float equipment, stage tools, etc. NPT will include the time spent fixing the problem. - Cementing-related surface equipment failure. - Any time associated with remedial cementing job performed during the Drilling phase. Repair due to bond log indicating cement integrity failure. - Problems with failed Kick Off plugs, abandonment plugs, squeezes. - Time spent cleaning cement from inside a casing and repairing cementing job (if any). Does not include cleaning shoe track in normal / successful cementing operations. - Additional time WOC to set as compared with the lab test results.	2.1	CMT UNIT/RCM/ CMT SYSTEM/CIRC SWEDGE/ CMT HEAD
	2.2	CEMENTING/SQUEEZING/MATERIAL/SERVICES
	2.3	DRY TESTING SERVICES(CREW/TOOLS)/HANDLING EQUIPMENT
	2.4	RETRIEVABLE PACKER
	2.5	CMT RETAINER/BRIDGE PLUG/SETTING TOOL
	2.6	CEMENT INTEGRITY TEST FAILURE
	2.7	CEMNTED UP DRILLSTRING/STINGER
	2.8	CMT DOWNHOLE EQUIP FAILURE
	2.9	UNPLANNED CEMENT INSIDE CASING
	2.10	WO CEMENT WHEN NOT SET ON TIME
	2.11	CMT SURF EQUIP FAILURE
	2.12	FAILED CEMENT PLUG
	2.13	KICKOFF PLUG SOFT CEMENT
	2.14	REMEDIAL JOB DUE TO CEMENT FAIL

	2.15	CASING CEMENT ACCESSORIES
	2.16	CEMENT PERSONNEL HUMAN ERROR
	2.17	CEMT FAILURE OF PRIMARY JOB
	2.18	CEMT FLASH SET
	2.19	CEMT.O/DISPL. DUE TO EQUIP FAIL
DRILLING - Any evident downhole equipment failure (i.e.: DP, Jars, PDM, RSS, Bit etc.) other than the following equipment: logging, cementing, casing pipe or any completion equipment, since these are considered in separate NPT categories. - Time spent trying to unplug bit, including any trips.	3.1	STABILIZERS
	3.2	SHOCK SUBS
	3.3	JARS
	3.4	POWER TONG/DP'S HANDLING EQUIP
	3.5	BIT CONE/ NOZZLE/ BREAKER/ PLUG
	3.6	HOLE OPENER/UNDER REAMER
	3.7	DRILL STRING FAILURE(WASHOUT/TWISTOFF/BACKOFF)
	3.8	UBD PACKAGE
	3.9	AIRDRILLING
	3.10	DRILL STRING FATIGUE
	3.11	DRILL STRING OVERPULL
	3.12	DRILL STRING COLLAPSE
	3.13	PDC/DIAMOND BIT
	3.14	ROCK BIT
	3.15	JUNK IN HOLE
	3.16	OVER/LESS TORQUE CONNECTION
DIRECTIONAL DRLG - Correction run(s) done as a result of deviating from the directional plan on directional or horizontal wells. - Failure to build angle according to plan - Time spent correcting consequential damages after colliding with another well (drilling, not driving pipe) until back on drilling into the desired trajectory, or a decision has been taken on well's objectives. - Problem with LWD equipment or services. Includes down hole tool failure, surface equipment or other problems obtaining required data - Problem with any survey equipment, tool or services (MWD, Teledrift, Gyro, etc). Includes failures of surface equipment used to run downhole tools (e.g. computer hardware/software) but NOT wireline/slickline unit (use Wireline or wireline unit problem) - Correction run(s) done as a result of deviating from the directional plan on vertical wells. Well unintentionally sidetracked when reaming hole or working a stiff assembly to TD.	4.1	DIRECTIONAL TOOL/OPERATOR
	4.2	STEERING TOOL/BENT HOUSING/ORIENTING SUB
	4.3	SINGLE SHOT GYRO SURVEYS
	4.4	MULTI SHOT GYRO SURVEY
	4.5	MAGNETIC SINGLE/MULTI SHOT SURVEYS
	4.6	UNABLE TO KICK OFF DOWN HOLE MOTOR
	4.7	DRILLING MOTOR/ PROBLEMS
	4.8	MWD PROBLEMS
	4.9	LWD PROBLEMS
	4.11	RSS PROBLEMS
	4.12	OTHER SURVEY TOOLS
	4.13	WHIP/PACK/ANCHORSTOCK/RETRIEVABLE TOOLS
	4.14	DRILLED INTO OTHER WELL
	4.15	DIRECTIONAL CONTROL
	4.16	SIDETRACK UNACCEPTABLE
	4.17	TROUBLE SHOOTING DOWN HOLE
	4.18	TROUBLE SHOOTING SURFACE EQUIP.
	4.19	LOST EQPT/FISHNG/S.TRACK
	4.20	MISS TARGET PLUG BACK/ST

DOWNHOLE EQPMT Any evident downhole equipment failure (i.e.: DP, MWD, LWD, Jars, PDM, RSS, Bit etc.) other than the following equipment: logging, cementing, casing pipe or any completion equipment, since these are considered in separate NPT categories.	5.1	TURBINE / OPERATOR
	5.2	PDC/DIAMOND BIT
	5.3	DOWNHOLE EQUIPMENT FAIL
FISHING Begins when fish is "identified" to start R/U fishing operations and ends once fish is recovered, and hole is conditioned, or after sidetracking and back to previous hole MD. This category is not a consequence of a stuck pipe incident Fishing all or a portion of the BHA as a result of a mechanical pipe failure (Washout, pipe fatigue, etc.). Fishing time as a result of accidentally dropping string while tripping or making a connection, by either human error or equipment failure. Fishing time as a result of any part of equipment left in hole as a result of the drilling / completion operation (bit cones, etc.).	6.1	OVERSHOT/GRAPPLE/GUIDE/SPEAR
	6.2	BUMPER SUB/JAR
	6.3	MILLING TOOL
	6.4	WASH OVER SHOE
	6.5	DIE COLLAR/GUIDE
	6.6	TAPER TAP
	6.7	OTHER FISHING TOOL
	6.8	BHA (OVERSHOT/JAR/SPEAR)
	6.9	DRILLSTING
	6.10	JUNK IN HOLE
	6.11	DROPPED JUNK, CSG/DRILL/TBG STRING
COMPLETION Extra time spent replacing or repairing any downhole equipment or tool from the completion assembly, including the necessary trips.	7.1	STIMULATION PACKAGE, STRING, SERVICES
	7.2	COILED TUBING PACKAGE/SERVICES
	7.3	DST TOOL PACKAGE
	7.4	TESTING EQUIPMENT/BURNER BOOM/COMPRESSOR
	7.5	WELLHEAD/XMASS TREE/VALVES/CHOKE MANIFOLD
	7.6	TUBING HANGER
	7.7	DOWN HOLE EQUIPT/SSV/CONTROL LINE/SSD
	7.8	SEAL ASSY
	7.9	PERMANENT PACKER
	7.10	GAS LIFT MANDREL
	7.11	DUAL HYDRAULIC PACKER
	7.12	SINGLE HYDRAULIC PACKER
	7.13	EXPANSION JOINT
	7.14	BLAST JOINT
	7.15	FLOW COUPLING
	7.16	NIPPLE
	7.17	WIRELINE ENTRY GUIDE
	7.18	TAIL PIPE
	7.19	CREW/POWER TONG/JAM UNIT/COMPUTER
	7.21	DUAL HANDLING EQUIPMENT
	7.22	SNUBBING UNIT
	7.23	WIRELINE(SLICKLINE) TOOLS/SERVICES
	7.24	OTHERS COMPLETION EQPT
	7.25	COMPONENT FAIL
	7.26	CORROSION

	7.27	SQUEEZE
	7.28	INJECTION LINE
	7.29	SLICK LINE SERVICES AND EQUIP
	7.30	ESP TOOL SERVICES/ EQUIP
	7.31	TUBING LEAK
	7.32	COMPLETION EQUIP LEAK
	7.33	COMPLETION STRING DROP
	7.34	COMPLETION STUCK
	7.35	PRODUCTION TEST STRING
	7.36	COMP.RUNNING OPERATION
	7.37	OLD COMPLETION RECOVERY
	7.38	NEGLIGENCE
CORING Coring issues	8.1	CORE BARREL
	8.2	CORE HEADS
MUDLOGGING Failure/Problems with Mud Logging Services	9.1	MUD LOGGING SERVICES
WIRELINE Wireline unit failure while performing wireline jobs different than logging during the Completion phase.	10.1	WIRELINE CABLE
	10.2	WIRELINE PLUGS
	10.3	WIRELINE DEPTH COUNTER
	10.4	WIRELINE UNIT
	10.5	OTHER WIRELINE EQPTS
RIG_SURFACE_EQPT Suspended operation due to any rig equipment failures provided by Rig contractor, including BOP (even if it is a third party rental). Do not consider routine maintenance practices (i.e., cut & slip drilling line, rig service). Rig downhole equipment, like DP or DC, will be captured under Downhole Equipment Failure.	11.1	TOP DRIVE/POWER SWIVEL
	11.2	RIG PUMPS
	11.3	ROTARY TABLE
	11.4	GENERATOR/SCR/DC/ELECT.POWER, VFD
	11.5	ENGINES
	11.6	JACKING/SKIDDING SYSTEM/ PRELOADING
	11.7	BOPS/KOOMY UNIT
	11.8	CRANE
	11.9	TRIP TANK
	11.11	MUD PIT / KILL LINE/ CHOCKE LINE
	11.12	DEGASER
	11.13	DESANDER/ DESILTER/ CENTRIFUGE
	11.14	SHALE SHAKER
	11.15	DRAW WORKS
	11.16	STAND PIPE/CHOKE MANIFOLD
	11.17	BELL NIPLLE/RISER
	11.18	SPUD CAN INSPECTION
	11.19	OTHER DRILLING CONTRACTOR EQUIPMENT
	11.21	IRON ROUGHNECK
	11.22	KELLY ASSY/KELLY SPINN

	11.23	WASH PIPE
	11.24	SWIVEL
	11.25	RIG ALIGNMENT
	11.26	MUD EQUIPMENT/MATERIALS
LOGISTIC Waiting on supply, tug, acid boats, etc	12.1	TUG BOATS/OFFLOADING/ACID BOAT
	12.2	DELAY OF SUPPLY BOATS
	12.3	CUTTING MOORING ROPE
	12.4	HITTING THE WELL HEAD/JACKER/SEA LINE/OIL LINE
	12.5	LOGISTICS OTHERS
	12.6	WAIT ON SERVICE CO.EQUIP
	12.7	MOBILE EQUIP/CRANE/CIVIL MACHINE
	12.8	TRANSPORTATION
	12.9	WAIT ON MUSSAFAH TRANSPORT
	12.10	WAIT ON BAB-13 TRANSPORT
	12.11	WAIT ON HAULAGE TRANSPORT
	12.12	EQUIPMENT SUPPLY
	12.13	WAIT ON FLUID HAULAGE
LOGGING Time lost tripping, repairing or waiting on equipment to fix the failure, until fully functional and back at the depth of the failure. Specify the individual part that failed (i.e. TLC system, MDT, PEX, FMI, HRLA, etc.). Time spent trying to unstick logging tools in either open hole or cased hole, including the unsuccessful fishing operation, until the time the source has been abandoned downhole and isolated as per regulations, and back to normal operation, or the well sidetracked Time spent trying to unstick logging tools in either open hole or cased hole and the time fishing it (if any) until fully recovered.	13.1	LOGGING TOOLS FOR CASED HOLE LOGS
	13.2	LOGGING TOOLS FOR OPEN HOLE LOGS
	13.3	CABLE/DRUM OF LOGGING UNIT
	13.4	PERFORATING TOOLS/CHEMICAL CUTTER/PUNCHER
	13.5	PRODUCTION LOGGING
	13.6	PERMENENT PACKER/BRIDGE PLUG/SETTING TOOL/CMT RETAINER
	13.7	OTHERS LOGGING TOOLS
	13.8	LOST SOURCE IN HOLE
	13.9	STUCK LOGGING TOOL
	13.10	FAIL RUN (BAD QUALITY)
	13.11	ELECTRIC WIRELINE
	13.12	NEGLIGENCE
SAFETY Operations stopped to investigate an incident. Operation stopped due to an injury or illness. Once the mitigation measures have been taken, an Incident Investigation will follow.	14.1	AIR LOOP SYSTEM
	14.2	OTHER SAFETY EQUIPMENT
	14.3	SAFETY STAND DOWN

Environmental issues caused by the drilling operation.	14.4	INCIDENT INVESTIGATION
	14.5	INJURY OR ILLNESS RELATED
	14.6	SPILL OR OTHER ENV
TOWER Delay or Issues in Tower	15.1	DELAY TOWER PREPARATION
	15.2	OTHER TOWER EQUIPMENT
RIG COMMUNICATION EQUIPMENT Failure of rig communication equipment	16.1	TELEPHONE
	16.2	RADIO
	16.3	COMPUTER
	16.4	EMAIL
	16.5	FAX
HOLE PROBLEM Circulating specifically to clean the hole of any unexpected cuttings build-up. Hole "packing off" when drilling, circulating, washing & reaming for any reason. Circulating or reaming sloughing and/or caving shale in the hole and/or dealing with it at the surface. Would only apply if casing was not stuck. Loss of fluid from well regardless of reason, including pack-offs where fluid loss occurs. If lost circulation occurs after another event (e.g. well control) then use previous problem event. Only use this problem if losses persist after previous event is closed Circulating time spent conditioning and/or treating mud to the required specs as a result of contamination from formation fluids or inappropriate existing mud properties. Logs did not get to bottom and further runs or wiper trips were required to re-run or complete the logging. Sidetrack hole due only to hole problems (hole collapse, formation instability, undergauge hole, inadequate hole cleaning). This is an intentional sidetrack. Dealing with tight hole which is alleviated when the mud weight is increased. Dealing with gumbo adhering to the BHA or drillstring, time spent dealing with inhibition causing accretion to metal parts. Incompatibility between formations drilled, crude oil and lubricants.	17.1	OPEN HOLE PROBLEM (FILL, GUMBO) RELATED TO HOLE CONDITION
	17.2	STUCK PIPE (PROBLEMS WITH STUCK DRILL PIPE, CASING/LINER OR TUBING)
	17.3	LANDING POINT/TARGET LOCATION (MUD/FLUID PROBLEM (DRILLING OR COMPLETION FLUID PROBLEMS)
	17.4	MUD LOSSES (LOST RETURN, CIRC. PROBLEMS)
	17.5	WELL CONTROL PROBLEM DRILLING
	17.6	WELL CONTROL PROLEM COMPLETION
	17.7	CASED HOLE PROBLEM
	17.8	CIRC OUT CUTTINGS BUILD-UP
	17.9	CIRC/REAM HOLE PACKING OFF
	17.10	CIRC/REAM UNSTABLE HOLE
	17.11	COULD NOT RUN CSG TO TD
	17.12	DRILLING / COMPLETION FLUID LOSSESS
	17.13	INADEQUATE MUD PROPERTIES
	17.14	LOG RUN COULD NOT GET TO TD
	17.15	SIDETRACK DUE TO HOLE PROBLEMS
	17.16	TIGHT HOLE FROM FORMATION STRESS
	17.17	TIGHT HOLE DUE TO MUD PROPERTIES / CHEMICALS
	17.18	BIT BALLING
	17.19	DRILL STRING PLUGGED
	17.20	CHERT FORMATION

	17.21	WINDOW IN-ACCESSIBILITY
	17.22	REMEDIALJOB CEMTFAIL/HOLEPACKOFF
	17.23	CEMT FAIL PRIMRYJOB /LOSSES
	17.24	REAMING/BACK REAMING
	17.25	JUNK IN OPEN HOLE
STIMULATION Failure of down whole stimulation equipment. All surface equipment is part of a different NPT category.	18.1	STIMULATION PACKAGE (ASIC PUMP, LINES), STRING, SERVICES
	18.2	ACID BOAT
COILED TUBING Equipment failure on the Coil Tubing Unit.	19.1	COILED TUBING PACKAGE (CT REEL, POWER PACK, INJECTOR HEAD)
	19.2	NITROGEN UNIT
WELL CONTROL Unexpected entry of formation fluids (gas, water or oil) that requires a mud weight increase or excessive circ. & condition of the mud. Divert the influx of gas, oil or water from the formation while drilling surface hole section. Condition mud properties that have been affected by formation fluids influx. Control well by circulating formation fluids out of the well in a controlled manner. Stripping pipe in or out during a well control situation. Control well by reinjecting formation fluids into the formation in a controlled manner.	20.1	DIVERT SHALLOW GAS FLOW
	20.2	GAS-CUT MUD
	20.3	SHUT IN/ CIRC OUT KICK/ COND MUD
	20.4	STRIPPING PIPE IN/OUT
	20.5	WC OPS W/O CIRCULATING
	20.6	WATERFLOW
	20.7	GAS KICK
	20.8	OIL KICK
	20.9	WATER KICK
STUCK PIPE Starts when pipe stops moving and ends once pipe is freed or fished, including hole conditioning, or once the well has been side-tracked and back to previous hole MD Low pressure zone resulting in sufficient pressure differential to stick drillstring. Includes any fishing time. Hole pack-off around the drillstring due to ineffective removal of drill cuttings / cavings from the wellbore. Includes any fishing time. Problems with or unable to pull pipe due to mechanically key seating the well. Includes any fishing time. Any other type of cased hole stuck pipe mechanism not mentioned in this NPT category. Includes any fishing time. Any other type of open hole stuck pipe mechanism not mentioned in this NPT category. Includes any fishing time. Sidetrack hole to pass around an obstruction resulting from any stuck pipe event. Ends when you are back to the previous hole's MD. Inability to move, rotate and/or circulate casing prior to	21.1	DIFFERENTIAL STUCK DRILLSTRING
	21.2	EXCESS CUTTINGS BED
	21.3	KEYSEAT STUCK DRILLSTRING
	21.4	OTHER STUCK DRILLSTRG CASD HOLE
	21.5	OTHER STUCK DRILLSTRG OPEN HOLE
	21.6	SIDETRACK AROUND STUCK PIPE
	21.7	STUCK CASING/LINER
	21.1.1	DRILLSTR. STK UNDER/INVESTIGATE
	21.1.2	DRILL STRING STUCK MECH.
	21.1.3	STUCK FRACTURE/FAULT FORM
	21.1.4	STRING STUCK CSG COLLAPSE
	21.1.5	STRING STUCK JUNK IN HOLE

reaching section TD. Includes any fishing time.	21.1.6	STRING STUCK REACT. FORM
	21.1.7	STUCK UNCONSOL.FORMATION
	21.1.8	STUCK UNDERGAUGE HOLE
	21.1.9	STUCK HOLE GEOMETRY
	21.1.10	STRING STUCK GREENCMT/BLK
	21.1.11	STRING STUCK SIDETRACK
	21.1.12	STRING STUCK DUE TO HOLE PACKOFF
	21.1.13	DRILLSTRING STUCK DIFF.
	21.8	CASING STUCK UNDER INVESTIGATION
	21.8.1	CSG STUCK DIFFERENTIAL
	21.8.2	CASING STUCK MECH.
	21.8.3	CSG STUCK UNCONSOL.FORM
	21.8.4	CSG STUCK HOLE GEOMETRY
	21.8.5	CSG STUCK REACT.FORMATION
	21.8.6	CSG STUCK U.GAUGE HOLE
	21.8.7	CASING PACKED-OFF
	21.8.8	CSG STUCK DUE TO HOLE PACK OFF
	21.9	LINER HANGER STUCK/SETTING TOOL
	21.10	COILED TUBING STUCK
	21.11	LOGGING TOOL STUCK
OFFSHORE Collision with adjacent well while driving conductor pipe. Stability problem with the legs on the jack-up rig. Diving / ROV fail to work properly. Hydrates blockage	22.1	COLLISION WHILE DRIVING COND
	22.2	JACK-UP RIG LEG STABILITY PROB
	22.3	DIVING / ROV EQUIPMENT
	22.4	HYDRATES
PEOPLE Lost time due to wrong specs, design, or calculations on engineering plan. Failed to order services or equipment in a timely manner, ran the wrong equipment, or some other error that caused a delay. Clearly wrong operating procedures done by rig contractor personnel while drilling, tripping, etc., or handling any surface equipment.	23.1	ENGINEERING PLANNING ERROR
	23.2	OPERATIONS PLANNING ERROR
	23.3	RIG CREW ERROR
TUBING Problems with the tubing like crossed threads, failure / leak during a pressure test, etc and which may require remedial work. Not related to Tubular Running Services equipment.	24.1	MECHANICAL PROBLEM RUNNING TUBING

GEOLOGICAL Plug & Abandon time resulting from an unexpected geological issue (i.e., fault, wet zone) calling an earlier well / hole TD or shortening the section. Includes the extra / additional logging time to confirm this geological issue.	25.1	PLUG & ABANDON HOLE SECTION
Sidetrack time resulting from an unexpected geological issue (i.e... fault, wet zone). Includes time spent setting cement plugs. Ends once new wellbore has reached previous hole MD. Includes the extra / additional logging time to confirm this geological issue.	25.2	SIDETRACK FOR GEOLOGICAL REASON
Any time associated with problems resulting from a geologic change that was neither expected, nor included in the geologic prognosis, or not communicated prior to spudding the well. The time spent on these problems typically could have been reduced or eliminated through proper planning had they been known in advance.	25.3	GEOLOGICAL UNCERTAINTY

8. Key Dates Definitions

It is critical that all OPCO's use the same definitions in order to enable ADNOC roll-up of drilling performance data directly from OpenWells® (or rather from the EDM data base)

8.1 Key dates

Key date/times are stored at the Event level, the Well level and the Wellbore level.

- Event Properties – Start Date and End Date on the General Tab
- Event Properties – date/time fields on the Associated Rig Operations Tab
- Well Properties – Well Start Date on the General Tab
- Wellbore Properties – Wellbore Start Date on the General Tab

8.2 Event Properties

8.2.1 Event start date:

The earliest date of all the dates in the Associated Rig Operations Tab.

8.2.2 Event end date:

The last date of all the dates in the Associated Rig Operations Tab

8.3 Associated Rig Operations Dates and Times

8.3.1. Rig Pick up:

- If there is no preceding MAJOR RIG MOVE Event, and the rig is coming from a previous well to drill the well, the date the rig was released from the previous well.
- If the rig is moved directly from a yard, a stacked location, or another well, it is the date when the rig started accruing costs or when the first load of equipment is loaded for transport to the well location, whichever is earlier.
- If there is a preceding MAJOR RIG MOVE Event, the Rig Pick-Up date is the Event End Date of the MAJOR RIG MOVE Event.

- If there is an immediately preceding Event (for example, a completion event following a drilling event), the Rig Pick-Up is the End Date of the previous Event.

8.3.2. Rig on Location:

If the rig is moved directly from a yard, a stacked location, or another well, it is the date when the rig started accruing costs or when the first load of equipment is loaded for transport to the well location, whichever is earlier.

8.3.3. Rig up Complete:

Date/Time that the rig is 100% on location and 100% rigged up for operations (ready to assemble BHA and pick up bit to drill). If there is any wait time required, it must be included in this time interval.

8.3.4. Rig Charges:

Date/Time that full rig rate starts to apply; this value depends upon the rig contract. Could be at the start of the rig move if a Move Rate is charged, or could be at the end of the move for a lump-sum move.

8.3.5. Start Drilling: (Spud Date):

Date/Time the rig started drilling new formation with a drilling assembly (could be dirt at ground level, new formation below pre-set conductor, or mud at sea bottom) after moving on location. On a Re-drill, the time that a drilling assembly drills new formation past a window or whipstock.

8.3.6. Reached TD Drilling:

The moment the bit finishes cutting the last formation of the last wellbore drilled during the continuous operations of the rig. Next operations would be evaluation followed by completion or abandonment. Small additional drilling for casing rathole would not change the Finish Drilling time if no additional logging is performed and casing is run immediately after the additional rathole is drilled. If new hole is drilled, followed by logging operations, then the Finish drilling time is the time the bit finishes drilling the additional hole.

8.3.7. Rig Release / Change of Event:

- The time when the rig contractor is approved to begin rig down. Could occur after drilling or after completion if completion is done by the drilling rig under the management of the drilling group.
- If another event immediately follows, the Rig Handover of the first event must be the same as the Rig Pick-Up of the second event.
- If a completion event will follow, Rig Release is when the last casing string is landed and cemented, cleaned, displaced and tested/approved. If the last hole section is open hole or a slotted liner is installed, the End Date is the date when all tests/evaluations are complete and the rig is ready to start completion operations.

8.3.8. Rig Down Complete:

When the rig is 100% rigged down. If the rig is released prior to rig down, the Rig Down date will be later than Rig Release. If another event immediately follows, using the same rig, Use same Rig Release date.

8.3.9. Rig Off Location:

When the rig is 100% rigged down and 100% off location, including drill pipe. If the rig is released prior to moving, the Rig Off Location date will be later than Rig Release. If another event immediately follows when using the same rig, use same Rig Release date. If due to logistic reasons some equipment is left on location after Release the rig is considered to be off location.

8.4 Well Properties

Well Start Date/Time is the earliest date and time when any work was performed on the well in the field. It cannot be later than the Start Date of any Event on the well, and could be earlier if field work was performed without a record in OpenWells®. For example, if a conductor pipe is set before the rig has moved on location, the Well Start Date/Time is the date and time that the conductor-setting operation began. A well only has one Well Start date/time throughout its life. It can be earliest date when first time well was spud during its life

8.5 Wellbore Properties

Start Date: The Start Date of the original wellbore is the Spud Date. If the new wellbore is a sidetrack, then the Start Date will be the date the bit deviates from the original well bore, drills off a cement plug, drills off a whipstock, or passes through a window and starts making new hole. A Wellbore can be the Original Wellbore, a sidetrack, a lateral section, or a new wellbore in a previously drilled and produced well. Each will have a Start Date.

The Wellbore Start Date will be used to identify the time break-point between lateral sections on a multi-lateral well. For a well with a single wellbore, the Wellbore Start Date will be the Spud Date (recorded in the Event Properties, Associated Rig Operations Tab).

9. Appendix

*The Start and End definitions of the Stages are defined in the below table.

CODE	DESCRIPTION	START	END	INCLUDES
00MRMI	Major Rig Move In	*When released from previous well*	*Rig accepted on location*	For Field to Field Move
00PSCD	Preset Conductor			
01MIRU	MIRU Equipment			
02MAIN	Rig Maintenance			
05BOPT	Nipple Up and Test BOP			
06PRES	Pre-Spud	*When rig is accepted on location*	*Start to drill new formation with drilling BHA or after FIT/LOT*	
07PRWO	Pre-Workover	*When rig is accepted on location*	*When M/U landing joint to recover old completion*	All task related to prepare for Workover (Kill & NU & ND BOP
08RECM	Recover Old Completion	*M/U landing joint to recover old completion*	*When old completion is laid down*	
81DMOB	Rig Down, Demobilization, Move	*When well operations is completed*	*When rig is rigged down and ready for move*	
82MRMO	Major Rig Move Out	*When Rig is ready to Move out*	*When Move out is completed*	
09PRED	Pre-Drill (only for Re-entry side tracks)	*When rig is accepted on location*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*Cased hole logs, tests, Kill well/recover old completion, plug back, tie back jobs prepare for kick off till start to drill first foot*
11STDR	Jet, Drill, Open <u>Structural</u> Hole	*When well is spudded*	*When rigging up for structural Pipe*	
11STRC	Run, Cement <u>Structural</u> Pipe	*When rigging up for running pipe*	*When starting to drill formation below structural pipe*	
12CODR	Drill, Open <u>Conductor</u> Hole	*When well is spudded/Start to drill new formation with Drilling BHA*	*When rigging up for casing commences*	

12CORD	Run, Cement Conductor Pipe	*When rigging up for conductor*	*Start to drill new formation with Drilling BHA below conductor or after FIT/LOT*	
13SUDR	Drill, Open Surface Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down*	*Any pilothole drilled*
13SUEV	Evaluate Surface Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wipertrips performed to*
13SURC	Run, Cement Surface Pipe	*When rigging up for casing equipment*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*Run/cemt casing WH/ BOP Operation/Tripping Drilling BHA till start of first footage drilled*
21INDR	Drill 1st Intermediate Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down*	*Any pilothole drilled*
21INEV	Evaluate 1st Intermediate Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wipertrips performed to*
21INRC	Run, Cement 1st Intermediate Pipe	*When rigging up for Casing equipment*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*Run/Cemt casing WH/ BOP Operation*
22INDR	Drill 2nd Intermediate Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down*	*Any pilothole drilled*
22INEV	Evaluate 2nd Intermediate Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wipertrips performed to achieve logs*
22INRC	Run, Cement 2nd Intermediate Pipe	*When rigging up for Casing equipment*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	
23INDR	Drill 3rd Intermediate Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down*	*Any pilothole drilled*
23INEV	Evaluate 3rd Intermediate Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wipertrips performed to achieve logs*
23INRC	Run, Cement 3rd Intermediate Pipe	*When rigging up for Casing equipment*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*Run/cemt casing WH/ BOP Operation*

30PILO	Drill / Evaluate / Abandon Pilot Hole	*Start to drill pilot hole section with Drilling BHA or after FIT/LOT*	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*Any drilling, coring and logging*
31PRDR	Drill 1st Production Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down*	*Any coring and intermediate logging/Clean out previous casing/liner for drilling this section*
31PREV	Evaluate 1st Production Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wiper trips performed to achieve logs*
31PRRC	Run, Cement 1st Production Pipe	*When rigging up for Casing equipment*	*When casing is set and wellhead work completed, or Start to drill new formation with Drilling BHA or after FIT/LOT*	
32PRDR	Drill 2nd Production Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down includes*	*Any coring and intermediate logging/Clean out previous casing/liner for drilling this section*
32PREV	Evaluate 2nd Production Hole	*When rigging up for logging equipment*	*When logging equipment is rigged down*	*Any wiper trips performed to achieve logs*
32PRRC	Run, Cement 2nd Production Pipe	*When rigging up for Casing equipment*	*When casing is set and wellhead work completed, or Start to drill new formation with Drilling BHA or after FIT/LOT*	
33PRDR	Drill 3rd Production Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down includes*	*Any coring and intermediate logging*
33PREV	Evaluate 3rd Production Hole	*When rigging up for logging*	*When logging equipment is rigged down*	*Any wiper trips performed to achieve logs*

33PRRC	Run, Cement 3rd Production Pipe	*When rigging up for Casing*	*When casing is set and wellhead work completed, or Start to drill new formation with Drilling BHA or after FIT/LOT*	
34PRDR	Drill 4th Production Hole	*Start to drill new formation with Drilling BHA or after FIT/LOT*	*When BHA is laid down includes*	*Any coring and intermediate logging*
34PREV	Evaluate 4th Production Hole	*When rigging up for logging*	*When logging equipment is rigged down*	*Any wiper trips performed to achieve logs*
34PRRC	Run, Cement 4th Production Pipe	*When rigging up for Casing*	*When casing is set and wellhead work completed, or Start to drill new formation with Drilling BHA or after FIT/LOT*	
41PCOP	Pre-DST Operations	*When ready to rig up for DST operations*	*When making up DST string*	
42PCTC	Prod Testing - Cased Hole (DST)	*When making up DST string*	*When DST string and equipment is removed*	*Includes any Stimulation work performed as part of DST*
42PCTO	Prod Testing - Open Hole (DST)	*When making up DST string*	*When DST string and equipment is removed*	
45WOVR	Work-Over Operations	*When Old completion is laid down*	*When Work-Over is completed/Rigging up running equipment for New Completion run*	

50CMPL	Completion Operations	*When final TD Drilling BHA is Lay down*	*When running Completion equipment is rigged down and Install/Tested Xmass Tree*	Scraper run/Clean out trip for logging or completion & Logging operation, Perforation, ICD & Drift Run ND BOP, Install Test X-mass Tree and run non-cementing liner.
51 STIM	Stimulation	*When making up DST string*	*When Completion is rigged down and ready for rig demobilization*	
55POST	Post-Completion Operations	*When Completion is rigged down and activity is not covered by other phases*	*When ready for rig demobilization*	
61ABND	Abandonment Operations	*When rigging up for Abandonment*	*When abandonment is completed and ready for rig demobilization*	
62SUSP	Suspending Operations	*When rigging up for Suspension*	*When Suspension is completed and ready for rig demobilization*	
90 RLOP	Rigless Operations	All Rigless Activities	All Rigless Activities	Include all Barge activities

Below is the Description of Table/Fields Name in OpenWells@ of Standard ADCOP

Name	Table Name	Field Name
Event Name	DM_EVENT	event_type
Event Code	DM_EVENT	event_code
Objective	DM_EVENT	event_objective_1
OP Sequence	DM_ACTIVITY	billing_code
Stage	DM_ACTIVITY	activity_alt_code1
Phase	DM_ACTIVITY	activity_phase
Code	DM_ACTIVITY	activity_code
Sub	DM_ACTIVITY	activity_subcode
Op Type	DM_ACTIVITY	activity_class
NPT Category	DM_OPER_EQUIP_FAIL	equipment_group
NPT Code	DM_OPER_EQUIP_FAIL	equipment_type
NPT Subcategory	DM_OPER_EQUIP_FAIL	equipment_manufacturer
NPT Company	DM_OPER_EQUIP_FAIL	System_vendor

APPENDIX C

ADIPEC 2013 Technical Conference – Successful Implementation of NCR

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Abstract ID: 899
Title: SUCCESSFUL IMPLEMENTATION OF NCR/NPT INVESTIGATION SYSTEM TO IDENTIFY THE ROOT CAUSES AND THE AREAS FOR IMPROVEMENT FROM FAILURES
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Abstract: Operational failures and incidents such as Non-Productive Time (NPT) are significant contributors to delaying drilling projects. These incidents are very costly & time consuming and may lead to a complete (catastrophic) or partial failure of the project, if the remedies, short term solutions & immediate actions, are not implemented accurately. So it is very important for a Drilling organization to have a systematic approach to investigate completely and accurately all these operational failures and NPT incidents. A process to record all the failures and track the failure types was established and set-up in the ZADCO Drilling Department and later a Non-Conformance/NPT investigation process was implemented. The purpose of this process is to establish a system to investigate all the Operational Incidents, Near Misses and Non-Conformance, where service companies, vendors or third parties are involved in ZADCO operations. This process will make sure that all the Non-Conformances and Service Quality Incidents by service companies must be investigated regardless of the severity of the incident and makes sure that lessons learned are collected with root causes. Later these root causes can identify as the areas for improvement.

A simplified process was developed which includes;

1) Formal process to capture the Non-Conformance/NPT (a written request for investigation of the incident)
2) Record of all NCR/NPT for future tracking
3) Agreed recommendations and future actions by service providers
4) Approval process to the recommendations
5) Monitor the service providers' performance and use the tool to select the best performer in order to reduce the operational failures and project risks.
6) Areas to focus for improvements for ZADCO and service companies based on the defined root causes.

Besides all major benefits, a standardized investigation process was developed to investigate all the incidents of the different service providers, which brings a consistency in failure investigation across all areas.

Introduction:

Non-Productive Time (NPT) is recognized in the oil & gas industry as the delay in a project or delay in drilling and completing a well. The definition of NPT varies from company to company. Some companies consider NPT as anything that happens outside the original well plan including any extra days to drill and complete a well [1]. This approach makes difficult to investigate NPT events as some of the NPT is hidden in operating procedures and difficult to recognize as an NPT event. A second and widely use definition for NPT is *the lost time, downtime or wait time for a rig to execute a certain job*. *NPT is recorded as the operating time elapsed between a Non-Conformance or a failure, and returning back to the same position before the event occurred or it is the operating time elapsed to* *recover from the consequences of the incident or Non-Conformance*. By this definition NPT only includes time where operations could normally proceed e.g. waiting on Weather (WOW) is not included in NPT. It is very easy to recognize and is sometimes considered as direct or visible NPT. This paper discusses only the direct or visible NPT.

NPT varies from project to project from 0% to 30% of the operating time or sometime more in case of a catastrophic failure. Where 0% to 10% NPT is considered as reasonable NPT which is normally budgeted and 20% to 30% NPT is considered as high NPT and not acceptable, even not budgeted for a project. For example, a 20% NPT of the total operating time for a year means that 1 (one) rig out of 5 (five) active rigs is idle and non-operating for the whole year, which is very costly business especially in current high demand of drilling activities where the rigs are very difficult to acquire for drilling operations. Normally NPT is always high at start of a drilling project and reduces with passage of time as the learning from NPT events progresses and the project is more matured. So, it is very important to recognize all the NPT events and their root causes to avoid reoccurrence.

A simplified method was introduced to the ZADCO Drilling Department to capture all NPT incidents and to make sure all the NPT events are recorded and investigated regardless of severity of the incident. Some of the rules were defined in order to recognize and distribute the NPT to the right areas, so more participation and right knowledge should be received in investigating these NPT events. These NPT events are divided mainly into two categories; 1) ZADCO NPT, an NPT event where only ZADCO personnel and facilities are involved in the NPT and no vendor is involved in the activity, 2) Vendor NPT, an NPT where a vendor/service company is directly or indirectly involved in an activity and could cause NPT. Two different processes were developed to handle both NPT categories. The former, ZADCO NPT, is investigated and discussed through a process called Binlist where all the significant internal issues are handled and tracked. (Discussion of Binlist process is out of scope of this article). For later, Vendor NPT, a NCR/NPT investigation process was developed to complete the failure investigations. Prior to this process, no systematic approach was existed to track the failures and detailed NPT. A flexible approach is adopted in assigning the NPT. Initially NPT is assigned to the main vendor of the job when an NPT event occurred. After completion of an NPT investigation and reviewed by ZADCO management, NPT can be removed from the vendor, as vendor is involved but could not cause the NPT or different vendor caused the NPT. In these cases, the NPT gets assigned either back to ZADCO or other vendor for further investigation. Further, a Non-Conformance Report (NCR) is also implemented along with NPT investigation to check and investigate all the incidents which may have not caused the NPT, but may lead to NPT. Such Non-Conformance incidents are not fully traceable, unless engineers report and discuss the non-conformance with the management. Once these Non-Conformances are reported in the system, they are traceable to a conclusion and lessons learned are captured for future applications.

For the majority of time, NPT investigations are mainly focused on capturing and implementing the learning from the failure to avoid re-occurrence, however sometime areas for improvement are ignored. With the implementation of NCR/NPT investigation process, ZADCO uses the both methodologies; 1) capturing & implementing the lessons learned from failures, and 2) areas for improvements for individual, companies etc. With this process, we can track easily a company approach/style to handle failures and significant issues [fig 8, fig9, fig10].

Process:

It was very imperative to start with a process which can be easily adoptable by ZADCO Engineers and variety of different service companies (+32 service companies are currently providing services to the ZADCO Drilling Department). Not only was a simplified process considered, but also the ease in reporting incidents, failures, non-conformances are taken into account by providing portal based solution. **Fig 1** illustrates the simplified NCR/NPT investigation report process. As per this process, an NCR/NPT investigation report is initiated after a Non-

Conformance incident or failure to the company involved and the company (vendor) starts and completes the initial investigation report. After ZADCO management review (End of Well Review), a final report is produced by the vendor and the NCR/NPT investigation report is closed with appropriate actions to avoid the similar failure in the future. During the management review, if the initial investigation is not satisfactory, the vendor is requested to investigate the failure further in detail. An NCR/NPT investigation report is remained opened till all parties, ZADCO and the vendor, are agreed on long term corrective and preventive actions. Fig 2 discusses the stages (step by step) of the NCR/NPT investigation process. Below are the objectives of the NCR/NPT investigations process which are clearly identified and discussed with all parties:

- To establish a system to record all the incidents, near misses, and non-conformance, where vendors are involved
- To ensure that all non-conformances and incidents are investigated regardless of the severity
- To define the immediate root causes and analyze for improvement
- To identify the areas for improvements for vendors, as well as ZADCO
- To have written commitment from supplier for future course of actions
- Finally, a Performance Management System for the vendors of the Drilling services can be established

The Form:

A wide range of service companies from local to international and small to large footprint with different origins are currently working on ZADCO drilling projects. Where some top ranked international companies have the best failure investigation process, often some small vendors are always struggling with the investigation reports and process. So it was imperative to bring consistency across all companies in the failure and NCR/NPT investigation process. A minimum standard was established with a standard NCR/NPT investigation form to make sure all the necessary information are captured as a minimum and an analysis can be conducted at the same scale. Fig 3 shows the current NCR/NPT investigation request form.

The NCR/NPT investigation request form has the following information:

- NCR/NPT information
    - NCR log No
    - Status of NCR
    - Location and Well Information
    - Vendor responsible for the Non-conformance
    - Type of Non-Conformance
    - Description of the non-conformance
- Contributing factors to the Non-Conformance or failure
- Immediate corrective actions taken (Problem fix/deposition)
- Root Cause Analysis
- Long term corrective or preventive actions

Two important points related to the immediate and long term corrective & preventive actions are:

1- Immediate corrective & preventive actions: Troubleshooting experience can play a significant role to reduce the operation failure cost/time. Chances of success and failure to fix the problem are dependent on the type of failure and availability of resources with competency at the location or in the area. Most of the time, high experience puts the corrective action quickly and accurately. In case of lack of appropriate experience, small incident leads to catastrophic failure.

2- Long term corrective & preventive actions: Regardless the short term/immediate solutions are successful or not, long term solutions play very significant role in rectification. So, these long term solutions must be in place for all the failure events. These long term actions are more dependent on the investigation techniques at the location or in the area.

Similar to a typical NCR , where description of failures along with long term corrective actions are always captured, a short term corrective and preventive action is also required to identify what course of actions were taken while handling the failures. Along with a conventional NCR[2], a root cause category was added to look for area for improvements. These root cause categories are carefully selected and chosen:

- Inadequate Supervision/Leadership
- Inadequate work Instructions
- Inadequate Engineering
- Inadequate Manufacturing
- Inadequate Maintenance
- Out of Specification Application
- Inadequate system/process
- Lack of Implementation
- Faulty Equipment/Tool
- Excessive Wear & Tear
- Lack of Resources
- Inadequate Contracting
- Inadequate Logistics/Delivery
- Lack of Quality Control
- Inadequate Purchasing
- Ineffective Internal Communication
- Ineffective External Communication
- Lack of Training/Competency
- Personal Factors

Successful Implementation:

For successful implementation of any new process, many factors were considered and all the hurdles were recognized and removed with the appropriate support and hard work from all levels. Especially for vendors, to implement the new NCR/NPT investigation process it became compulsory to provide the adequate level of support in closing the NCR/NPT investigation requests. The major elements of this implementation and vendor support include:

a) *Need vs Change*: An important factor in implementation of any new process that how big is the need. So need has to overcome the resistance against change, otherwise implementation may fail. So, the need to have a systematical process to capture all the failures and learning from them was realized at all levels, i.e engineers, field personnel and management. It was recognized on many occasions that a platform at which engineers can raise their concerns to the management on any service providers and track the follow-ups was required. Similar to many organizations, resistance to the change in the current practices was observed too, but the need for the implementation of the process overcame on all the resistances.

b) *A simple process*: After the recognition of the need, it was necessary to have a simple process which should be easy to understand, to adopt and to implement. Fig 2 shows the step by step process of the NCR/NPT Investigation request. It was clear at the beginning of the project that an overly complicated process can hinder the implementation of the NCR/NPT investigation process, so a simple process was required.

c) *End user believes in*: For the success of the implementation of NCR/NPT process, end users (engineers) need to believe that the process will bring the improvements not only in follow up with service companies but also in selection of right vendor for the job at a later stage. Initially, all the NCR/NPT investigation reports were issued under the authority of Sr. Drilling Manager, which shows management commitment in supporting for the process.

d) *Self-sustained process*: For the successful implementation of the NCR/NPT investigation process, it was clear that process must be self-sustained with little supervision, otherwise process will be overwhelmed with resources and may ended up a complete failure. Initially process was initiated with help of KM & Best Practice, later end users (engineers and rig supervisor) started to initiate the NCR/NPT process themselves. Currently more than 300 NCR/NPT investigation requests have been recorded till year-to-date (August 2013). Fig 4 shows the number of the NCR/NPT investigation requests recorded per month since it started in 2012 till YTD (August 2013). It shows clearly that the utilization have been increasing radically in 2013. An average of 12 NCR/NPT investigation requests per month was recorded in 2012, which has been increased to an average of 20 NCR/NPT investigation requests per month in 2013. Fig 5 shows the number of the NCR/NPT investigation requests closed out as of today (August, 2013). Fig 6 shows two pie-charts; left pie-chart shows the distribution of the status of NCR/NPT investigations reports in numbers (year to date), right pie-chart shows the distribution of the status of NCR/NPT investigation reports in percentage (year to date). As of August 2013, a total of 309 NCR/NPT investigation requests have been recorded, where 120 (39%) NCR/NPT investigation requests have been either closed or are ready to close. Ready to close means that NCR/NPT investigation requests are reviewed & agreed and under circulation for signatures.

e) *Ownership*: For the successful implementation, it was required someone must own the process and monitor is closely till it is successfully implemented. Once the process is started and running successfully and becomes self-sustained, it is required to monitor the process making sure that roles and responsibilities are intact, as a close follow-up with vendors is deemed required. One of the drilling departments took full ownership of the process and set resources for successful implementation.

f) *Management support*: Like other projects, the NCR/NPT investigation process implementation need management support. The VP-Drilling is the sponsor of NCR/NPT investigation process and full support was given by all managers to make sure the process is running and no hurdle at any level stops it.

g) *IT Support*: It was important for the process to be implemented successfully, each user has access to create NCR/NPT documents and some users have access to fill the data i.e., to attach the reports and finalize the status of NCR. So IT support for the project was deemed required. However, due to the fear that the process may became complicated or delayed with the involvement of other departments, So only the IT support within drilling department was utilized to create the workflow using one of the existing templates.

Besides all above factors, an approach "each NPT event must have NCR/NPT investigation request" helped to enforce end users to create/initiate the request. Time to create an NCR/NPT investigation request was also taken into consideration. As it was recognized that longer time required in initiating an NCR/NPT investigation request can create major resistance in end users not to support the process. Currently an average time to create an NCR/NPT investigation request is around 3 minutes.

Areas for Improvements:

One of the main objectives of the NCR/NPT investigation process was to ensure that lessons learned are captured and areas for improvements for an organization/service company are developed and implemented. These areas for improvements are focused on key components of an organization as mentioned above. As direct root causes are recorded at the closure of each NCR/NPT investigation request and agreed with each vendor/service company, i.e, a signed agreement is finalized so each party is agreed and committed on the areas for the improvements. After closure of a number of NCR/NPT investigation requests, normally 15-20 NCR/NPT investigation request, there is sufficient data to analyze the areas for improvements for a company. Similarly we can develop a same analysis for all companies jointly showing as industry. Fig 7 shows a pie-chart analysis of the all closed-out NCR/NPT investigation requests (112 NCR/NPT investigation requests) for the local industry (almost 24 companies).

Fig 7 clearly shows that *Inadequate systems and processes, Inadequate maintenance program* and *Lack of training & competency* are the major concerns of the local industry, where as it shows different distribution of failure in different categories. This information is essentially a baseline to evaluate and compare each company's performance and management style. For example, Fig 8 shows a pie-chart distribution of Company A (an international renowned company), where *Inadequate systems/processes, Lack of training & competency* and *Lack in implementations of procedures/process* are the major concern comparing to the overall industry profile. Industry has the 16.82% failure linked to the *Inadequate systems/processes*, whereas company A has higher failure rate, 24.62% linked to the *Inadequate systems/processes*. Company A has also major concern with training and competency, where 10% failure rate are linked to *Lack of training and competency* for the industry average, but for the company A (an international company) has 15.38% failure rate linked to the *Lack of training and competency*. Lack of Implementation is also a major concern for company A comparing with the local industry. So, Fig 8 represents the company A's profile at this moment and shows how the company is running its business.

Besides having a profile of a company, the information provides a base for further discussion to implement changes to improve each company's profile. For example, Company A is an international company. Why is "lack of systems and process" the major concern for the Company A in the region? It is unrealistic for a company working in more than 80 countries and having 100 years of experience to have a lack in systems/process. So upon further analysis, the analysis found lack of competency and lack of management commitment is the major underlying issues. So now the company is making significant changes into its competency program for the local industry with a greater commitment from management. Fig 8A and Fig 8B are the profiles of the same company for the different periods. Fig 8A shows the Company A's profile after closing the NCR/NPT investigation reports of 2012 failures. Fig 8B shows the Company A's profile after closing the NCR/NPT investigation reports of 2013 YTD failures, which shows a significant shift in the company profile. For example, training and competency is still a major issue where some other issues are improved.

The NCR/NPT investigation process also helps to focus and identify the areas for improvements for specific services of a company. Fig 9 shows the root cause distribution profile of Company A for it certain services (associated with a single department of Company A). So, with the help of NCR/NPT investigation process we should be able to focus on certain departments or segments of a company, which again provides ZADCO a chance to intervene in a service company to improve it business model or practices, otherwise it may lose business with ZADCO based on its documented poor performance and commitments.

Fig 10 shows the root cause profile for Company B, a local company. The profile shows that company B has serious issues with its maintenance program. ZADCO has already informed Company B's management to improve its maintenance program. Fig 11 shows the root cause profile of Company C, a renowned International company. It has different profile, but still shows that at local level Company C has to improve in several areas which are not consistent with its international reputation. Discussions and performance reviews with higher management are in progress and a further analysis can be done based on the profile (Fig 11).

Further to above discussion, with the help of NCR/NPT investigation process, a root cause profile for a well (well A) based on the failures occurred on the well with different vendors can be viewed and discussed for further improvement. Fig 12 shows a well profile where Inadequate Work Instructions, Communications and Lack of Leadership was the main issues and caused failures. Such profile can be shown to well engineers to make sure vendors must have or provide proper work instruction for the all jobs at a well and better communications can be established. Similarly Fig 13 shows a root cause profile for a different well (well B), which indicates different issues and areas to improve.

Benefits;

1) ***Availability of a platform to raise concerns***: With the implementation of NCR/NPT investigation process, engineers are comfortable to raise their concerns with vendors facing during drilling & completion phase of a well. Before all the concerns remains on e-mails and get lost after a time period.
2) ***Availability of traceable database***: Now all the issues (NPT, NCRs) are recording in the system. These NCRs remains open till a resolution is proposed and approved. During performance review with vendors, the status of NCRs is discussed with higher management (ZADCO and vendor) for their support to close these NCRs in timely manner. NCT/NPT investigation database is available to all for all future references.
3) ***Bringing the consistency***: It has been observed that international service companies have much better NPT investigation process and investigation reports than that of local service companies [3,4,5] with some exemptions, where some local service company has a good NPT investigation process, too. Prior to implementation of NCR/NPT investigation process, it was considered to have the process simple and easy to understand, so that multiple companies can adopt the process easily. Currently having a simple NCR/NPT investigation form brings a consistency in the investigation of the NCR/NPT events across all the companies working on ZADCO drilling projects. All the companies have to fill the same form in order to close the NCR/NPT investigation report. Whether it is local company or an international company, it is now a same process and same type of information are required to close the incident report.
4) ***Areas for improvement***: As discuss earlier, one of the main benefits is to have the areas to improve for a service company and its subsidiaries as well as for a whole project jointly to see what can be done different next time to avoid failure.
5) ***Bringing value to the industry***: Once a service company goes through improvement process with ZADCO and makes significant changes in its management style and adds more resources locally and internationally to avoid failures, it also makes it improvement for the local industry. So overall, this NCR/NPT process will bring the value to the whole industry in the region with the passage of time.

Conclusion:

A structured NCR/NPT investigation process helps to identify the gaps in performance and minimize the failures on a project, as a database is available to share the lessons learned and track the failure analysis and follow-ups. Current NCR/NPT investigation process helps ZADCO to learn the strengths and weaknesses of a vendor and helps the vendor to improve it business organization and structure. Overall it helps the industry to improve the service quality and work style. Conclusively it is right to say that with the implementation of NCR/NPT system, right vendor can be selected for the a job based on vendors strengths and weaknesses.

Acknowledge:

NCR/NPT investigation process was implemented successfully with the great help and support of the following people and companies;

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3- Les Sept, Sr. Manager, Drilling and Completions Operations, ZADCO
4- Ali Eissa Al Mahri, Manager, Drilling and Completions Island Operations, ZADCO
5- Hamad Saleh Al Junaibi, Manager, Drilling & Completions Engineering Island, ZADCO
6- Malayattil Rajesh, Performance Analyst, ZADCO
7- Bill Grieve, Ex VP-Drilling, ZADCO
8- Jonathon Jean, Ex Sr. Manager Technical, ZADCO
9- Raafat Abbas, Ex Manager PBI, ZADCO
10- ZADCO Drilling and Completion Team
11- All service companies working on ZADCO project.
12- All the people who are not mentioned here, contributed to the project partially and wholly

I am especially thankful to Dr. Steve Butt for his contribution in validating the paper and its importance for the oil & gas industry.

References:

1- Rig NPT: the ugly truth / Drilling Contractor By Linda Hsieh, managing editor, drillingcontractor.org
http://www.drillingcontractor.org/rig-npt-the-ugly-truth-6795
2- ExxonMobil NCR process (internal Process)
3- Schlumberger NPT Investigation process
Schlumberger captures its own performance data via **QUEST**, an online system that provides immediate consolidation of HSE information. Accessible by all employees, QUEST monitors reporting of HSE events and Risk Identification Reports (RIRs), facilitates investigations and records audits, manages remedial work plans (RWPs), shows improvement suggestions, posts recognitions, tracks HSE training, and facilitates HSE reports and data analysis.
http://www.slb.com/hse.aspx
4- Baker Hughes NPT Investigation process
First Alert - A Baker Hughes system for reporting HS&E incidents, investigating the immediate and underlying causes and resolving them through completing assigned actions and/or issuing incident notices.
www.bakerhughes.com
5- Halliburton NPT Investigation process
CPI - The Correction, Prevention, and Improvement system is used as the main tool for the communication of improvement ideas, lessons learned, and process audit issues. Trends identified in CPI are used to help plan, prioritize, and coordinate corrective actions, maintenance requirements, and improvement initiatives. Process improvements are reflected as changes to best practices and are communicated through training and application within the organization. The CPI system helps to facilitate collection, analysis, and reporting of feedback on performance.
http://www.halliburton.com/public/ts/contents/books_and_catalogs/web/testtools/introduction.pdf

Appendix

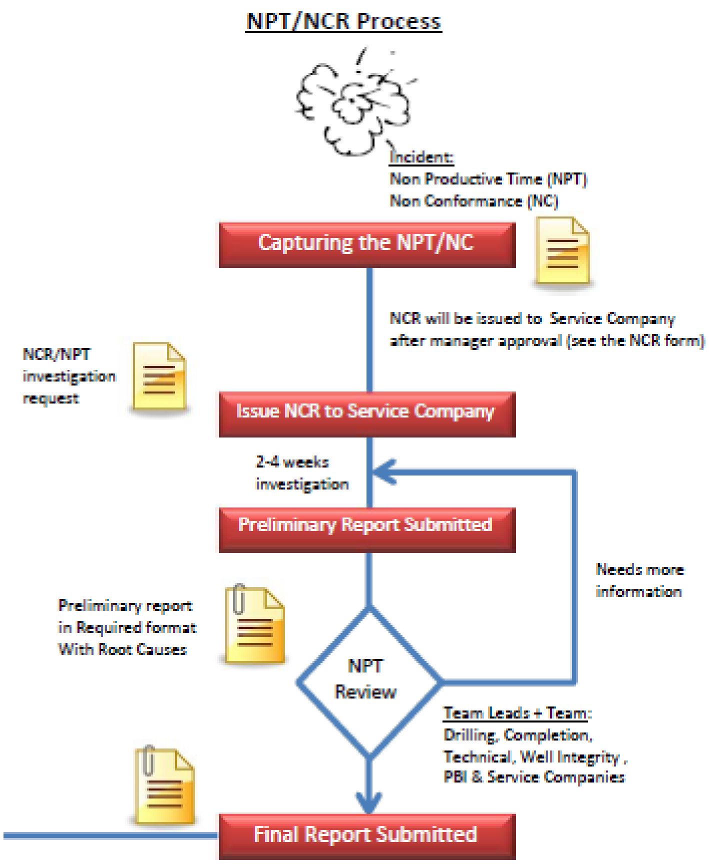

Fig 1: A simplified NCR/NPT investigation Process

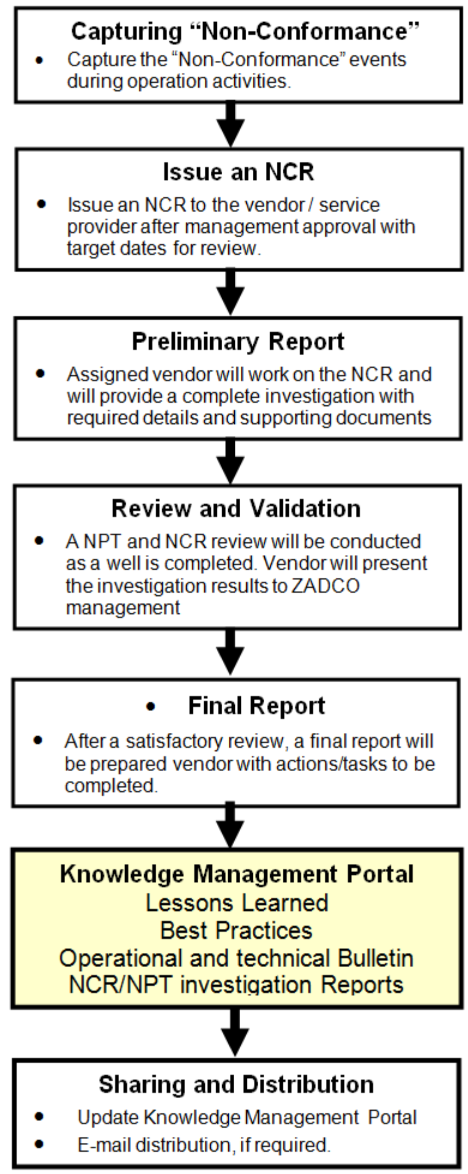

Fig 2: A step by step process of NCR/NPT investigation request

Drilling
Non-Conformance / NPT investigation Report

1 NCR/NPT Log No: Status : Date:

2 Location: Well Name/Number: Type:

3 Vendor Responsible for the Non-Conformance:

4 Non-Conformance initiated by: Initial report is required by:

5 Focal Team (ZADCO): Final Report is required by:

6 Vendor Representative Involved: Contract/Order No:

7 Type of Non-Conformance:

8 Description of the non-conformance

Depth (MD)

Temp

Repeat Failure?

Cost to ZADCO:

9 NPT as a result of this non-conformance / failure? **Hours?** NPT/NCR severity:

10 Contributing factors to the non-conformance/failure such as hole conditions or abnormal operating parameters?

11 Immediate corrective actions taken (Problem fix/deposition):

12 Corrective actions are approved by:

13 Root Cause Analysis is required for all non-conformances and NPT events

☐ Inadequate Supervision/Leadership	☐ Out of Spec. Application	☐ Lack of Resources	☐ Ineffective Internal Communication
☐ Inadequate Work Instructions	☐ Inadequate System/process	☐ Inadequate Contracting	☐ Ineffective External Communication
☐ Inadequate Engineering	☐ Lack of Implementation	☐ Inadequate Logistics/Delivery	☐ Lack of Training/Competency
☐ Inadequate Manufacturing	☐ Faulty Equipment/Tool	☐ Lack of Quality Control	☐ Personal factors
☐ Inadequate Maintenance	☐ Excessive Wear and Tear	☐ Inadequate Purchasing	

Note: Root Cause Analysis should be supported by a systemetical cause analysis such as Immediate casues, contribution factors etc.

14 Long term corrective or preventive actions:

15 Preventive actions are approved by:

16 ZADCO Initiator: Signature: Date:

17 ZADCO Representative: Signature: Date:

18 Vendor Representative : Signature: Date:

Administration instructions for submitting this NCR:

a) NCR will be initiated by Rig Supervisor/Drilling & Completion Engineer with relative details (first 9 items. minimum) as soon as a non-conformance occurs. An alert will be issued to Managers, Team Leads, NCR administrator and Contracts administrations for the record

b) NCR administrator to issue the hard copy within 3 working days to the responsible Vendor. Vendor to close out with ZADCO within 4-8 weeks (Initial Report is due within 4 weeks, final report is due within 8 week after Non-compliance occurrence date or described above. Please attach details Root Cause Analysis report with the NCR and fill items 10 to 14. Only KM & Best Practice Engineer will close the NCR, after NCR response is accepted by ZADCO Management.

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Fig 3: Current NCR/NPT investigation form

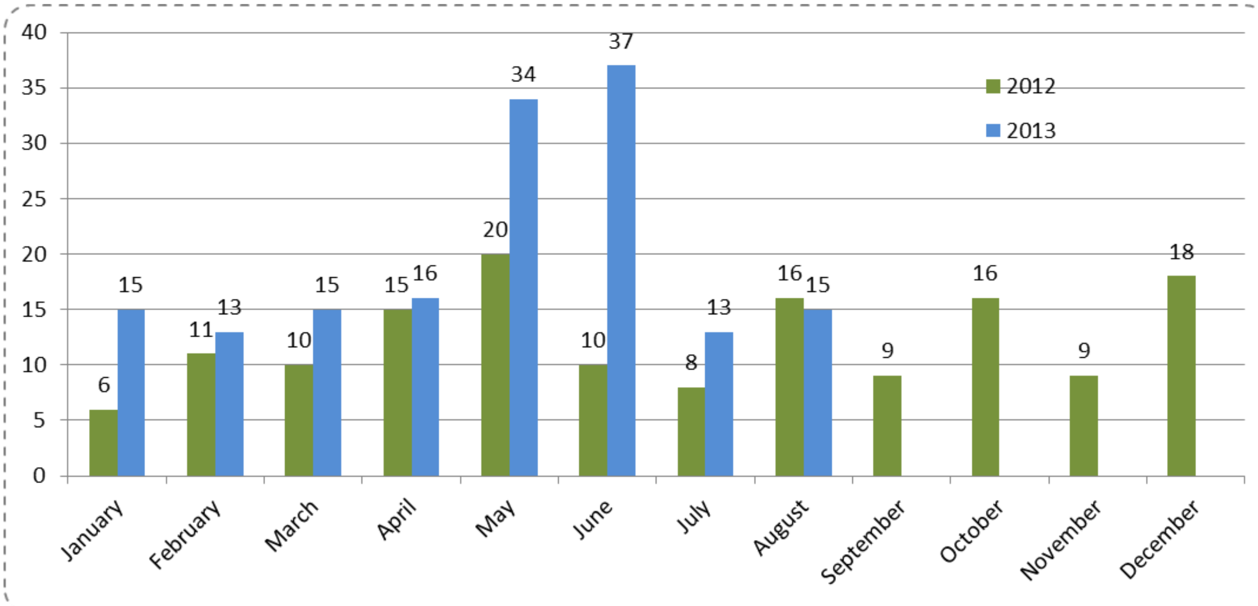

Fig 4: NCR/NPT investigation requests issued each month since 2012 to YTD (August 2013).

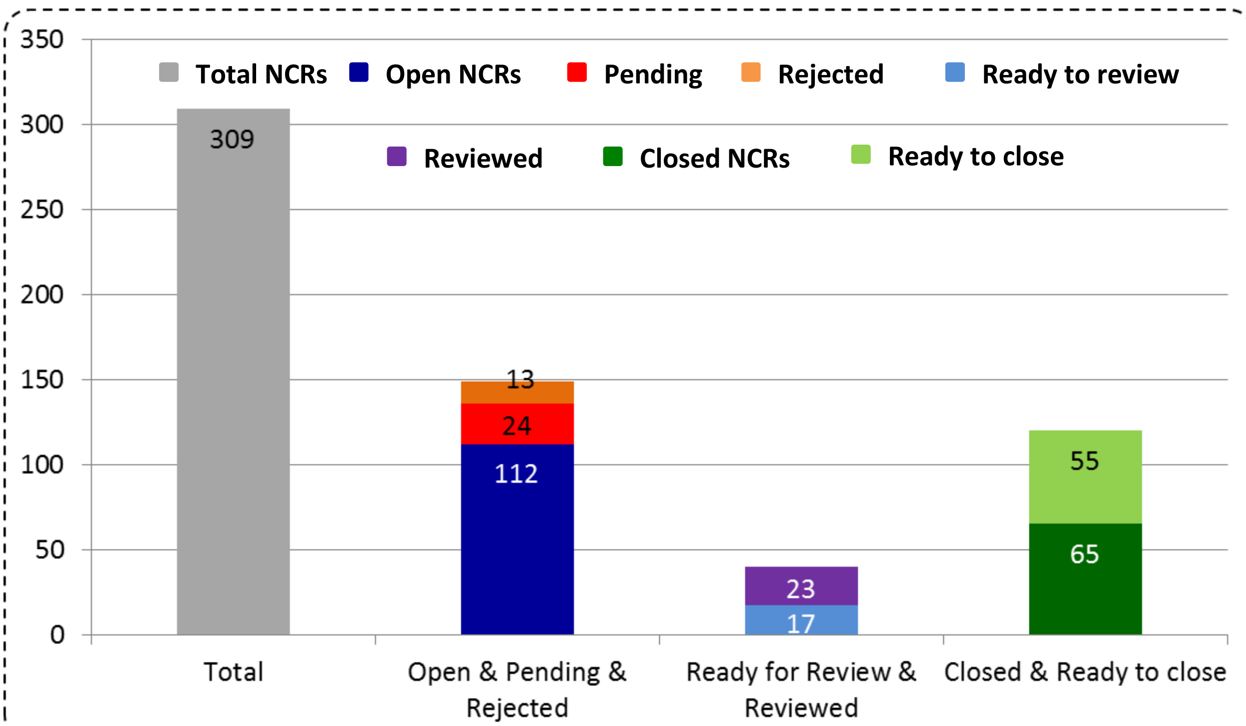

Fig 5: Current Status of the Total no. of NCR/NPT investigations request issued (28 August 2013)

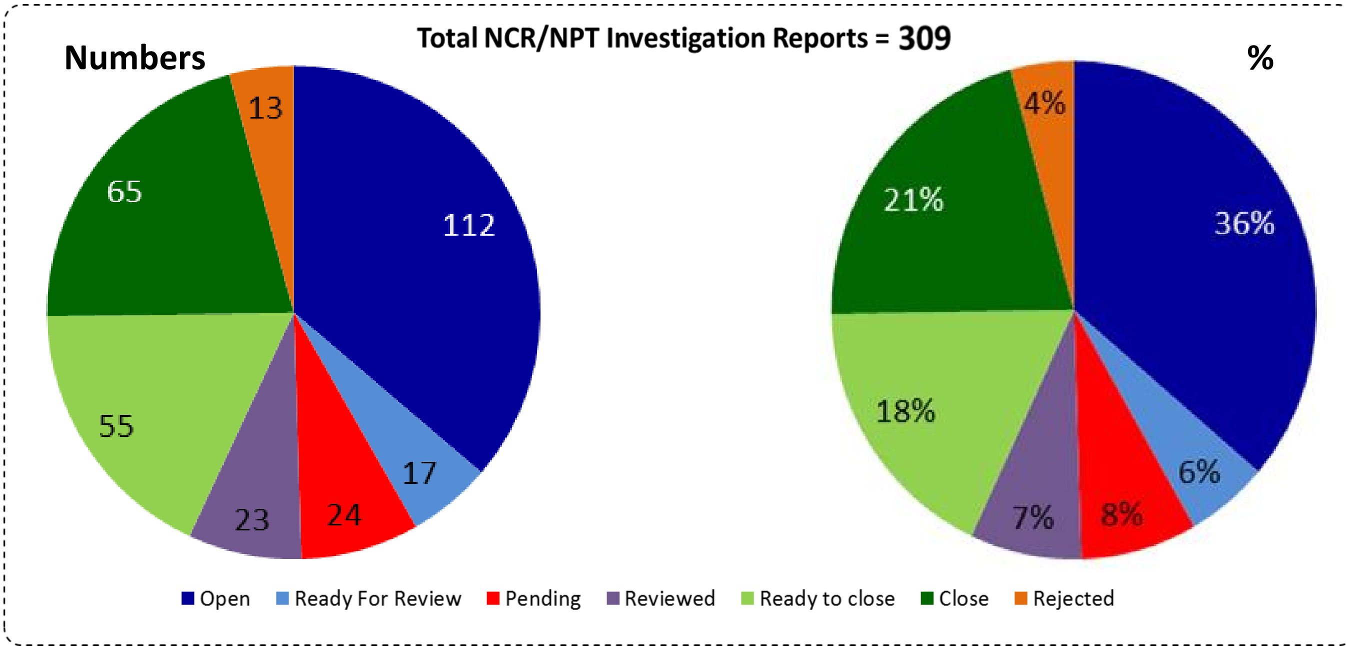

Fig 6: NCR/NPT investigation status with percentage

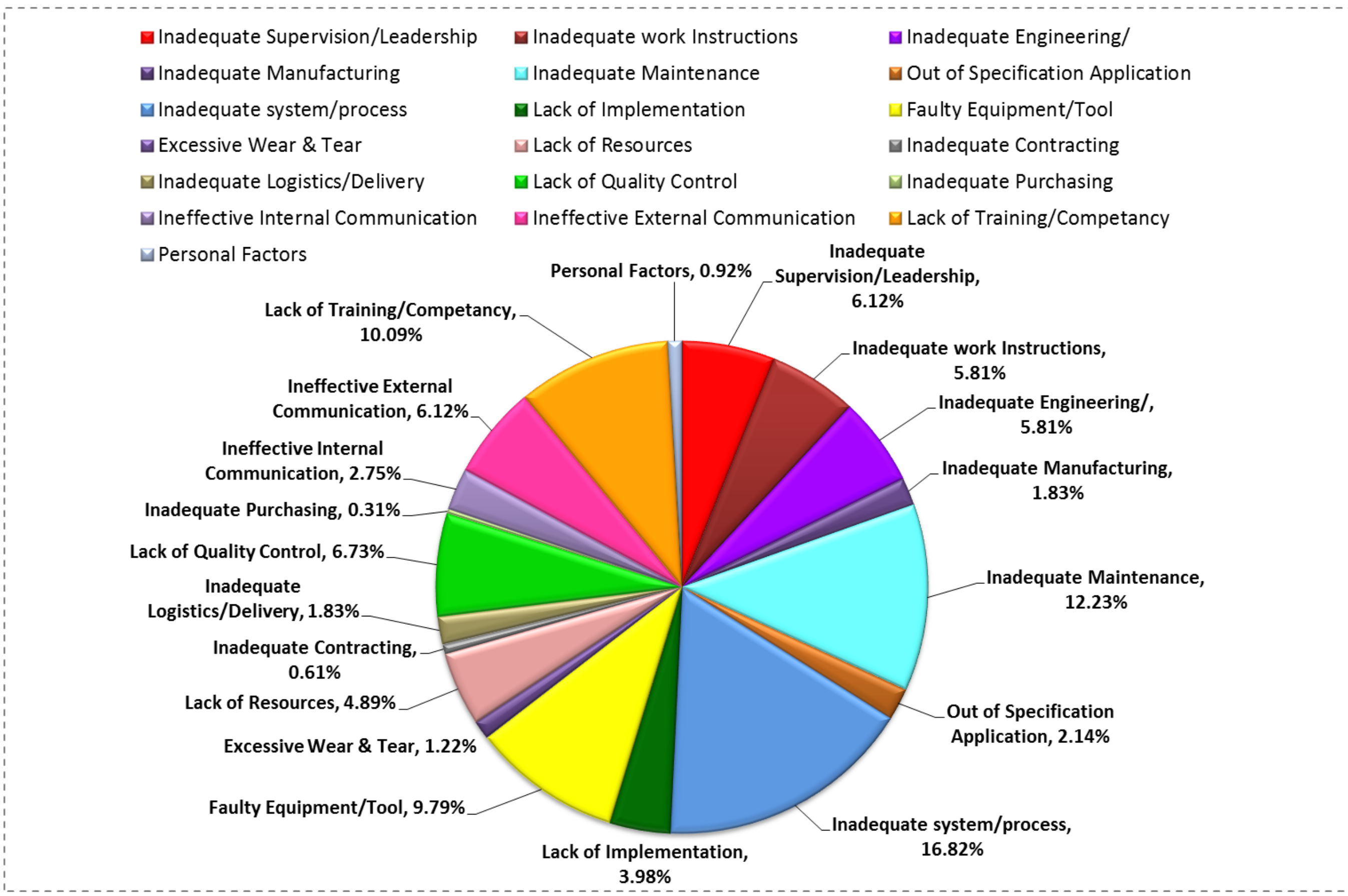

Fig7: Distribution of root causes of the failures of the industry (+24 companies)

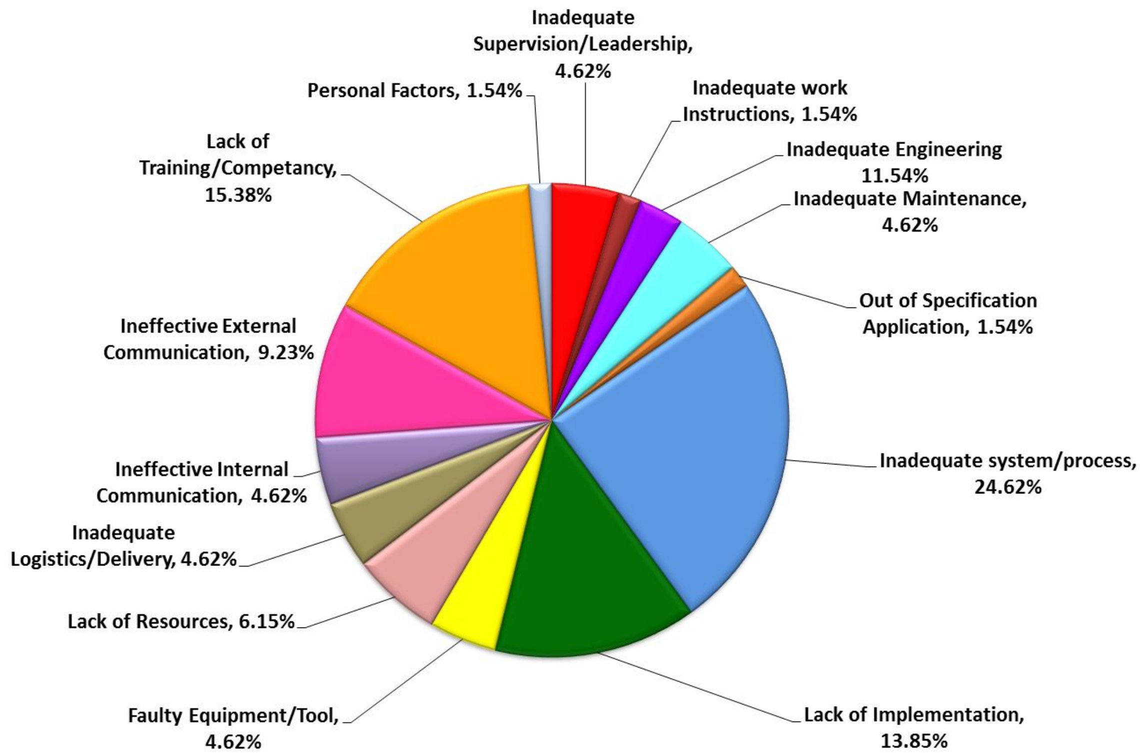

Fig 8a: Distribution of the root causes of Company A, an International company

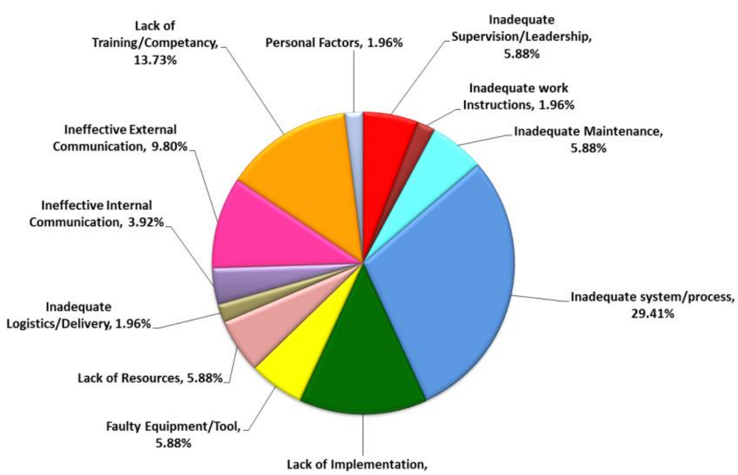

Fig 8b : Distribution of the root causes of 2012 failures related to Company A

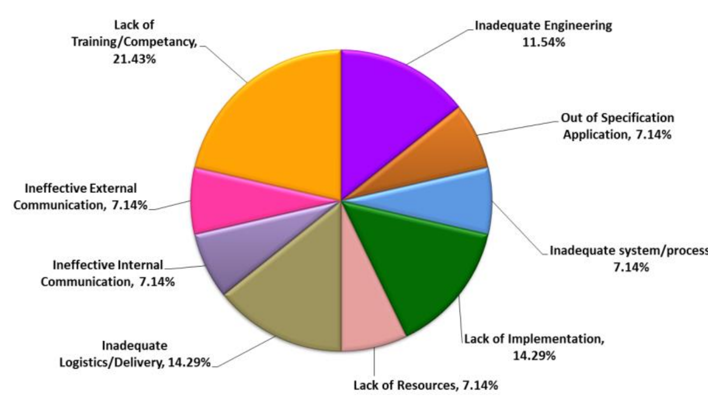

Fig 8c : Distribution of the root causes of 2013 YTD failures related to Company A

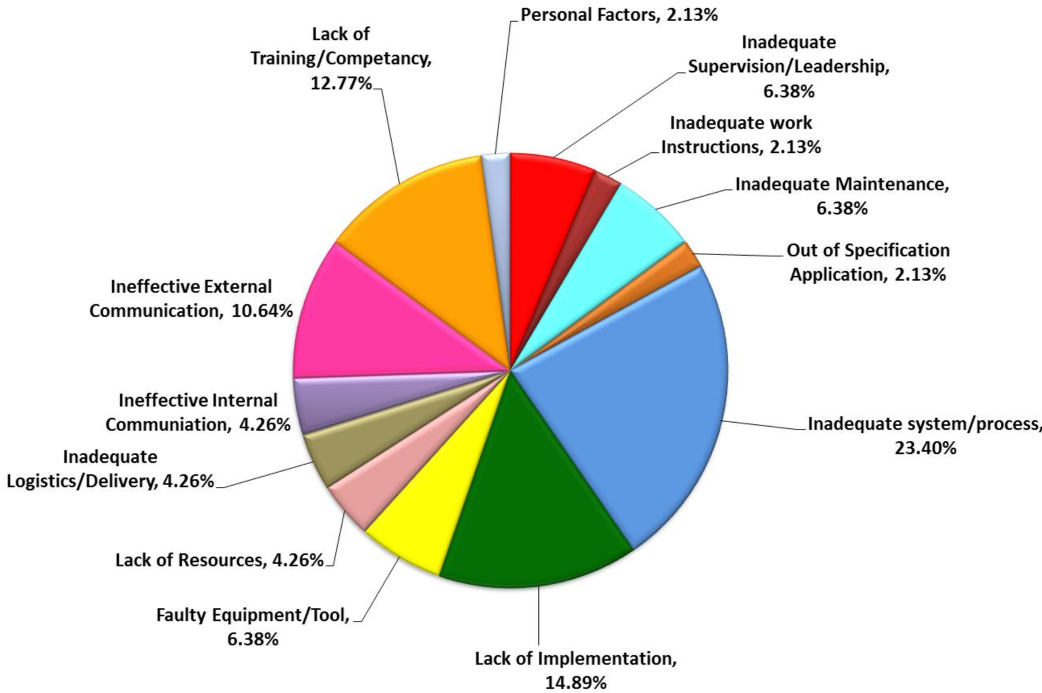

Fig 9: Distribution of the root causes of the failures of one of the department of the Company A

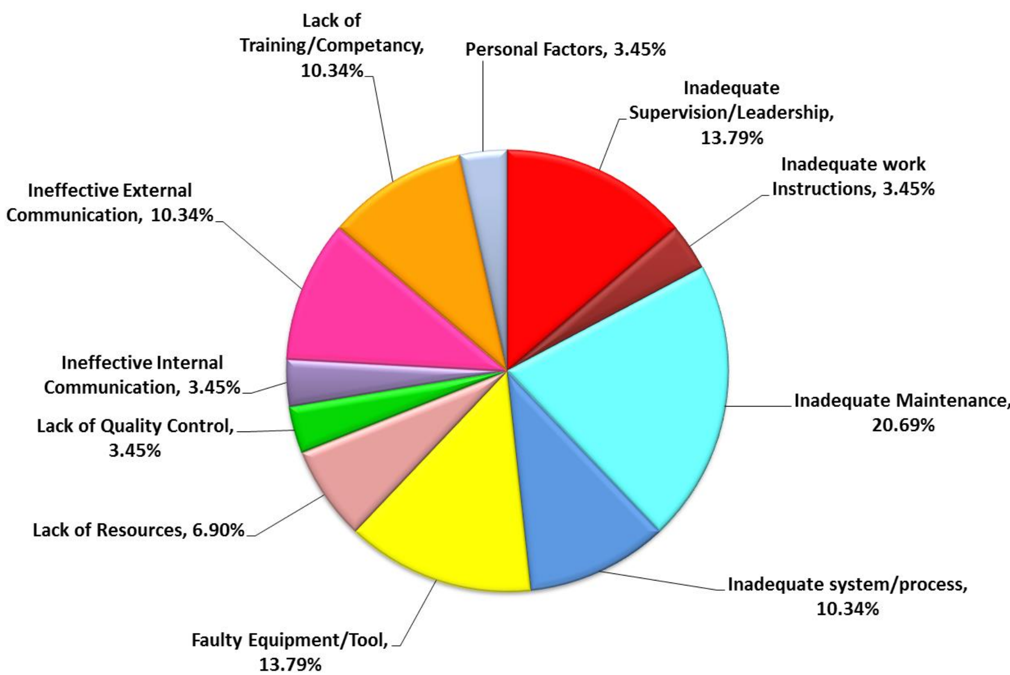

Fig 10: Distribution of the root causes of Company B, a local company.

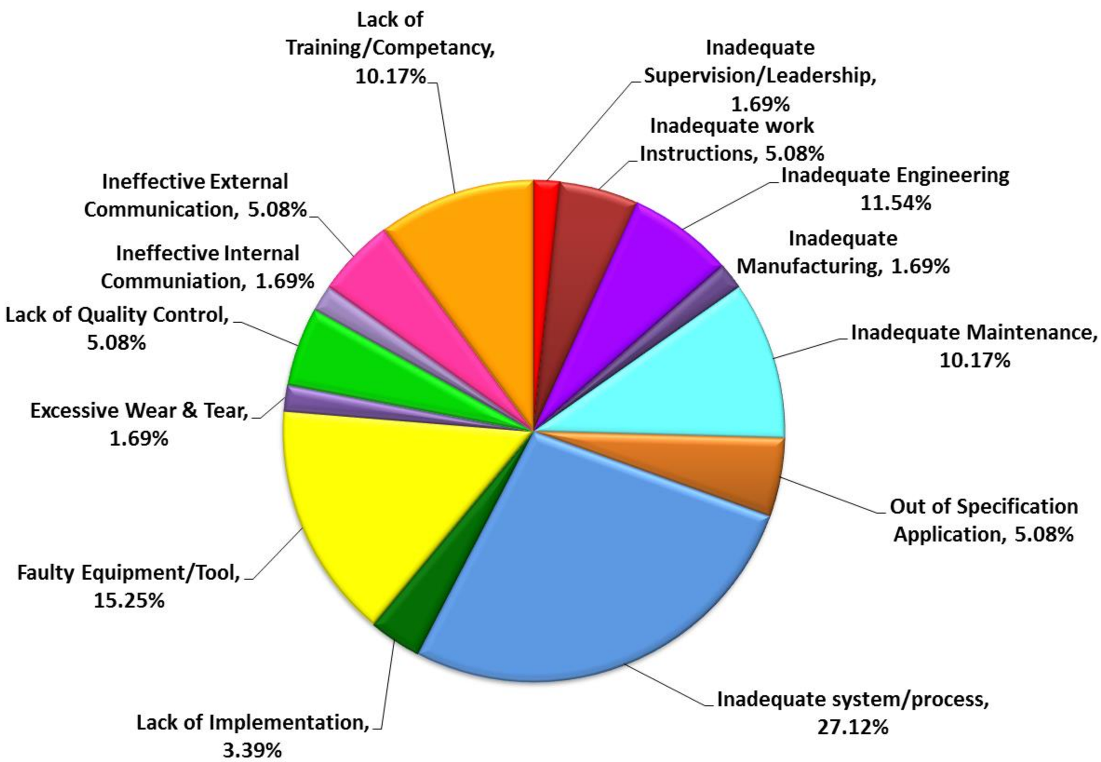

Fig 11: Distribution of the root causes of Company C, an International company.

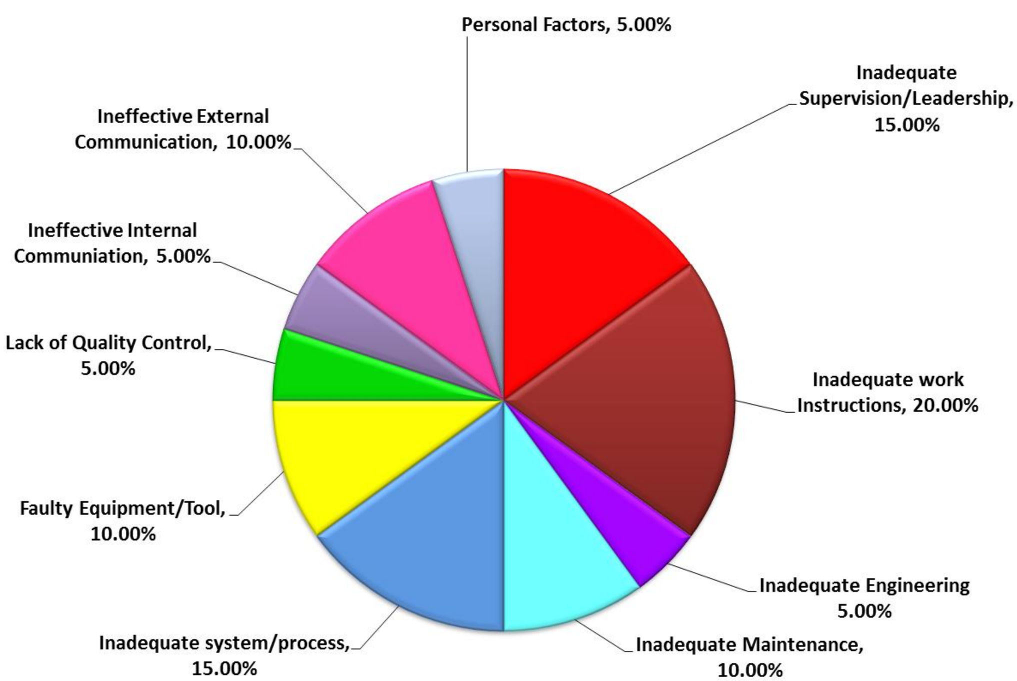

Fig 12: Distribution of the root causes of the failures of the Well A.

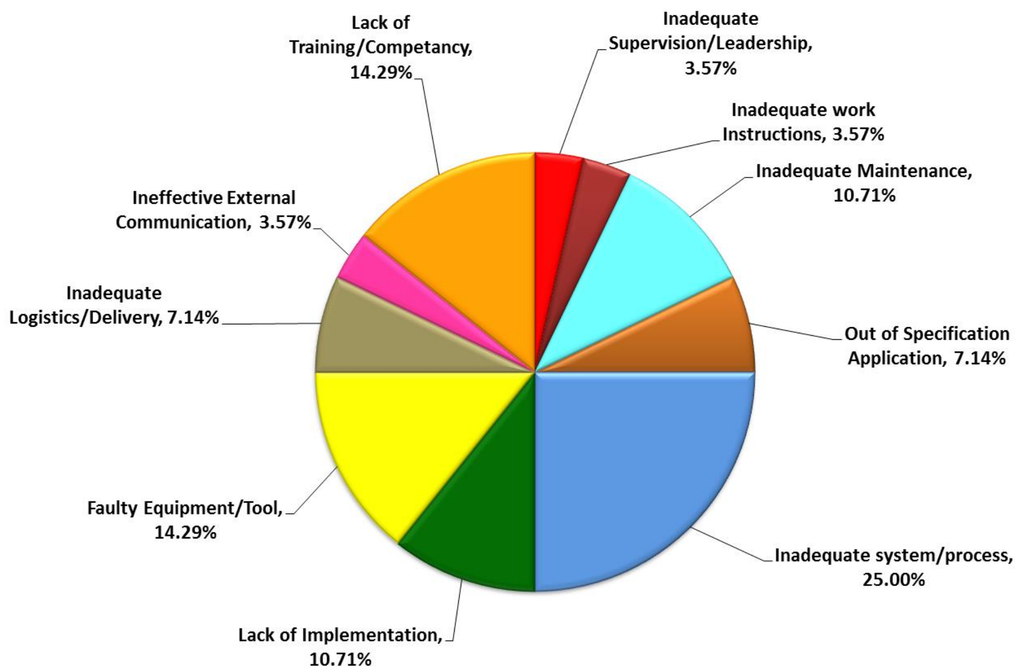

Fig 13: Distribution of the root causes of the failures of the Well B.

APPENDIX D

SPE 189423 – MS Confirming Well Quality at Well Delivery

SPE/IADC-189423-MS

New Approach: Confirming Well Quality at Well Delivery with stringent Well Integrity checks at a world class drilling project

F. Rashid, ADNOC Offshore; Dr. S. Butt, Memorial University;

Abstract

Drilling a well is comprised of multiple activities which are linked to the well objectives and requirements set in the design phase. Some of the activities have short term impacts on the well such as logging a section etc., and some of the activities have long term impacts on the well such as cementing, wellbore accessibility etc. It is quite important to list the activities based on their impact on a well and rate them individually to get the overall impact on the objectives of a well by these activities.

Conventionally a well quality score was reported 6-12 months after a well was completed. The quality cycle to improve the performance of a well became ineffective and irrelevant due to late reporting. The results of the activities of a completed well were so late that many wells had been drilled and completed during the reported period. First, this major flow turned the existing Well Quality KPIs into laggard KPIs, which were not contributing to enhancing the Quality of a delivered well. Second, the well quality score was distributed among four different categories where Well Integrity was an isolated category, and a well integrity issue has minimum impact on overall well quality scoring. Third, the scoring guidelines were very generic and were depended on the evaluator judgment. A lack of verification of the results was also evident during KPI reporting, which made the KPIs score skeptical and unreliable. Fourth a fixed scoring structure was used to evaluate all type of wells at the same scale. Such as the scoring of a complex well was treated the same manner as a scoring on a workover well. Last, some activities were ignored in the well quality scoring such as Coring Quality, minimum Well Integrity requirements etc. The overall score does not represent the actual picture of a well using existing Well Quality KPIs, which was impacting the overall project quality score.

A new approach was adapted to capture the well quality score right after a well is delivered so that improvement ideas can be implemented in the current drilling wells in the execution phase and coming wells in the design phase without any delays. The quality cycle was improved resulting in shorter well duration with lesser well integrity issues. A new weightage system was introduced to capture all activities in a well, where these activities are evaluated individually. Scoring criteria for each activity is defined clearly. Based on deviation from the planned activity, the actual score is recorded accordingly by the user. Later these activities are verified by the end users, so verification is enhancing the trust as well the validity of a lesson learned. Users and end users are connected at an early stage after a well completed to capture

the feedback. Improvements get quickly implemented as the quality cycle is short and quick. The new scoring method introduced a wide range of Well Integrity checks based on rigorous and clear guidelines, where failure to meet key well integrity policies can result in nulling the overall score of a well.

New well quality scoring guidelines provide a clear and efficient approach to score the key performance indicators of a well at the right time. Consistency in scoring, timely reporting and right weightage for well quality scoring results in high quality well programs, application of fit-for purpose technologies and better knowledge transfer among team members.

Introduction

With the launch of a mega drilling project in the Arabian Gulf, it was imperative to consider revisions of not only the drilling practices but also the guidelines used to measure the Performance and Quality of the project wells. The quality, one of the key element of any project, depends on the type of the project wells to be drilled and completed. These project wells are varied to be drilled from satellite platforms to an artificial island and are extended reach wells ranging from 18,000ft to 35,000ft. Figure 1 shows the layout of the four artificial islands with planned trajectories.

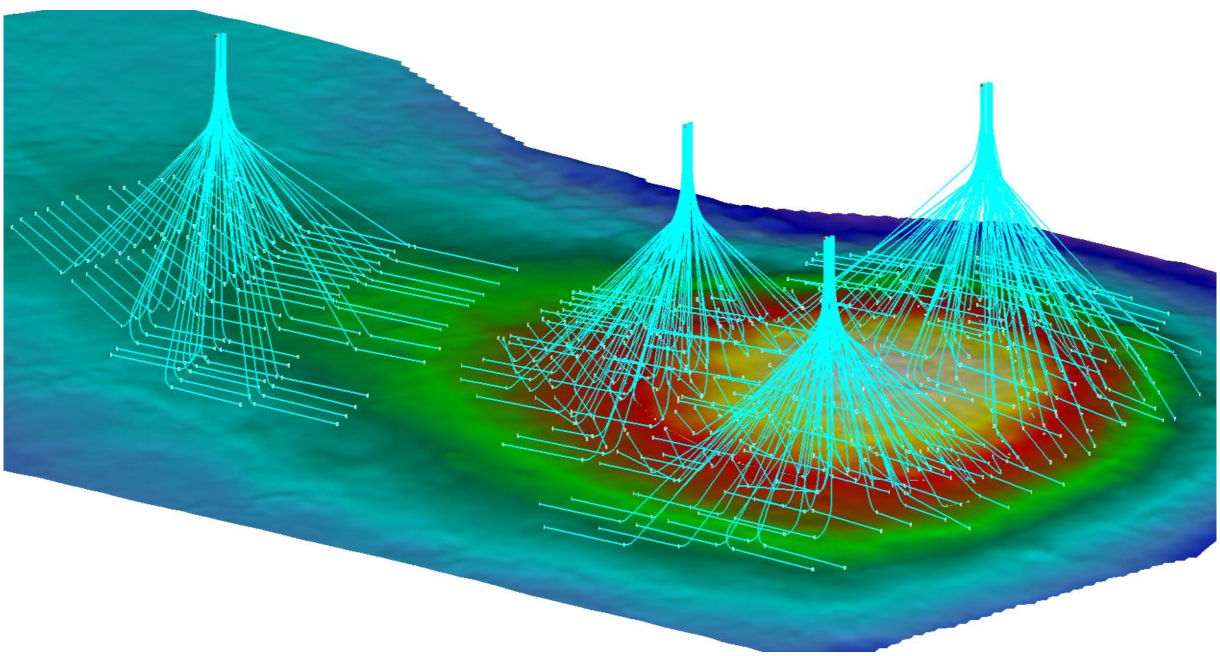

Figure 1: Four Artificial Islands with planned trajectories

The quality of these high profile wells requires strong measuring standards, which should be established on SMART (Specific, Measurable, Achievable, Realistic, Time bounded) criteria and adoptable to any well drilled and completed for the Island project or different consortium. With the launch of mega drilling project, the existing Quality capturing practices were re-evaluated to observe;

- Do these practices reflect current drilling/reservoir practices?
- Do these practices represent the department performance accurately & separately?
- What kind of values are these practices bringing to improve the well operations/performance?
- Are these practices fit SMART (Specific, Measurable, Achievable, Realistic, Time Bounded) Criteria

Existing Well Quality KPIs limitations

Existing Quality KPIs covered four areas; Well Operational Requirements, Well Integrity, Well Performance, and Data Gathering (Kikuchi, 2008). Among four areas, three of them were related to execution phase (Well Delivery Phase), and the fourth, Well Performance KPI, is related to reservoir pressure and flow rate. Ten projects wells were evaluated under the old set of Quality KPIs, and the results were discussed at the End of Well reviews. During reviews, the drilling team realized that;

- Scoring Criteria in existing KPI does not reflect Well Objectives, so need to have dynamic and versatile scoring method for Quality measures based on well type and complexity was recognised.
- Many of the existing Quality KPIs are not specified and defined. Engineers have to assume and make a guess to find the results of the KPIs. Especially a very little information is available for the coring and logging scoring. KPIs states 0 or 8 score for the data gathering, but it is noticed engineers, sometimes, assign 3, 4 or 6 scores based on unknown criteria which are different for a different engineer.
- Set target does not measure actual drilling performance as Well performance KPIs are linked with reservoir planning and management.
- Some of the KPIs are not Time Bounded, such as well performance KPIs required more than six months before KPIs are captured, as the stability in the well flow is one of the conditions to measure KPIs. It is observed that the majority of well take more than a year before KPIs are finalised and reported. KPIs on some of the wells are not finalized more than two years.
- KPIs do not match with Well Delivery Process (WDP)
- Roles and Responsibilities are not defined. Some of the KPIs had not been captured properly.
- Historical Performance does not reflect on improving the performance of future wells.
- Data Gathering KPI discusses only two component with equal weight; Coring and Logging. Data Recovering is merged with Data Quality as both are different concepts. In case of Coring is not run, there are no guidelines to score overall Well Quality KPI

Based on above findings, drilling management captured the need for change to improve the existing Quality KPIs to meet the mega drilling project needs and it is stated as "During WDP, it should be stated that what can be done and what can't be done. Well Quality KPI needs revision. Well Quality KPI should be based on the clear goals discussed during WDP considering each well an individual design (complexity, placement limitations, availability of information/data, etc.). For example, NPT target should be based on the complexity of the well and landing point criteria to be reviewed again, etc."

New Well Quality KPIs

A realistic approach to align the KPIs with Well Delivery Process is adopted and Well Quality KPIs are mainly linked with the measures of the quality of the works delivered during drilling phase before the well is handed-over to the production team. Well Quality KPIs are split from Well Performance KPIs which measure the performance of the well comparing with the reservoir management basics such as well flow rate, reservoir pressure, etc. Both set of KPIs, Well Quality KPIs (Delivery) and Well Performance KPIs, need to be measured separately by two different teams as the different timelines are required with different objectives. This paper discusses only the Well Quality KPIs (Delivery).

Well Quality KPIs (Delivery) focus on all the activities and operations conducted by the rig and evaluate the level of achievement in each activity separately. KPIs are split into further six major categories;

a) Drilling & Well Placement
    - Landing point location (north/east coordinate and vertically in target reservoir) as per plan
    - Total horizontal length in target layer achieved as per plan
b) Running Casing & Cementing
    - All casings successfully landed in planned formation (Landing points & sizes) as per plan
    - Successful cementing and testing as per plan
    - Casings are corrosion protected at surface (conductors, surface casing etc.)
    - Liner hangers/packers are run, set and tested successfully

c) Completion & Stimulation
- Completion successfully run to target set depth within tolerance limits as per plan
- Successful completion equipment tests including, DHSV, wellhead tests,
- Enzyme/breaker treatment spotted
- Stimulation program is executed (only with the rig) as per plan

d) Wellbore Accessibility
- Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc.
- Wireline Accessibility (Completion)
- Coiled Tubing Accessibility

e) Well Integrity
- Zonal Isolation successful
- Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure

f) Data Gathering & Evaluation
- Coring
  - Core recovery (% Core recovery)
  - Core quality & usability (Mechanical stability of the core)
- LWD data (Recovery and Quality)
  - Geo steering well log data (quality and frequency, sample/ft.) - Real-time
  - Reservoir Data (memory Data)
- Wireline logging data (Recovery and Quality)
  - Cased Hole Data (Gyro, Corrosion, cement log.etc...)
  - Open Hole Data (reservoir data)
- Post completion Data (Reservoir surveillance)

The detailed guidelines are developed to discuss the roles and responsibilities of each team, and scoring criteria of each KPI of each major category. Maintaining Well Integrity during is one the key objective of every activity of a well. Due to its importance, well integrity became a necessary component of every work conduced on a well and is linked with all major KPI categories of Well Quality KPIs. Figure 2 shows the interrelationship between Well Integrity and other key categories of the Well Quality KPIs.

Figure 2: The elements of New Well Quality KPIs

Actual vs. Plan

Instead of measuring the KPIs against pre-set definition or targets as previously used in the old set of KPIs (Kikuchi, 2008), a different methodology is used to make sure KPIs are applicable to all type of wells, complex to simple, long horizontal to vertical, and new drilling well to workover etc. The methodology comparing actual results with the plan provides the significant flexibility to measure the quality of works delivery on all type of wells and provides the chances to improve the well design during planning phase based on the learnings from previously delivered wells. Traditionally a benchmarking method is recognized globally for target setting (Weekse, 2013), new approach Actual vs. Plan provides fit-for-purpose KPI to improve the performance by comparing the results with plan requirements.

To accommodate the changes to the plan, MOC (Management of change) becomes compulsory. Otherwise, KPIs score will be affected based on the completed work using the detailed scoring guidelines. In some cases, where the change in the plan can cause major casing design change and impact of the future production profile, KPIs score will be considered nil for that category. For example, Running Casing to the planned depth required all strings to be run at the planned depth within the tolerance limit. If a failure to compliance can result in more casing strings, high well cost and affecting main objectives of the well, the score under running casing to plan depth will be considered '0' regardless a MOC is provided or not.

Reporting and Verification

Majority of the KPIs are captured by the admin staff. These admin staffs are not technically competent to verify the KPIs. The most of the KPIs reporting is normally depended on the single reporting structure, where the KPIs' values are confirmed by a single person. New Quality KPIs has a new feature where a verifier is also required to confirm the KPI score. An admin contacts the related person of the well for reporting and gets confirmation of the KPI by different person equally qualified to calculate the KPIs. Table 1 shows each KPIs with reporting and verification responsibilities.

Table 1 Well Delivery KPIs with Responsibility Structure

Well Delivery KPIs	KPI Responsibility	
Program executed within planned limits with respect to; (including MOC)	Reporting	Verification
1) Drilling and Well Placement		
a) Landing point location (north/east coordinate and vertically in target reservoir) as per plan	Operations Geologist	Well Engineer
b) Total horizontal length in target layer achieved as per plan	Operations Geologist	Well Engineer
2) Running Casing and Cementing		
a) All casings successfully landed in planned formation (Landing points & sizes) as per plan	Well Engineer	Operations Geologist
b) Successful cementing and testing as per plan	Well Engineer	Well Integrity Engineer
c) Casings are corrosion protected at surface (conductors, surface casing etc.)	Well Engineer	Well Integrity Engineer
d) Liner hangers/packers are run, set and tested successfully	Well Engineer	Well Integrity Engineer
3) Completion and Stimulation		
a) Completion successfully run to target set depth within tolerance limits as per plan	Well Engineer	Well Integrity Engineer
b) Successful completion equipment tests including, DHSV, wellhead tests,	Well Engineer	Well Integrity Engineer
c) Enzyme/breaker treatment spotted	Mud Engineer	Well Engineer
d) Stimulation program is executed (only with the rig) as per plan	Well Engineer	Well Engineer
4) Wellbore Accessibility (actual results or model based on actual well path/actual completion design)		
a) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc.	Well Engineer	Well Integrity Engineer
b) Wireline Accessibility (Completion)	Well Engineer	Well Integrity Engineer
c) Coiled Tubing Accessibility	Well Engineer	Wells Works Engineer
5) Well Integrity		
a) Zonal Isolation successful	Well Integrity Engineer	Reservoir Engineer
b) Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure	Well Integrity Engineer	Well Integrity Engineer
6) Data Gathering and Evaluation		
a) Coring		
1. Core recovery (% Core recovery)	Operations Geologist	Reservoir Geologist
2. Core quality & usability (Mechanical stability of the core)	Reservoir Geologist	Reservoir Geologist
b) LWD data (Recovery and Quality)		
1. Geo steering well log data (quality and frequency, sample/ft.) - Real-time	Operations Geologist	Well Engineer
2. Reservoir Data (memory Data)	Operations Geologist	Well Engineer
c) Wireline logging data (Recovery and Quality)		
1. Cased Hole Data (Gyro, Corrosion, cement log.etc...)	Well Integrity Engineer	Well Engineer
2. Open Hole Data (reservoir data)	Operations Geologist	Well Engineer
d) Post completion Data (Reservoir surveillance)	Reservoir Engineer	Well Engineer

Scoring Logic

A drilling and completion program of a well is comprised of many subprograms such as cementing, logging a section etc. A Macro and Micro KPI concept (Benyeogor, 2016) is used to capture overall well Quality KPI (Macro KPI) for the company by monitoring and measuring KPIs (Micro KPI) at a planned activity level.

A weighting scheme is introduced to assign more weightage to the KPIs where multiple or extended activities such as multiple logs, Multilateral wells, Extended Reach wellbore etc. are planned. For example, 4.0 weightage is assigned to High Deviated or Horizontal single lateral, 4.0 weightage is assigned to each lateral, in Multi-lateral well, and 2.0 weightage is assigned for a pilot hole or a vertical hole under Well Placement KPIs. All the weightages are later added to give a well score. More that work is conducted on a well, more that weightage is assigned to the well. Figure 3 shows different wells with different KPI weightage. The grey bar represents total weightage of a well assigned due to planned activities on the well. Well-1 carries a lot of activities compared to Well-2, where Well-1 is a multilateral well with a pilot hole and coring and Well-2 is a simple work-over well to fix completion integrity. The blue bar represents the sum of the score achieved against each activity.

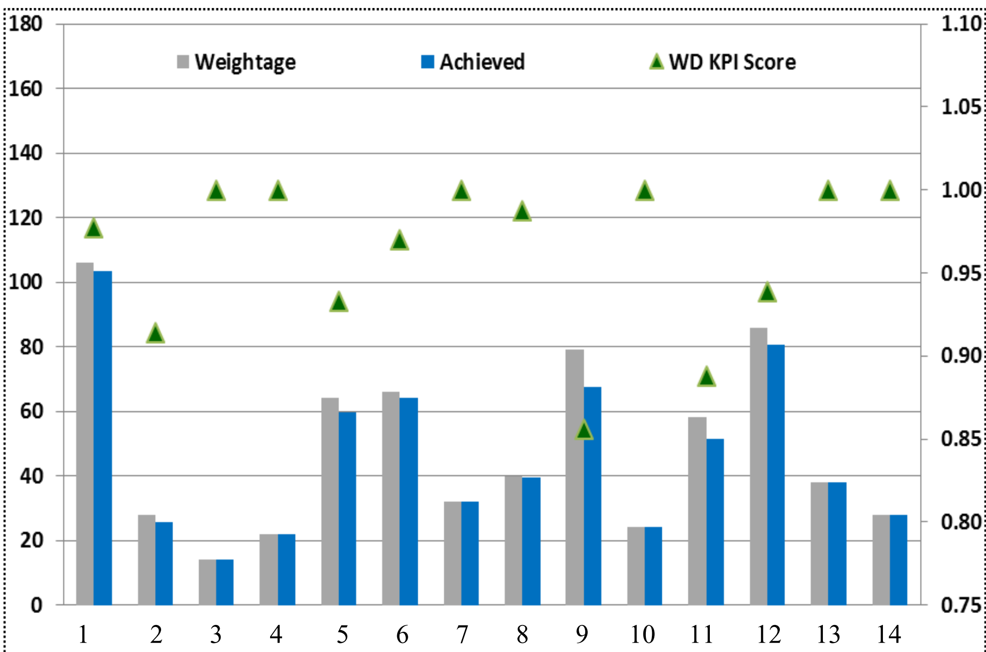

Figure 3 Different Wells with Different Weightage

After assigning a weightage based on planned activities under single KPI, a score is assigned based on actual work completed. A different methodology is adopted for different KPIs. Some of the KPIs receive either full score or 'nil' based on the compliance to the KPIs described in the detailed guidelines. For example, landing point location as per plan within target zone will receive a full score based on 0.0 to 1.0 scale, otherwise missing the target will receive minimum score '0'. Some of the KPIs receive a partial score or '%' of the total sore based on 0.0 to 1.0 scale. For example, a percentage score will be applied based on percentage recovery of the core to the planned core length. Similarly, a percentage score will be applied based on percentage recovery of the data to the planned data length etc.

A zero weighting will be applied to all non-applicable KPIs, i.e., if no activity is performed, weightage will be zero for the KPI related to the specific activity.

The new weightage method makes the KPIs more flexible to use in all situations and all type of wells from vertical to highly deviated or horizontal wells to extended reach well. New scoring method captured all simple to complex wells.

Well Integrity KPI - Killer KPI

Well Integrity is a main common objective of all the completed wells, new drill wells or work-over wells. A well is considered not completed till it passes the all the Well Integrity checks. Some of these checks were added to the well integrity KPIs to make sure these are captured while reporting KPI. Integral Wells are operating within design limits, their integrity is assured and they do not have any known integrity issues or concerns, such as;

1) External leak from the tree or wellhead
2) Tree and wellhead valves which fail to function or leak test
3) DHSV system fails to function or leak test (passing)
4) Tubing to casing, or casing to casing communication
5) Annuli in communication with the reservoir
6) Un-bleedable annulus pressure
7) Any well with tubing clearance or obstruction issues

In case any well integrity issue is observed on a well at its delivery, KPIs score for the complete well be considered ‘0’ till the issue is fixed. Well Integrity is a Killer KPI, which is introduced to make sure that delivered wells meet Well Integrity requirements. Figure 4 shows a weightage distribution of KPIs on normal new drill well.

In case any well integrity issue is observed on a well at its delivery, KPIs score for the complete well be considered ‘0’ till the issue is fixed. Well Integrity is a Killer KPI, which is introduced to make sure that delivered wells meet Well Integrity requirements. Figure 4 shows a weightage distribution of KPIs on normal new drill well.

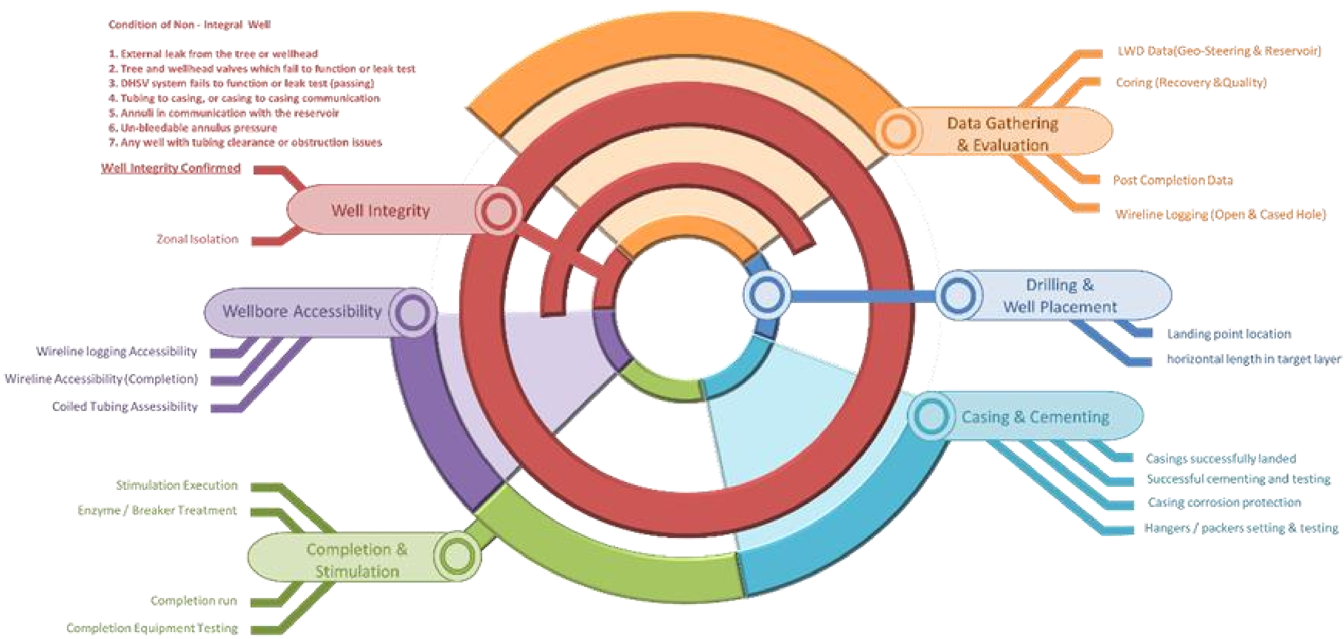

Figure 4 weightage distribution of KPIs on normal new drill well

Gain Analysis

Each KPI under New Well Quality KPIs is developed based upon S.M.A.R.T (Specific, Measurable, Achievable, Realistic and Time bounded) criteria. Well Quality KPIs at delivery supported by detailed guidelines are providing miscellaneous benefits to the organization. Below are some of the visible benefits achieved after implementing new Well Quality KPIs;

a) Versatile & Adaptable: Well Quality KPIs are flexible and applicable to all type of wells. So a simple excel sheet is used to cover all type of wells. Scoring guideline provides set-by step procedure for scoring each activity and non-applicable activities are ignored from the calculation, which makes the Well Quality KPIs to be used on all type of wells.

b) Activity based Valuation: KPIs are set for many different activities from spud to handover a well. Each KPI is scored based on the performance of the activity. So, KPI for each activity is tracked and monitored separately for performance enhancement by one specific team assigned for the activity.

c) Concentrated on Requirements: The major change observed related to the KPIs setting is using requirements as a baseline for scoring instead of fixed scoring guidelines. It is one of the smart ways to accommodate the changing requirements from simple to complex wells.

d) Well Integrity Focused: New Well Quality KPIs receive more attention in term of well Integrity. Well integrity became the main focus of the KPIs, and certain well integrity criteria are strictly considered to avoid full impact on overall Well Quality KPIs.

e) Technical Enhancement: The method to provide data and verification process supported by detailed guidelines are changing the team approach to solve issues and improve the activities. Well Quality KPIs became a good source of technical enhancement for the engineers and coordinators who worked full or partially in KPIs preparation.

f) Self-Supported: As role and responsibility of each person is clearly defined to prepare the Well Quality KPIs of a well, the KPIs reporting was carried out with minimum resources assigned for the KPIs preparation. As a well is completed, assigned engineer prepares the KPIs and sends to the focal point for consolidation. So, currently KPIs are self-supported and extra technical resources are not required.

Well Delivery KPIs	Comments	KPI Responsibility	Score	Actual	Weightage	Total Achieved	Scoring Guideline
Program executed within planned limits with respect to; (including MOC)							
1) Drilling and Well Placement							
a) Landing point location (north/east coordinate and vertically in target reservoir) as per plan		OG/DCE	1.00		4.00	0.00	Yes/No, Yes=1, No=0
b) Total horizontal length in target layer achieved as per plan		OG/DCE	1.00		4.00	0.00	%
2) Running Casing and Cementing							
a) All casings successfully landed in planned formation (Landing points & sizes) as per plan		DCE/OG	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful cementing and testing as per plan		DCEFE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Casings are corrosion protected at surface (conductors, surface casing etc)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Liner hangers / packers are run, set and tested successfully		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
3) Completion and Stimulation							
a) Completion successfully run to target set depth within tolerance limits as per plan		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful completion equipment tests including, DHSV, wellhead tests,		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Enzyme/breaker treatment spotted		IDT/DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Stimulation program is executed (only with the rig) as per plan		DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
4) Wellbore Accessibility (actual results or model based on actual well path/actual completion design)							
a) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc		DCE/WI	1.00		2.00	0.00	%
b) Wireline Accessibility (Completion)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Coiled Tubing Accessibility		DEC/WW	1.00		2.00	0.00	%
5) Well Integrity							
a) Zonal Isolation successful		WI	1.00		6.00	0.00	Yes/No, Yes=1, No=0
b) Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure		WI	1.00		Killer KPI		Yes/No, Yes=1, No=0
6) Data Gathering and Evaluation							
a) Coring							
1. Core recovery (% Core recovery)		OG/RG	1.00		2.00	0.00	%
2. Core quality & usability (Mechanical stability of the core)		RG	1.00		2.00	0.00	%
b) LWD data (Recovery and Quality)							
1. Geo steering well log data (quality and frequency, sample/ft) - Realtime		OG	1.00		2.00	0.00	%
2. Reservoir Data (memory Data)		OG	1.00		2.00	0.00	%
c) Wireline logging data (Recovery and Quality)							
1. Cased Hole Data (Gyro, Corrosion, cement log..etc...)		WI/DCE	1.00		2.00	0.00	%
2. Open Hole Data (reservoir data)		OG/DCE	1.00		2.00	0.00	%
d) Post completion Data (Reservoir surveillance)		PE/DCE	1.00		2.00	0.00	Yes/No, OR, %
Well Delivery KPIs (Total Score) (2-4 weeks)		**0.00**			**50.00**	**0.00**	

Lesson Learned / Improvements	Recommendations	Category/ Job type	Hole Sec

Position	Signature
Well Engineer (Drilling)	
Well Engineer (Completions)	
Operations Geologist	
Well Integrity Engineer	
Cementing Engineer	
Mud Engineer	
Reservoir Geologist	
Knoweldge Management Engineer	
WDP Manager	

Note: Each responsiple party has to varify and sign the KPIs Document for WDP record.

Figure 5 Excel Sheet to calculate the Well Quality KPIs

Figure 5 shows the excel sheet used for the entire KPI structure to capture the weightage and score achieved against each KPI. Score for each KPI is calculated separately. It helps to evaluate the performance of a specific KPI for different wells to compare the individual performance of the KPI. For example, score for coring sample recovery can be evaluated on all previous wells where coring is performed to check if there is any constant issue related to coring sample, so performance can be improved using alternate solutions.

Performance Enhancement

New Well Quality KPIs bring the changes to the mindset in running to planning operations. Performance enhancement on drilling project contains many internal and external variables ranging from individual efforts to collective attempts. Well Quality KPIs play one of its role, too, to improve the overall project performance, especially KPIs measurement against the planned requirements helps to pick the best services and fit-for purpose technologies for a drilling and completion activity. It proves it is a chain reaction that teams are considering requirements based on needs and eliminating extra requirements (wishes) from the drilling and completion programs. Drilling and Completion teams are looking for the best available technologies and fit-for-purpose approach to design and plan wells.
Figure 6 shows the significant reduction in average well days since 2015, the year new Well Quality KPIs were implemented. Trend-line clearly indicates the well day duration will keep improving till an optimum days are achieved for a 25Kft well.

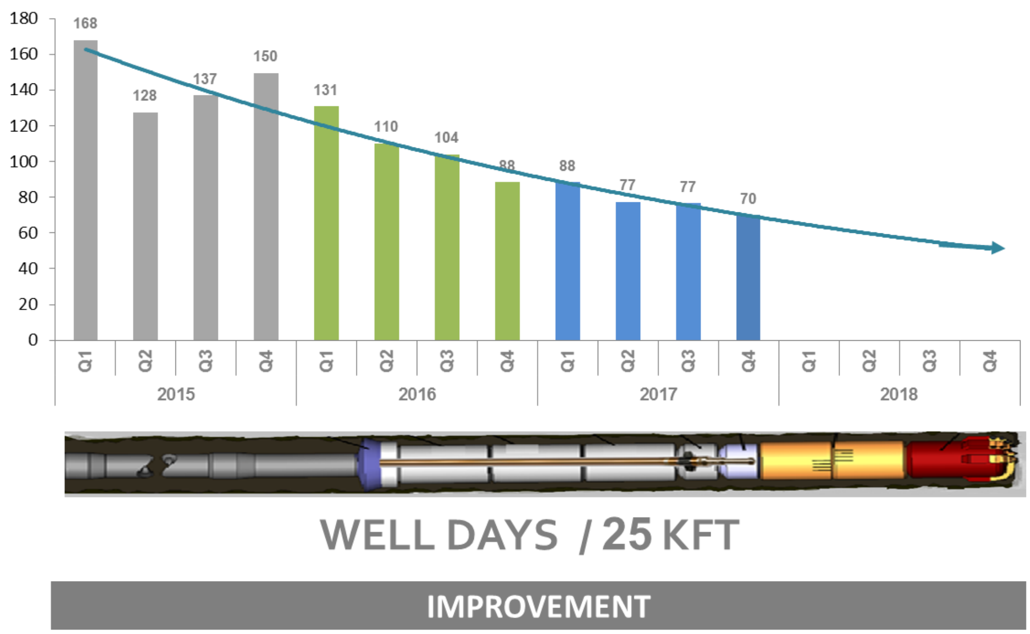

Figure 6 Well Days Reduction

Conclusion

New Well Quality KPIs covers all types of wells based on requirements sets in planning phase. Actual results comparison against plan brings significant improvement in various drilling activities, as responsible teams review requirements in more details to make sure drilling programs are more practical and easy to implement. This practice helps to achieve the best score as well as fade away the unnecessary requirements from drilling and completion programs. The new approach in setting KPIs is proven better than the traditional benchmarking approach.

Acknowledgments

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APPENDIX E

Well Delivery KPIs Guidelines

Well Delivery KPIs Guidelines

Business Process Owner: DR-PBI

The only official version of any Drilling Procedures or Guidelines is That published by DR-PBI on the DR Portal

Prepared by

15-1-2015

Manager DR-PBIPS
Faisal Rashid

Approved by

Well Delivery KPIs have been presented to DWISC shareholders on:

- KPIs Shareholder Workshop (16th April 2013)
- 10th DWISC (29th October 2013)
- 11th DWISC (23rd April 2014)
- 12th DWISC (29th October 2014)
- Well Delivery KPIs are approved by DWISC shareholders to be implemented for 2015 as per 12th DWISC CnR

Revision/last updated: January 2015

Well Delivery KPIs Guidelines

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Well Delivery KPIs Guidelines

PURPOSE

Well Delivery KPIs focus on all the activities and operations conducted by the rig (jack-up / land) and evaluate the level of achievement for following major elements;

a) Drilling & Well Placement
b) Running Casing & Cementing
c) Completion & Stimulation
d) Wellbore Accessibility
e) Data Gathering & Evaluation
f) Well Integrity

The guidelines discuss the roles and responsibilities of each team and scoring criteria of each KPI under major elements. A weighting factor is introduced to assign more weightage to certain KPIs based on number of activities such as multiple logs runs, Multilateral wells, Extended Reach Well etc. A zero weighting will be applied to all non-applicable KPIs i.e., if no activity is performed, weightage will be zero for the KPI related to the activity. A Killer KPIs is introduced under Well Integrity for the wells, if Well Integrity is compromised during execution phase.

Ownership: DR-PBI is the Owner of the Process and will be the responsible to update the Well Delivery KPIs Guidelines.

Responsibility: DR, WO and FD are responsible for implementation of the guidelines.

Stakeholders: Drilling, Well Operations and Field Development

Functional Support: will be provided by DR-PBIPS.

Time Line: Well Delivery KPIs should be reported within 2-4weeks after the Well is delivered by all the parties and consolidated by PBIPS

Lesson Learned: In case, 100% KPI is not achieved for any section or any work, responsible team will provide the lessons learned. Knowledge Management Engineer will capture the lessons learned in Well Delivery KPIs Sheet.

Validation and verification: Responsible teams to report and to verify the each KPI have been defined. Each responsible person will validate and sign the final Well Delivery KPI sheet of the well.

1. DRILLING & WELL PLACEMENT KPIs

a) Landing point location (north/east coordinate and vertically in target reservoir) as per plan.

The actual location of landing point (north/east coordinate & vertically in target reservoir) within target as per plan or MOC. Full score to be applied in case of landing as per plan or MOC, otherwise 0 score will be applied for not landing within the target limits.

Landing point target should be agreed in **Appraise and Select Stage** during Well Delivery Process.

<u>Weightage Guideline</u>: 4.0 weightage is assigned to single lateral (Deviated or Horizontal), 4.0 weightage is assigned to each lateral, in Multi-lateral well, and 2.0 weightage is assigned for a pilot hole and all vertical hole wells. For long and highly complex lateral, 4.0 - 8.0 weightage can be assigned with agreement with OG and DCE based on DCI.

Responsibility: It is responsibility of the Operation Geologist (OG) to report and the Well Engineer (DCE) to verify the KPI score.

b) Total horizontal length in target layer is achieved as per plan

The actual total horizontal length in target layer should be as per program or MOC. A percentage score will be used if the actual horizontal length in the target layer is within 70% of the planned horizontal length in target layer (30% is tolerance is allowed). If the total length is less than 70% of the plan or MOC requirement, a 0 score will be applied

Note: Use actual score (% of the actual in targeted layer) if minimum 70% of the planned horizontal length in the target layer is achieved. Use 0 score, if less than 70% of the planned horizontal length in the target layer is achieved.

Weightage Guideline: 4.0 weightage is assigned to single lateral (Deviated or Horizontal), 4.0 weightage is assigned to each lateral, in Multi-lateral well and No weightage for pilot hole and vertical wellbore. For long and highly complex lateral, 4.0 - 8.0 weightage can be assigned with agreement with OG and DCE based on DCI.

Responsibility: It is responsibility of the Operation Geologist (OG) to report and the Well Engineer (DCE) to verify the KPI score.

2. RUNNING CASING & CEMENTING KPIs

a) All casings are successfully landed in planned formation (Landing points and sizes)

Landing of each casing at plan depth is very important. It may cause significant change in well path or well flow, if all the casings are not landed at desired depths especially for ERD wells. Full score will be given if all the casing strings are landed as per plan, i.e., all the designed casing sizes are landed in planned formation at planned landing point. If a casing is landed shallower than planned, and this results in a major change in well plan/path or casing designs, or well costs, a 0 score will be given. The 0 score will be given provided an MOC is issued to approve the modified well design. All casing strings must satisfy this criteria, otherwise 0 score will be applied

Weightage Guideline: 2.0 weightage is assigned to each casing run. If 3 casing strings are design for a well, total weightage is 6.0.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Operation Geologist (OG) to verify the KPI score.

b) Successful Cementing and Casing Testing as per plan

Criteria for successful cementing and casing testing will be determined by the Cementing Engineer and Well Integrity Engineer. Successful Cementing and Casing Testing should include;

I. Cementing has been conducted as per plan. Pumped cement slurry density should be within +/- 0.2ppg of the designed slurry. Spacers and slurries volumes are pumped as per designed. Displacement rate are as per designed rates.
II. After WOC, no wet shoe issues. At least 10ft hard cement inside shoe must be found.
III. Cement tops are confirmed and matched with final cementing program. Cement tops can be confirmed with mechanical job parameters or with cement bond logs.
IV. Casing/liners are successfully pressure tested to the value as prescribed in the drilling program.
V. Shoe bond integrity for Casing and Formation are confirmed by pressure test to the value as prescribed in the drilling program.

In case any of above criterion is not met for a cementing job, a 0 score can be applied for that cement job in consultation with Drilling Engineer and Well Integrity Engineer.

Note: In case of cement plugs (P&A, sidetrack plugs, plug back plugs, etc) all the cement plugs must be successfully placed at the planned depth with planned length and plugs are tested as per plan to get full score. In case verification of depth and length of the placed cement plug is not available, a best judgment can be made for the KPI scoring based on execution of the cement plug job and while drilling, if planned. For example, if the execution meets all the planned requirements, a full score for cement plug will be applied, otherwise 0 score. In case, there is a pressure test is planned and pressure test is failed, a 0 score will be applied for that plug.

Weightage Guideline: 2.0 weightage is assigned to each primary cementing job. 1.0 weightage is assigned to each plug job as per plan. Any Extra plugs other than plan will not be added in total weightage.

Each cementing job will be scored separately. An average score will be used for the KPI. For Example, 3 casings and 1 plug was planned for a well, 3 casing jobs and 2 plugs were actually placed. Total weightage will be 7.0 through 2 plugs were placed. In case one casing cementing does not meet the requirements, then 5/7 (0.71) will be used for the score.

Responsibility: It is responsibility of the Cementing Engineer (IDT) to report and the Well Integrity Engineer (WI) to verify the KPI score.

c) Casing is protected from corrosion at surface

Conductor pipe is coated and cemented to surface or to the mud line. Surface casing is cemented to surface as per guidelines. Fluids left in all the annulus contain corrosion inhibitor as per guidelines. Cellars on inland wells are left dry.

A full score will be applied for the full compliance, otherwise 0 score will be applied.

Weightage Guideline: 2.0 weightage is assigned to the casing protection at surface.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

d) Liner hangers / Liner packer are run, set and tested successfully

Liner hangers and all packers are run and set as per plan. The packers are successfully pressure tested to the value as prescribed in the drilling program. An injectivity or pressure or any other type of confirmation test is performed to check no flow across the packer.

A full score will be applied for running, setting and testing the Liner hanger and packer etc. as per plan. An average score of packer/hanger run will be captured as the KPI.

Weightage Guideline: 2.0 weightage each is assigned to each planned packer and hanger run.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

3. COMPLETION & STIMULATION

a) Completion successfully set to target setting depth (within tolerance limits)

Setting of completion especially lower completion at the right depth is critical for well productivity and well life. Program must discuss the desired setting depth and tolerance to it. 0 score will be applied, if the completion is set outside the tolerance limits. A tolerance limits should be discussed and recorded in Appraise and Select phase. In absence of tolerance limits, actual planned or MOC depth will be used for KPI scoring. If the completion is run to the setting depth, but packer is not set, 0 score will be applied.

In case of dual or multi completion, each completion will be scored separately. An average score from all completion will be applied. However weightage will be increased based on number of completion strings.

Weightage Guideline: 2.0 weightage is assigned to each completion run. In case ESP completion, an extra 2.0 weightage is assigned.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

b) Successful completion equipment tests

A full score will be applied for having successful following tests as per plan;

1. Tubing strings is successfully pressure tested to the value prescribed in the completion program.
2. Tubing hanger body seals are successfully pressure tested to the value prescribed in the completion program.
3. Tubing & casing annulus is successfully pressure tested to the value prescribed in the completion program.
4. SC-DHSV function test is confirmed
5. All X-mass Tree valves are successfully function tested & pressure tested to the value prescribed in the completion program.
6. All valves of the Casing Housing & Tubing Head Spool (annuli valves) are successfully function tested & pressure tested to the value prescribed in the completion program.

In case of failure to test any above equipment, 0 score will be applied.

In case of dual completion, each completion will be scored separately. An average score from all completion will be applied. However weightage will be increased based on number of completion strings.

Weightage Guideline: 2.0 weightage is assigned to each completion run.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

c) Spotting enzyme/breaker treatment

Full score will be given for all successful Enzyme/breaker treatment as per plan. 0 score will be applied in case of any deviation from the original plan.

In case of multilateral well, each lateral will be scored separately based on treatment. An average score from all lateral will be applied. However weightage will be increased based on number of treatments.

Weightage Guideline: 2.0 weightage is assigned to each planned enzyme/breaker treatment.

Responsibility: It is responsibility of the Mud Engineer (IDT) to report and Well Engineer (DCE) to verify the KPI.

d) Stimulation program is executed as per plan

A full score will be given for successful implementation of the stimulation plan as per requirements after the confirmation of the following:

- Acid volume pumped as per plan
  - Acid access to multilateral (where applicable)
  - Acid access to Design Depth
- Treatment distribution as per design confirmed by Production/Injection logs, if available.

In case acid volume is not pumped as per plan (a low volume is pumped), a percentage (%) score will be calculated based on volume pumped. In case volume pumped is less than the half of the volume planned, a 0 score will be applied.

In case of multilateral well, each lateral will be scored separately based on treatment. An average score from all lateral will be applied. However weightage will be increased based on number of treatments.

Weightage Guideline: 2.0 weightage is assigned to each enzyme/breaker treatment.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and verify the KPI.

4. WELLBORE ACCESSIBILITY

a) Wireline Accessibility (Open and Cased Hole) wireline, Drill pipe, Tractor

Full score will be given for all successful wireline open and cased-hole jobs as per plan and wireline accessibility to the planned depth. The score of accessibility will be calculated according to the percentage of coverage length in zone of interest. Incase wireline is not run to the desired depth, a percentage score will be applied based on actual planned length coverage.

In case of multiple wireline runs, each runs will be scored separately. An average score from all runs will be applied. However weightage will be increased based on number of planned runs. Scoring will be calculated based on successful runs regardless number of runs.

Weightage Guideline: 2.0 weightage is assigned to each wireline planned run. Any Extra runs other than planned will not be added in total weightage.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

Run #	Actual /1.0	
Run #1 (--------)		
Run #2 (--------)		
Run #3 (--------)		
	Total Score	

b) Wireline Accessibility (Completion)

Full score will be given for all successful wireline jobs inside completion as per plan and wireline accessibility to the planned depth. In case wireline job through completion is not planned, then score will be applied after confirming a wireline clearance inside tubing string and in nipples' profile in the actual completion assembly.

In case of dual completion, each completion will be scored separately. An average score from all completion will be applied. However weightage will be increased based on number of completion strings.

Weightage Guideline: 2.0 weightage is assigned to each wireline planned run for each string.

Responsibility: It is responsibility of the Well Engineer (DCE) to report and the Well Integrity Engineer (WI) to verify the KPI score.

Run #	Actual /1.0	
Run #1 (--------)		
Run #2 (--------)		
Run #3 (--------)		
	Total Score	

c) Coiled Tubing Accessibility

Full score will be given for all successful Coiled Tubing jobs as per plan. The score of coiled tubing accessibility is calculated according to the percentage of coiled tubing coverage length to the planned wellbore section.

In case of multilateral well, each lateral will be scored separately. An average score from all lateral will be applied. However weightage will be increased based on number of laterals. Scoring will be calculated based on successful runs regardless of runs.

Weightage Guideline: 2.0 weightage is assigned to each coiled tubing planned run.

Responsibility: It is responsibility of the Well Engineer (DCE) and Well Works Engineer (WW) to report and verify the KPI score.

Run #	Actual /1.0	
Run #1 (--------)		
Run #2 (--------)		
Run #3 (--------)		
	Total Score	

5. WELL INTEGRITY

a) Zonal Isolation successful

Successful zonal Isolation is very important KPI for a newly drilled or a sidetrack well in order to make sure all the reservoirs are isolated and no communication among layers is expected or observed.

Full score to be applied in case of;

1) Zonal isolation between the reservoirs
2) No suspicious communication between layers

Zonal Isolation will be confirmed by the Well Integrity Engineer in consultation with Cementing Engineer by evaluating the cements jobs execution and interpretation of cement bond logs, if run. In case cement bond log is not run, a detailed post job analysis is required to confirm the cement tops as per plan.

Weightage Guideline: 6.0 weightage is assigned to the zonal isolation success.

Responsibility: It is responsibility of the Well Integrity Engineer to report and verify the KPI score.

b) Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure

Integral Wells are operating within design and their integrity is assured and do not have any known integrity issues or concerns, such as:

1) External leak from the tree or wellhead
2) Tree and wellhead valves which fail to function or leak test
3) DHSV system fails to function or leak test (passing)
4) Tubing to casing, or casing to casing communication
5) Annuli in communication with the reservoir
6) Un-bleedable annulus pressure
7) Any well with tubing clearance or obstruction issues

Well Integrity of any well delivered by rig/barge will not be compromised. 0 score will be applied, in case any of above conditions are met on the well.

Weightage Guideline: Due to the importance of the well integrity, this KPI will be treated as KILLER KPI for the Well Delivery KPIs overall score.

Responsibility: It is responsibility of the Well Integrity Engineer to report the KPI and Well Integrity Manager and Drilling Engineering Manager will verify and confirm the KPI.

6. DATA GATHERING & EVALUATION KPIs

Data gathering KPIs are focused on the data recovery and the quality of the recovered data for all data gathering activities related to the well delivery.

a) Coring

Scoring of the coring is divided into follow two key steps;

1) Core Recovery

   A percentage score will be applied based on percentage recovery of the core to the planned core. **Then the actual score is calculated as percentage of the expected success rate agreed upon in the Appraise and Select phase during Well Delivery Process**.

   Note: Use actual score (% of the expected success percentage) for the KPI.

   Weightage Guideline: 2.0 weightage is assigned to each core recovery activity/job (not runs).

   Responsibility: It is responsibility of the Operation Geologist to report and Reservoir Geologist to verify the KPI score.

2) Core Quality and usability

   A percentage score will be applied based on percentage of core quality and it's usability compared to planned use. This KPI is linked with mechanical stability of core as determined on the rig or shortly afterwards on shore (note KPIs to be finalized 2 weeks after rig departure from well.)

Note: Use actual score (% of the expected success percentage) for the KPI.

Weightage Guideline: 2.0 weightage is assigned to each coring job (not run).

Responsibility: It is responsibility of the Reservoir Geologist to report and verify the KPI score.

b) LWD data (Quality and Recovery)

1) Geo steering well logging data – Realtime mode

Score is divided into two parts;

I. 50% score is linked with the recovery of the Geo-steering well logging data in real-time mode. If the recovery of the data is 100% as per plan (needs are met) then 0.5 score will be applied.
II. 50% score is linked with the quality of the Geo steering well logging data in real-time mode. If the quality of the geo-steering data is attained as per plan (needs are met), then full score 0.5 will be applied.

In case of multilateral well, each lateral will be scored separately. An average score from all lateral will be applied. However weightage will be increased based on number of laterals.

Note: Use actual score (% of the expected success percentage)

Weightage Guideline: 2.0 weightage is assigned to geo steering well logging data.

Responsibility: It is responsibility of the Operation Geologist to report and verify the KPI score.

2) Reservoir Data - Memory mode

Score is divided into two parts;

I. 50% score is linked with the recovery of the reservoir data in memory mode. If the recovery of the data is 100% as per plan (needs are met) then 0.5 score will be applied.
II. 50% score is linked with the quality of the reservoir data in memory mode. If the quality of the data is attained as per plan (needs are met), then full score 0.5 will be applied.

In case of multilateral well, each lateral will be scored separately. An average score from all lateral will be applied. However weightage will be increased based on number of laterals.

Note: Use actual score (% of the expected success percentage)

Weightage Guideline: 2.0 weightage is assigned to reservoir data on memory mode for each planned run.

Responsibility: It is responsibility of the Operation Geologist to report and verify the KPI score.

c) Wireline logging data (Recovery and Quality)

1) Cased Hole Data (non-reservoir data)

This KPI cover all the wireline logs related to cased hole sections, i.e., gyro data, corrosion logs, cement evaluation logs etc.

Score is divided into two parts;

I. 50% score is linked with the recovery of the logging data. If the recovery of the data is 100% as per plan (needs are met) then 0.5 score will be applied. In case multiple logs, an average score will be applied.

II. 50% score is linked with the quality of the logging data. If the quality of the data is attained as per plan (needs are met), then full score 0.5 will be applied. In case multiple logs, an average score will be applied.

Recovery and quality will be added to the final KPI.

Note: Use actual score (% of the expected success percentage)

Weightage Guideline: 2.0 weightage is assigned to each planned cased hole run.

Responsibility: It is responsibility of the Well integrity Engineer to report and Well Engineer (DCE) to verify the KPI score.

Run #	Tool Name	Activity	Actual		/1.0
Run #1 (---------)	Tool # 1 (--------)	Recovery			
		Quality			
	Tool #2 (--------)	Recovery			
		Quality			
	Tool #3 (--------)	Recovery			
		Quality			
Run #2 (---------)	Tool #1 (--------)	Recovery			
		Quality			
	Tool #2 (--------)	Recovery			
		Quality			
			Total Score		

2) Open Hole Data (reservoir data)

This KPI cover all the wireline logs related to reservoir data.

Score is divided into two parts;

I. 50% score is linked with the recovery of the logging data. If the recovery of the data is 100% as per plan (needs are met) then 0.5 score will be applied. In case multiple logs, an average score will be applied.

II. 50% score is linked with the quality of the logging data. If the quality of the data is attained as per plan (needs are met), then full score 0.5 will be applied. In case multiple logs, an average score will be applied.

Note: Use actual score (% of the expected success percentage)

Weightage Guideline: 2.0 weightage is assigned to each planned open hole run.

Responsibility: It is responsibility of the Operation Geologist to report and Well Engineer (DCE) to verify the KPI score.

Run #	Tool Name	Activity	Actual		/1.0
Run #1 (---------)	Tool # 1 (--------)	Recovery			
		Quality			
	Tool #2 (--------)	Recovery			
		Quality			
Run #2 (---------)	Tool #1 (--------)	Recovery			
		Quality			
	Tool #2 (--------)	Recovery			
		Quality			
			Total Score		

d) Post completion data (Reservoir surveillance)

This KPI cover all the activities such as wireline logs (PLT), injection tests, flow tests etc. conducted for Reservoir surveillance using **the Rig**. Score is divided into two parts:

- If injection or flow test are carried out, then score will be based on the confirmation of whether the well is flowing or not & whether injection test is performed (Yes or No).
- If the job conducted with a tool is as per planned or not;

I. 50% score is linked with the recovery of the surveillance data. If the recovery of the data is 100% as per plan (needs are met) then 0.5 score will be applied. In case multiple logs, an average score will be applied.

II. 50% score is linked with the quality of the surveillance data. If the quality of the data is attained as per plan (needs are met), then full score 0.5 will be applied. In case multiple logs, an average score will be applied.

Note: Use actual score (% of the actual)

Weightage Guideline: 2.0 weightage is assigned to each planned post completion data run/job (test).

Responsibility: It is responsibility of the Petroleum Engineer to report and Well Engineer (DCE) to verify the KPI score.

Appendix

a) Well Delivery KPIs Sheet

ZADCO Well Delivery KPI - L1 KPI

Well Name: **Well Type:** **Field:**

Well Delivery KPIs	Comments	KPI Responsibility	Score	Actual	Weightage	Total Achieved	Scoring Guideline
Program executed within planned limits with respect to; (including MOC)							
1) Drilling and Well Placement							
a) Landing point location (north/east coordinate and vertically in target reservoir) as per		OG/DCE	1.00		4.00	0.00	Yes/No, Yes=1, No=0
b) Total horizontal length in target layer achieved as per plan		OG/DCE	1.00		4.00	0.00	%
2) Running Casing and Cementing							
a) All casings successfully landed in planned formation (landing points & sizes) as per		DCE/OG	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful cementing and testing as per plan		IDT/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Casings are corrosion protected at surface (conductors, surface casing etc)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Liner hangers / packers are run, set and tested successfully		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
3) Completion and Stimulation							
a) Completion successfully run to target set depth within tolerance limits as per plan		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
b) Successful completion equipment tests including, DHSV, well head tests,		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Enzyme/breaker treatment spotted		IDT/DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
d) Stimulation program is executed (only with the rig) as per plan		DCE	1.00		2.00	0.00	Yes/No, Yes=1, No=0
4) Wellbore Accessibility (actual results or model based on actual well path/actual completion design)							
a) Wireline logging Accessibility (Open and Cased Hole), wireline, DP, tractor conveyor, etc		DCE/WI	1.00		2.00	0.00	%
b) Wireline Accessibility (Completion)		DCE/WI	1.00		2.00	0.00	Yes/No, Yes=1, No=0
c) Coiled Tubing Accessibility		OEC/WW	1.00		2.00	0.00	%
5) Well Integrity							
a) Zonal isolation successful		WI	1.00		6.00	0.00	Yes/No, Yes=1, No=0
b) Well integrity is confirmed as per ZADCO procedures (WIMS) prior to rig departure		WI	1.00		Killer KPI		Yes/No, Yes=1, No=0
6) Data Gathering and Evaluation							
a) Coring							
1. Core recovery (% Core recovery)		OG/RG	1.00		2.00	0.00	%
2. Core quality & usability (Mechanical stability of the core)		RG	1.00		2.00	0.00	%
b) LWD data (Recovery and Quality)							
1. Geo steering well log data (quality and frequency, sample/ft) - Realtime		OG	1.00		2.00	0.00	%
2. Reservoir Data (memory Data)		OG	1.00		2.00	0.00	%
c) Wireline logging data (Recovery and Quality)							
1. Cased Hole Data (Gyro, Corrosion, cement log, etc...)		WI/DCE	1.00		2.00	0.00	%
2. Open Hole Data (reservoir data)		OG/DCE	1.00		2.00	0.00	%
d) Post completion Data (Reservoir surveillance)		PE/DCE	1.00		2.00	0.00	Yes/No, OR, %
Well Delivery KPIs (Total Score) (2-4 weeks)			0.00		50.00	0.00	

Lesson Learned / Improvements	Recommendations	Category/ Job type	Hole Sec

Position	Signature
Well Engineer (Drilling)	
Well Engineer (Completions)	
Operations Geologist	
Well Integrity Engineer	
Cementing Engineer	
Mud Engineer	
Reservoir Geologist	
Knowledge Management Engineer	
WDP Manager	

Note: Each responsible party has to verify and sign the KPIs Document for WDP record.

15/01/2015

APPENDIX F

Key Performance Indicators for Service Companies

KEY PERFORMANCE INDICATORS (KPIs)
for
Service Companies
Directional Drilling & Measurement
Drilling Fluids
Cementing
Wireline (E-line)
Coiled Tubing

The only official version of any DR-PBI Procedures or Guidelines is that published by DR-PBI on the DR Portal in Intranet

Approved by

DR-VP
John Jorden

Date Prepared/Last Revised August 2014

ZADCO KPIs for Key Services

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	Mohamed Ishaq	DR-PBI Sr. Manager	17.Sep.2014

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ZADCO KPIs for Key Services

1. PURPOSE

The main purpose of having Key Performance Indicators for key services related drilling and completion is to establish unified indicators on which the performance of a service providers/vendor can be evaluated against set targets or expectations and can be compared with historical data, so that future improvement plans can be developed.

Ownership: DR-PBI Sr. Manager will be the Owner of these KPIs. Service Companies will provide the KPIs data. An audit by ZADCO at random interval is required to confirm the quality of the data reported.

Stakeholders: Drilling

Functional Support: will be provided by DR-PBIPS

2. SEGMENT SPECIFIC HSE KPIs

HSE KPIs will be tracked for each service and will be reported by service providers/vendors monthly or quarterly or agreed duration. HSE KPI data will be provided by Service Companies and confirmed by ZADCO Drilling HSE, Performance Analyst.

1. **LTIF (Lost Time Incidents Frequency):** It is sum of all lost time injuries whether or not they have resulted in deaths, permanent total disabilities, permanent partial disabilities, lost workday cases, and/or restricted workday cases per 200,000 working hours.
2. **TRIR (Total Recordable Incidents Rate):** It is Sum of all injuries whether or not they have resulted in deaths, permanent total disabilities, permanent partial disabilities, lost workday cases, and/or restricted workday cases per 200,000 working hours.
3. **Hurt Severity Levels:**

   Below table show the Hurt Severity levels. Actual Hurt Level (AHL) and Potential Hurt Level (PHL) are required to be captured for each hurt. Report the numbers in KPI as AHLs (PHLs); starting with the highest Potential Hurt level. For example; Total 10 incidents are reported for a quarter. Out of them, three are Hurt Level 1 incidents and seven are Hurt Level 0 (no hurts). Two of Hurt Level 3 have potential Hurt Level 5 (Multiple Fatalities) and one has the potential hurt level 3. Report in KPIs table against Hurt Level 1 as 3(2,0,1,0). Similarly, one of seven Hurt level 0 (No Hurt) incidents has potential level hurt level 5, three of them have potential level 4, two of them have potential Hurt level 2, one of them has potential hurt level 1, then report in KPI table as 7(1,3,0,2,1).

Hurt Severity Levels	Actual Hurt Level (AHL) (How bad was it?)	Potential Hurt Level (PHL) (How bad could it have been?)
Level 5 "Multiple Fatalities"	Multiple Fatalities	Multiple fatalities or a safety event that could reasonably have resulted in an "Actual Hurt Level 5-Multiple Fatalities" but did not.
Level 4 "Fatality"	Fatality	Fatality or a safety event that could reasonably have resulted in an "Actual Hurt Level 4-Fatality" and a higher Potential Hurt Level (Multiple Fatalities) is not reasonable.

Level 3 "Severe Hurt"	Injuries or illnesses causing severe physical body damage with probable long-term and/or significant life-altering complications such as: • Life-altering fractures, lacerations, or penetrations • Amputations • Significant third degree burns • Disfigurement • Loss / impairment of body organ function • Severe to complete loss of hearing • Severe visual impairment to total Blindness • Confirmed debilitating ergonomic or Serious Illness Events (SIE) cases	A safety event that could reasonably have resulted in an "Actual Hurt Level 3- Severe Hurt" and a higher Potential Hurt Level (Fatality) is not reasonable.
Level 2 "Moderate Hurt"	Injuries or illnesses causing significant physical body damage; reasonably expected to heal without significant life-altering complications in a moderate time period (weeks to months) such as: • Fractures, Loss of tooth/teeth • Significant lacerations / penetrations • Partial / single digit amputations • Significant second degree burns (blistering) • Minor third degree burns • Significant Sprains & Strains • Major infections post-injury or from illness • Dislocations • Punctured ear drum or moderate to moderately severe hearing loss • Moderate visual impairment • Confirmed ergonomic and SIE cases requiring significant treatment, surgery or physical therapy	A safety event that could reasonably have resulted in an "Actual Hurt Level 2- Moderate Hurt" and a higher Potential Hurt Level is not reasonable.
Level 1 "Minor Hurt"	Injuries or illnesses causing minor physical body damage; reasonably expected to heal without any Life-altering complications in a short time period (hours to days) such as: • Minor lacerations / penetrations (that bleed freely) • Minor chipping or cracking of a tooth/teeth • Minor second degree burns (blistering) • Skin rashes / burns from exposure to chemicals / non-aqueous fluids • Sprains & Strains • Minor Infections post-injury or from illness • Bruises • Partial and self-resolving dislocations • Confirmed slight to mild hearing loss • Mild eye (corneal) abrasions • Confirmed ergonomic or SIE cases requiring minor treatment	A safety event that could reasonably have resulted in an "Actual Hurt Level 1- Minor Hurt" and a higher Potential Hurt Level is not reasonable.
Level 0 "No Hurt"	No Hurt occurred (no physical body damage) but there are actionable learning's to take to possibly prevent future Hurt.	No Hurt occurred (no physical body damage) but there are actionable learning's to take to possibly prevent future Hurt and a higher Potential Hurt Level is not reasonable.

4. **Environment Incidents:** Total number of environment incidents such as spills etc

5. **ZADCO Golden Rules of Safety followed (%):** ZADCO 8 Golden Rules of Safety; 1- Job safety Analysis, 2- Permit to work, 3- Confined Space Entry, 4- Energy Isolation, 5-Crtical Equipment & System Override, 6- Working at Heights, 7- Lifting operations, 8- PPE are followed. It will be compare with the total number of violation to ZADCO golden rules to the total number days onsite.

$$ZADCO\ Golden\ Rules\ of\ Safety = 1 - \frac{Total\ voilations\ during\ a\ period}{Total\ days\ onsite\ during\ the\ period}$$

Note: Adherence to utilizing the high technology work gloves (PPE) and current color coding for equipment (lifting Operations) is required. Any violation exceed more than one day will be considered as multiple violations till it is fixed.

6. **Stop cards/Observation per person per day:** Total number of stop card/observations per person per day.
7. **Line Management rigsite visit:** Total number for line management(Field Service Manager and Above) visits
8. **Number of LOPC:** Total number of loss or primary containments events.
9. **Close-Out of Incident Investigations Within 6 Weeks:** All the HSE incidents must be investigated and action items are in place within 6 weeks from the day of the incident.
10. **Rig Site Safety Inspections:** Number of the rig site safety inspections by the service providers for specified services/jobs.
11. **Equipment Certification followed (%):** All the equipment at ZADCO projects must have proper valid certification by ZADCO approved companies for example As per ZADCO-HSE, equipment going offshore must be certified for zone -2 areas. KPI will be compare with the total number of violation in equipment certification to the total number days onsite.

$$Equipment\ Certification = 1 - \frac{Total\ voilations\ during\ a\ period}{Total\ days\ onsite\ during\ the\ period}$$

12. **Turnover Rate:** Project Employee turnover rate (resignation, transfers) for ZADCO and industry. It is the ratio number of turnovers to the total number of employee for ZADCO project and UAE industry.

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

3. DIRECTIONAL DRILLING & MEASUREMENT (DD/LWD/MWD) KPIs

Directional Drilling and Measurements (DD/LWD, MWD) KPIs will be reported by Directional Drilling and Measurements companies working on ZADCO projects on monthly/quarterly basis. UAE Industry means same type of jobs/operation conducted in UAE for all clients/operators including ZADCO. For KPIs that cannot be captured under UAE industry, entre NA (not applicable). KPI results will be provided by Service Companies and confirmed by ZADCO Performance Analyst/KM Engineer/Well Engineers.

1. Total Number of jobs and job success rates:

Total numbers of Directional Drilling and Measurements (DD/LWD, MWD) jobs are performed within the period.

a. RSS Jobs success rate (%flawless Jobs): It is ratio of all RSS successful jobs (flawless jobs) to the total number of RSS jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes required dogleg achieved as per plan (no change in plan because of tool operability issue), desired parameters are achieved as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully.

b. Downhole Motors Jobs success rate (%flawless Jobs): It is ratio of all successful Downhole Motors Jobs (flawless jobs) to the total number of Downhole Motors Jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes required dogleg achieved as per plan (no change in plan because of tool operability issue), desired parameters are achieved as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully.

c. MWD Jobs success rate (%flawless Jobs): It is ratio of all successful MWD jobs (flawless jobs) to the total number of MWD jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully.

d. LWD Jobs success rate (%flawless Jobs): It is ratio of all successful LWD jobs (flawless jobs) to the total number of LWD jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. For LWD jobs, success rate of all sensors should be monitored and available to share with ZADCO.

Note: All the changes to the original plan must be supported by ZADCO approved MOC, otherwise job should be considered as a failure.

Note: Actual calculation (actual successful runs/total number of runs) along with result in % is required. For example; if total 10 jobs were performed in a month and 9 jobs were considered as successful, then result should be shown as **9/10=90%** under the KPI

Note: Report failure rate of each tool/service running within specifications separately for comparison purpose.

Failure Classification Definition

- Class 0 : no failure –
- Class 1 failure: pull out required or failure during surface testing (critical path) –
- Class 2 failure: drill ahead but needs additional time and cost (NPT) to fix problem or to capture data later e.g., failure of required formation evaluation tool –
- Class 3 failure: interruption of ordered service causing no immediate NPT cost e.g., resistivity tool or GR failed but G&G let drill ahead –

- Class 4 failure: incidents that have no influence on the actual well but might on future wells; includes all problems or observations that could influence future work e.g., poorly prepared work plans; data not delivered as agreed; poor data quality; tool functions that were not ordered, but that came with the tool and failed.

2. Overall Operating Efficiency (%):

It shows the overall performance comparing the effective operating time to the total operating time.

$$Overall\ Operating\ Efficiency = \frac{Total\ rig\ Operating\ Time\ related\ to\ D\&M\ activities - Total\ NPT\ hrs\ related\ to\ D\&M\ activities}{Total\ rig\ Operating\ Time\ related\ to\ D\&M\ activities}$$

Total rig operating time is the time that a rig is directly involved in handling LWD/MWD/DD services. All the off-line time, where rig is not part of any operation, will not be considered as operating time. Accurate reporting of total rig operating time is required. Consider all disputed NPT as assigned NPT till a final singed NCR proving NPT is removed is issued. Revise and send the update KPIs data, if there is any change in NPT hours either assigned or removed.

Note: It is required to show the actual calculation along with result in %. For example; if total 100 hrs are reported as operating time in a month and 5 hrs are reported as NPT, then result should be shown as **95/100=95%.**

3. Footage Between Failure (Ft):

The Footage Between Failures (FBF) is a mean footage drilled for error-free operation. It is mean footage drilled between one failure to another failure.

$$FBF = \frac{Sum\ of\ Drilled\ Footage\ for\ a\ specific\ period}{Total\ number\ of\ failures\ for\ the\ period}$$

4. Mean Time Between Failures (hrs):

The Mean Time Between Failures (MTBF) is a mean operating time for error-free operation. It is mean operating time between one failure to another failure.

$$MTBF = \frac{Sum\ of\ operating\ times\ between\ failures\ for\ a\ specific\ period}{Total\ number\ of\ failures\ for\ the\ period}$$

5. NPT hours per 1000ft Drilled:

It is the ratio between total NPT hrs to each 1000ft drilled for the period.

$$FBF = \frac{Total\ NPT\ (hrs)\ for\ a\ specific\ period}{Total\ Drilled\ Footage\ for\ the\ specific\ period}\ x\ 1000$$

6. Landing point location (%):

The actual location of landing point (north/east coordinate & vertically in target reservoir) within target as per plan. Full score to be applied in case of landing as per plan, otherwise 0 score will be applied for not landing within the target limits. If a sidetrack occurred due to missing the target, 0 score will be applied automatically for the well.

7. Unplanned runs (%):

This KPI compare the total number of the unplanned runs to the total number of the planned run irrespective of the failure reason. For example, if 10 runs were planned for the different wells in the period where the service provider was involved, but 14 run was actually occurred on these wells regardless of the reason , then % of unplanned run is 40% (4/10).

Note: Sometimes it is difficult to differentiate the reason of the extra run, so it is team KPI and can be discussed during KPIs review why the additional run was occurred.

8. Tool/Equipment/Personnel availability (%):

Number of the times the required tools/equipment are available to the total number of jobs.

$$\%Availability = \frac{Total\ Job\ performed - No.of\ times\ tools/equipment/personnel\ unavailable}{Total\ Job\ perfromed}$$

Any NPT related to the unavailability of tools/equipment/personnel or any change in plan due to unavailability of tools/equipment/personnel will count a single event. When a job is assigned to a service company, it is the responsibility of the service company to discuss the job plan in advance confirming type of tools/equipment/personnel and to track the daily operation activity making sure tool/equipment/personnel are available. This KPI will track all incidents related to unavailability of tools/equipment/personnel regardless enough notice by ZADCO is given or not. This KPI is a quantitative measure of availability of tools/equipment/personnel for the jobs.

Note: Report the Toole/equipment/people availability within contractual terms separately for comparison purpose.

9. Data Turnaround Time (%)

a. Field Prints: After Laying down the BHA, field prints need to be delivered within 24hrs.

$$Field\ Prints\ Turnaround = \frac{Total\ number\ of\ field\ print\ given\ within\ 24hrs}{Total\ Job\ perfromed}$$

b. Provisional Prints: After Laying down the BHA, Provisional prints need to be delivered within 3 working days.

$$Provisional\ Prints\ Turnaround = \frac{Total\ number\ of\ Provisiona\ print\ given\ within\ 3days}{Total\ Job\ perfromed}$$

c. Final Prints: After receiving QC comments from ZADCO, final prints (Conclusive report/data) need to deliver within 4days.

$$Final\ Prints\ Turnaround = \frac{Total\ number\ of\ Final\ print\ given\ within\ 4\ days\ after\ ZADCO\ QA/QC}{Total\ Job\ perfromed}$$

Note: Time to wait on QC comment will be captured.
Note: More than one prints or copies for same job will be considered as one print.

10. Data Gathering (%)

This KPI is split into two group; Data Recovery and Data Quality

a. Data Recovery %: It is the ratio of total Data recovery to the total requested data. For example, if 5 different data types are requested, but only 4 data type are provided due to issues in processing etc, then data recovery score for the job will be 80% recovery. Or data for 100m accessible section was requested and only data for 70m section was recovered, then data recovery will be 70%.

$$Data\ Recovery = \frac{Total\ Recovered\ data}{Total\ requested\ data\ for\ accessible\ section}$$

b. Data Quality %: it is the ratio of the total Data readable to the total recovered data. Data quality needs to be 100% and tracked by ZADCO and Service provider. Scoring will be discussed with ZADCO DR & UZFD by service provider).

$$Data\ Quality = \frac{Total\ Readable\ data}{Total\ Recovered\ data}$$

11. Personnel Compliance (%):

100% compliance for all jobs is required. All Crew are trained and competent to work on ZADCO rigs. People are competent and approved as per each specific rig requirements.

It can be captured by comparing the total number of incident where 100% personnel compliance is met to the total number of the jobs.

12. Equipment Compliance (%):

100% compliance for all jobs is required. All the equipment is fully maintained and working operationally as per expectation during a job. It may or may not have any effect on the job such as broken guage etc. However such incident should be recorded as KPI reporting.

$$Equipment\ Compliance\ (\%):\ =\frac{Total\ number\ of\ Equipment\ incidents/failure\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

13. Non Conformance Reports

a. # of NCRs/Job: it is the ratio of total NCRs issued for a specific period to the total number of jobs performed for the specific period.

$$\#of\ NCRs\ per\ job\ =\frac{Total\ number\ of\ NCR\ issed\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

b. It is the ratio of total closed NCR to the total number of NCRs issued.

$$NCR\ Closure\ Rate\ =\frac{Total\ number\ of\ NCR\ closed}{Total\ NCRs}$$

Note: Ready to close NCR will be counted as closed NCR for KPIs purpose. All rejected NCRs will be removed from the total number of the NCRs.

14. CAR closure /Audit action closure: (%)

Corrective Action report after any audit or any failure is required to be closed within specific time period.

a. Number of CAR's closed within due time mentioned in CAR – Target 100%
b. Number of Critical CAR's closed within due time mentioned in CAR. Target 100%

$$CAR\ closure\ \%\ =\frac{Total\ CAR\ closed\ within\ due\ time}{Total\ CAR\ issued}$$

15. End of well/End of Job Report: (%)

End of well report/job report is required to be submitted within four weeks after the end of well review held or job is performed (which ever come first)

$$End\ of\ well\ report\ or\ job\ report\ =\frac{End\ of\ well\ report/job\ reports\ submitted\ within\ time}{Total\ jobs}$$

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

4. DRILLING FLUIDS KPIs

Drilling Fluids KPIs will be reported by Drilling Fluids companies working on ZADCO projects on monthly and quarterly basis. UAE Industry means same type of jobs/operation conducted in UAE for all clients/operators including ZADCO. For KPIs that cannot be captured under UAE industry, entre NA (not applicable). KPI results will be provided by Service Companies and confirmed by ZADCO Performance Analyst/KM Engineer/Mud Engineer.

1. Total Number of jobs and job success rates:

Total numbers of Drilling Fluids jobs are calculated based on fluid type for the specified period. Different types of the Drilling fluids are listed below. Success rate of each type of job is required to be captured separately as;

a. Water Base Fluids Success Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A Job will be considered as successful (flawless), if it is executed as per plan which includes maintaining fluid properties as per plan, chemical consumptions as per plan, volume calculation as per plan, no NPT related to unavailability of products or equipment operability etc., and all the objectives of the job are met successfully.

b. NAF Success Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A Job will be considered as successful (flawless), if it is executed as per plan which includes maintaining fluid properties as per plan, chemical consumptions as per plan, volume calculation as per plan, no NPT related to unavailability of products or equipment operability etc. and all the objectives of the job are met successfully.

c. RDF Success Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A Job will be considered as successful (flawless), if it is executed as per plan which includes maintaining fluid properties as per plan, chemical consumptions as per plan, volume calculation as per plan, no NPT related to unavailability of products or equipment operability etc. and all the objectives of the job are met successfully.

d. Completion fluids/breaker Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A Job will be considered as successful (flawless), if it is executed as per plan which includes maintaining fluid properties as per plan, chemical consumptions as per plan, volume calculation as per plan, no NPT related to unavailability of products or equipment operability etc. and all the objectives of the job are met successfully.

Note: All the changes to the original plan must be supported by ZADCO approved MOC, otherwise job should be considered as a failure.

Note: Actual calculation (actual successful runs/total number of runs) along with result in % is required. For example; if total 10 jobs were performed in a month and 9 jobs were considered as successful, then result should be shown as **9/10=90%** under the KPI.

Note: Report failure rate of each tool/service running within specifications separately for comparison purpose, if any.

2. Average NPT (Non-Productive Time) hours per job:

Instead of operating efficiency, average NPT hours per job is required to discuss the NPT reduction plan. Below is the calculation;

$$Average\ NPT\ per\ job = \frac{Total\ NPT\ hours\ for\ the\ specified\ period}{Total\ number\ of\ jobs\ for\ the\ sepcified\ period}$$

Consider all disputed NPT as assigned NPT till a final singed NCR proving NPT is removed is issued. Revise and send the update KPIs data, if there is any change in NPT hours either assigned or removed.

3. Number of Service Quality incidents (%):

This KPI is related to the number of total incident to the total jobs. These incidents may not be an NPT event. Any service quality incident related to material, people, equipment, service to deliver etc., will be counted here. It shows the % of incidents per job.

$$Average\ incident\ per\ job = \frac{Total\ incidents\ for\ the\ specified\ period}{Total\ number\ of\ jobs\ for\ the\ sepcified\ period}$$

4. Actual Cost vs plan (ASME calculation):

This KPI is linked with the cost of the mud which should be within plan cost. It is comparison of the actual cost of a job to the plan cost of the job. Plan cost will be taken from ASME calculation.

$$Actual\ cost\ vs\ plan = \frac{Total\ Actual\ cost\ of\ the\ mud\ of\ the\ jobs\ for\ the\ speified\ period}{Total\ Plan\ cost\ (ASME\ calculation) of\ the\ muds\ of\ the\ jobs\ for\ the\ specified\ period}$$

5. Planning Index:

Availability of final Drilling fluids program (detailed program) two weeks before spud a well is required.

$$Planning\ Index = \frac{Total\ number\ of\ times\ programs\ provided\ two\ week\ advance\ prior\ to\ spud}{Total\ number\ of\ jobs\ for\ the\ sepcified\ period}$$

6. Tool/Equipment/Personnel availability (%):

Number of the times the required tools/equipment are available to the total number of jobs.

$$\%Availability = \frac{Total\ Job\ performed - No.of\ times\ tools/equipment/personnel\ unavailable}{Total\ Job\ perfromed}$$

Any NPT related to the unavailability of tools/equipment/personnel or any change in plan due to unavailability of tools/equipment/personnel will count a single event. When a job is assigned to a service company, it is the responsibility of the service company to discuss the job plan in advance confirming type of tools/equipment/personnel and to track the daily operation activity making sure tool/equipment/personnel are available. This KPI will track all incidents related to unavailability of tools/equipment/personnel regardless enough notice by ZADCO is given or not. This KPI is a quantitative measure of availability of tools/equipment/personnel for the jobs.

Note: Report the Toole/equipment/people availability within contractual terms separately for comparison purpose.

7. Daily Mud Report Accuracy (%):

This KPI is focused to the accuracy of the daily mud report. A report with mistakes or missing information will be considered as inaccurate report. A missing report is also considered as inaccurate report for the purpose of KPI calculation.

$$Daily\ mud\ report\ Accuracy = \frac{Total\ number\ accurate\ reports}{Total\ number\ of\ the\ reports\ required}$$

Total number of accurate reports = Total number of reports required – total number of inaccurate reports.

8. Personnel Compliance (%)

100% compliance for all jobs is required. All Crew are trained and competent to work on ZADCO rigs. People are competent and approved as per each ZADCO specific rig requirements.

It can be captured by comparing the total number of incident where 100% personnel compliance is met to the total number of the jobs.

9. Equipment Compliance (%):

100% compliance for all jobs is required. All the equipment is fully maintained and working operationally as per expectation during a job. It may or may not have any effect on the job such as broken guage etc. However such incident should be recorded as KPI reporting.

$$Equipment\ Compliance\ (\%):\ = \frac{Total\ number\ of\ Equipment\ incidents/failure\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

10. Non Conformance Reports:

a. <u># of NCRs/Job:</u> it is the ratio of total NCRs issued for a specific period to the total number of jobs performed for the specific period.

$$\#of\ NCRs\ per\ job\ = \frac{Total\ number\ of\ NCR\ issed\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

b. It is the ratio of total closed NCR to the total number of NCRs issued.

$$NCR\ Closure\ Rate\ = \frac{Total\ number\ of\ NCR\ closed}{Total\ NCRs}$$

Note: Ready to close NCR will be counted as closed NCR for KPIs purpose. All rejected NCRs will be removed from the total number of the NCRs.

11. CAR closure /Audit action closure: (%)

Corrective Action report after any audit or any failure is required to be closed within specific time period.

a. Number of CAR's closed within due time mentioned in CAR – Target 100%
b. Number of Critical CAR's closed within due time mentioned in CAR. Target 100%

$$CAR\ closure\ \%\ = \frac{Total\ CAR\ closed\ within\ due\ time}{Total\ CAR\ issued}$$

12. End of well/End of Job Report: (%)

End of well report/job report is required to be submitted within four weeks after the end of well review held or job is performed (which ever come first)

$$End\ of\ well\ report\ or\ job\ report\ = \frac{End\ of\ well\ report/job\ reports\ submitted\ within\ time}{Total\ jobs}$$

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

5. CEMENTING KPIS

Cementing KPIs will be reported by Cementing companies working on ZADCO projects on monthly and quarterly basis. UAE Industry means same type of jobs/operation conducted in UAE for all clients/operators including ZADCO. For KPIs that cannot be captured under UAE industry, entre NA (not applicable). KPI results will be provided by Service Companies and confirmed by ZADCO Performance Analyst/KM Engineer/Cementing Engineer.

1. Total Number of jobs and job success rates:

Total numbers of Cementing jobs are performed within the specified period.

a. Primary Cementing Success rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A primary Cement job will be considered as successful (flawless), if it is executed as per plan which includes flow rates as per plan, fluids volumes (spacers & slurries) as per plan, chemical utilization as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. Successful cementing also considered that all contingencies are in place and available including how to handle losses, bulk supply issues etc. Any unexpected incidents such as severe channeling, unplanned cement left in pipe, incomplete displacement etc., during a job will be considered as a failed cement job. In case a squeeze job is required after a primary cementing job, then primary cement job will be considered as a failure.

b. Kick-off Cement Plugs Success Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A Kick-off Cement plug job will be considered as successful (flawless), if it is executed as per plan which includes flow rates as per plan, fluids volumes (spacers & slurries) as per plan, chemical utilization as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. Successful cementing also considered that all contingencies are in place and available including how to handle losses, bulk supply issues etc. Any unexpected incidents such as severe channeling, unplanned cement left in pipe, incomplete displacement etc., during a job will be considered as a failed cement job. In case a 2nd (additional, not planned) kick-off plug is required, then 1st plug will be considered as a failure. Success rate will be 1/2= 50%. In case 3rd plug is required, then first two plugs will be considered as failure. Success rate will be 1/3=33%.

c. Others Cement Plugs/squeeze Success Rate: It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A cement plug job will be considered as successful (flawless), if it is executed as per plan which includes flow rates as per plan, fluids volumes (spacers & slurries) as per plan, chemical utilization as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. Successful cementing also considered that all contingencies are in place and available including how to handle losses, bulk supply issues etc. Any unexpected incidents such as severe channeling, unplanned cement left in pipe, incomplete displacement etc during a job will be considered as a failed cement job. In case a 2nd (additional, not planned) plug is required, then 1st plug will be considered as a failure. Success rate will be 1/2= 50% . In case 3rd plug is required, then first two plugs / squeeze will be considered as failure. Success rate will be 1/3=33%

Note: All the changes to the original plan must be supported by ZADCO approved MOC, otherwise job will be considered as a failure.

Note: Actual calculation (actual successful runs/total number of runs) along with result in % is required. For example; if total 10 jobs were performed in a month and 9 jobs were considered as successful, then result should be shown as **9/10=90%** under the KPI.

Note: Report failure rate of each tool/service running within specifications separately for comparison purpose, if any.

2. Overall Operating Efficiency (%):

It shows the overall performance comparing the effective operating time to the total operating time.

$$Overall\ Operating\ Efficiency = \frac{Total\ rig\ Operating\ Time\ related\ to\ cementing\ -\ Total\ NPT\ hrs\ related\ to\ cementing}{Total\ rig\ Operating\ Time\ related\ to\ cementing}$$

Total rig operating time is the time rig is directly involved in handling cementing jobs services. All the off-line time, where rig is not part of any operation, will not be considered as operating time. Consider all disputed NPT as assigned NPT till a final singed NCR proving NPT is removed is issued. Revise and send the update KPIs data, if there is any change in NPT hours either assigned or removed.

3. **Density Control (% of the slurries within design limits):**

This KPI is linked with the quality of the cement slurries pumped within limit of +/- 0.02SG.
For example: If 100bbl of 1.9SG tail slurry is pumped and only 90bbl slurry was within acceptable range of 1.88 SG and 1.92 SG. 90% should report as Density control. A weighted average calculation should be used for the KPI calculation.

$$Density\ Control\ (\%) = \frac{Total\ slurry\ volume\ pumped\ with\ specified\ limit\ \left(\pm\ 0.02\text{SG}\right)}{Total\ Slurry\ volumed\ pumped\ for\ the\ specific\ period}$$

4. **QA/QC of the Cementing fluids & Cement Blend:**

This KPI is directly linked with QA/QC of the cementing fluids and cement blends confirming that the properties of pumped fluids and blends are similar or closed to the designed properties used in cementing simulation and matching with lab data.

$$QA/QC\ (\%) = \frac{Total\ number\ of jobs\ where\ properties\ of\ pumped\ fluids\ and\ cment\ blend\ matched\ with\ designed\ properties}{Total\ number\ of jobs}$$

5. **Tool/Equipment/Personnel availability (%):**

Number of the times the required tools/equipment are available to the total number of jobs.

$$\%Availability = \frac{Total\ Job\ performed\ -\ No.of\ times\ tools/equipment/personnel\ unavailable}{Total\ Job\ perfromed}$$

Any NPT related to the unavailability of tools/equipment/personnel or any change in plan due to unavailability of tools/equipment/personnel will count a single event. When a job is assigned to a service company, it is the responsibility of the service company to discuss the job plan in advance confirming type of tools/equipment/personnel and to track the daily operation activity making sure tool/equipment/personnel are available. This KPI will track all incidents related to unavailability of tools/equipment/personnel regardless enough notice by ZADCO is given or not. This KPI is a quantitative measure of availability of tools/equipment/personnel for the jobs.

Note: Report the Toole/equipment/people availability within contractual terms separately for comparison purpose.

6. **Data Turn Around Time:**

Timely delivery of critical data such as initial pressure match after cement jobs is very important to make key decisions.

a. Pressure match Analysis (within 12 hrs): All Initial pressure match results should be available within 12hour.

$$Initial\ Pressure\ match\ (\%) = \frac{Total\ number\ of\ times\ Initial\ pressure\ math\ available\ within\ 12\ hrs}{Total\ number\ of\ jobs}$$

b. Post Job Analysis/report (within 2 days): A final post job analysis/report should be available with 2 days for detailed analysis and discussion.

$$Post\ Job\ Analysis/Report\ (\%) = \frac{Total\ number\ of\ times\ post\ job\ analysis\ /\ report\ available\ within\ 2\ days}{Total\ number\ of\ jobs}$$

7. Data Acquisition system:

This KPI is linked with the operability and accuracy of Coiled Tubing Data Acquisition System. Supporting documents may be required to verifying KPIs are met.

a. Sensors Calibration: All the sensors are calibrated and tested as per operations' requirements and no malfunction linked to sensors calibration is reported. It is the ratio of the jobs with no calibration issues to the total number of jobs.

b. All parameters monitored and recorded: This KPIs linked with the data availability and usability. Parameters such as pressure, density, flowrate, volume etc. are available during the job and recorded for analysis and tracking purpose. It is the ratio of the total parameters monitored and recorded to the total number of parameters requested for the job.

8. Personnel Compliance (%)

100% compliance for all jobs is required. All Crew are trained and competent to work on ZADCO rigs. People are competent and approved as per each ZADCO specific rig requirements.

It can be captured by comparing the total number of incidents where 100% personnel compliance is not met to the total number of the jobs.

$$Personnel\ Compliance\ \% = \frac{Total\ number\ of\ jobs - total\ non\ compliance\ incidents}{Total\ number\ of\ jobs}$$

9. Equipment Compliance (%):

100% compliance for all jobs is required. All the equipment is fully maintained and working operationally as per expectation during a job. It may or may not have any effect on the job such as broken guage etc. However such incident should be recorded as KPI reporting.

$$Equipment\ Compliance\ (\%):\ = \frac{Total\ number\ of\ Equipment\ incidents/failure\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

10. Non Conformance Reports:

a. # of NCRs/Job: it is the ratio of total NCRs issued for a specific period to the total number of jobs performed for the specific period.

$$\#of\ NCRs\ per\ job\ = \frac{Total\ number\ of\ NCR\ issed\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

b. It is the ratio of total closed NCR to the total number of NCRs issued.

$$NCR\ Closure\ Rate\ = \frac{Total\ number\ of\ NCR\ closed}{Total\ NCRs}$$

Note: Ready to close NCR will be counted as closed NCR for KPIs purpose. All rejected NCRs will be removed from the total number of the NCRs.

11. CAR closure /Audit action closure: (%)

Corrective Action report after any audit or any failure is required to be closed within specific time period.

a. Number of CAR's closed within due time mentioned in CAR – Target 100%
b. Number of Critical CAR's closed within due time mentioned in CAR. Target 100%

$$CAR\ closure\ \% = \frac{Total\ CAR\ closed\ within\ due\ time}{Total\ CAR\ issued}$$

12. End of well Report: (%)

End of well report/job report is required to be submitted within four weeks after the end of well review held or job is performed

$$End\ of\ well\ report\ or\ job\ report = \frac{End\ of\ well\ report\ submitted\ within\ time}{Total\ jobs}$$

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

6. WIRELINE (E-LINE) KPIs

Wireline (E-line) KPIs will be reported by Wireline (E-line) companies working on ZADCO projects on monthly and quarterly basis. UAE Industry means same type of jobs/operation conducted in UAE for all clients/operators including ZADCO. For KPIs that cannot be captured under UAE industry, entre NA (not applicable). KPI results will be provided by Service Companies and confirmed by ZADCO Performance Analyst/KM Engineer/Well Engineers.

1. Total Number of jobs and job success rates:

Total number of wireline jobs is performed within period.

a. Case hole Jobs success rate (%flawless Jobs): It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related to equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

b. Open hole Jobs success rate (%flawless Jobs): It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related to equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

c. Coiled Tubing Convey Jobs success rate (%flawless Jobs): It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

d. Tractor Convey Jobs success rate (%flawless Jobs): It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

e. Drill Pipe convey Jobs success rate (%flawless Jobs): It is ratio of all successful jobs (flawless jobs) to the total number of the jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all data is acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

Note: All the changes to the original plan must be supported by ZADCO approved MOC, otherwise job should be considered as a failure.

Note: Actual calculation (actual successful runs/total number of runs) along with result in % is required. For example; if total 10 jobs were performed in a month and 9 jobs were considered as successful, then result should be shown as **9/10=90%** under the KPI.

Failure Classification Definition

- Class 0 : no failure –
- Class 1 failure: pull out required or failure during surface testing (critical path)
- Class 2 failure: Keep continue with the job but needs additional time and cost (NPT) to fix problem or to capture data later e.g., failure of one tool with NPT but the work is till continue

- Class 3 failure: interruption of ordered service causing no immediate NPT cost e.g., e.g., failure of one tool with no NPT but the work is till continue
- Class 4 failure: incidents that have no influence on the actual well but might on future wells; includes all problems or observations that could influence future work e.g., poorly prepared work plans; data not delivered as agreed; poor data quality; tool functions that were not ordered, but that came with the tool and failed.

Note: Report failure rate of each tool/service running within specifications separately for comparison purpose.

2. Overall Operating Efficiency (%):

It shows the overall performance comparing the effective operating time to the total operating time.

$$Overall\ Operating\ Efficiency = \frac{Total\ rig\ Operating\ Time\ related\ to\ wireline\ activities\ -\ Total\ NPT\ hrs\ to\ wireline\ activities}{Total\ rig\ Operating\ Time\ related\ to\ wirline\ activities}$$

Total rig operating time is the time rig is directly involved in handling wireline Jobs. All the off-line time, where rig is not part of any operation, will not be considered as operating time. Accurate reporting of total rig operating time is required. Consider all disputed NPT as assigned NPT till a final singed NCR proving NPT is removed is issued. Revise and send the update KPIs data, if there is any change in NPT hours either assigned or removed.

Note: It is required to show the actual calculation along with result in %. For example; if total 100 hrs are reported as operating time in a month and 5 hrs are reported as NPT, then result should be shown as **95/100=95%.**

3. Wellbore accessibility (Open hole & Cased hole):

The score for wireline accessibility will be calculated according to the percentage of coverage length in zone of interest to the Total planned length.

$$Wellbore\ accessibility\ (Open\ hole\ \&\ Cased\ hole) = \frac{Total\ actual\ logged\ Length}{Total\ Planned\ Logged\ length}$$

4. Mean Time Between Failures (hrs):

The Mean Time Between Failures (MTBF) is a mean operating time for error-free operation. It is mean operating time between one failure to another failure.

$$MTBF = \frac{Sum\ of\ operating\ times\ between\ failures\ for\ a\ specific\ period}{Total\ number\ of\ failures\ for\ the\ period}$$

5. Pipe Recovery Success rate (%):

It is the ratio of the successful runs (Pipe is cut and recovered) to the total pipe recovery run.

$$Pipe\ Recovery\ Success\ rate = \frac{Total\ Pipe\ Recovery\ runs - failed\ runs}{Total\ Pipe\ Recovery\ runs}$$

6. Unplanned runs (%):

This KPI compare the total number of the unplanned runs to the total number of the planned run irrespective of the failure reason. For example, if 10 runs were planned for the different wells in the period where the service provider was involved, but 14 run was actually occurred on these wells regardless of the reason , then % of unplanned run is 40% (4/10).

Note: Sometimes it is difficult to differentiate the reason of the extra run, so it is team KPI and can be discussed during KPIs review why the additional run was occurred.

7. Tool/Equipment/Personnel availability (%):

Number of the times the required tools/equipment are available to the total number of jobs.

$$\%Availability = \frac{Total\ Job\ performed\ -\ No.of\ times\ tools/equipment/personnel\ unavailable}{Total\ Job\ perfromed}$$

Any NPT related to the unavailability of tools/equipment/personnel or any change in plan due to unavailability of tools/equipment/personnel will count a single event. When a job is assigned to a service company, it is the responsibility of the service company to discuss the job plan in advance confirming type of tools/equipment/personnel and to track the daily operation activity making sure tool/equipment/personnel are available. This KPI will track all incidents related to unavailability of tools/equipment/personnel regardless enough notice by ZADCO is given or not. This KPI is a quantitative measure of availability of tools/equipment/personnel for the jobs.

Note: Report the Toole/equipment/people availability within contractual terms separately for comparison purpose.

8. Data Turnaround Time (%)

a. Field Prints per job: After Laying down the BHA, field prints need to be delivered within 24hrs.

$$Field\ Prints\ Turnaround = \frac{Total\ \#\ of\ field\ prints\ given\ within\ 24hrs}{Total\ Job\ perfromed}$$

Note: More than one prints or copies for same job will be considered as one print.
Note: Identify the print type clearly on the print copies.

b. Provisional Prints per job: After Laying down the BHA, Provisional prints need to be delivered within 3 working days.

$$Provisional\ Prints\ Turnaround = \frac{Total\ \#\ of\ Provisional\ print\ given\ within\ 3days}{Total\ Job\ perfromed}$$

Note: More than one prints or copies for same job will be considered as one print.
Note: Identify the print type clearly on the print copies.

c. Final Prints per job: After receiving QC comments from ZADCO, final prints (Conclusive report/data) need to deliver within 4days.

$$Final\ Prints\ Turnaround = \frac{Total\ \#\ of\ Final\ print\ given\ within\ 4\ days\ after\ ZADCO\ QA/QC}{Total\ Job\ perfromed}$$

Note: Time to wait on QC comment will be captured.
Note: More than one prints or copies for same job will be considered as one print.

9. Data Gathering (%)

This KPI is split into two groups; Data Recovery and Data Quality;

a. Data Recovery %: It is the ratio of total Data recovery to the total requested data. For example, if 5 different data types are requested, but only 4 data type are provided due to issues in processing etc, then data recovery score for the job will be 80% recovery. Or data for 100m accessible section was requested and only data for 70m section was recovered, then data recovery will be 70%.

$$Data\ Recovery\ = \frac{Total\ Recovered\ data}{Total\ requested\ data\ for\ accessible\ section}$$

b. <u>Data Quality %:</u> it is the ratio of the total Data readable to the total recovered data. Data quality needs to be 100% and tracked by ZADCO and Service provider. Scoring will be discussed with ZADCO DR, WO & UZFD by service provider).

$$Data\ Quality\ = \frac{Total\ Readable\ data}{Total\ Recovered\ data}$$

10. Personnel Compliance (%)

100% compliance for all jobs is required. All Crew are trained and competent to work on ZADCO rigs. People are competent and approved as per each ZADCO specific rig requirements.

It can be captured by comparing the total number of incidents where 100% personnel compliance is not met to the total number of the jobs.

$$Personnel\ Compliance\ \%\ = \frac{Total\ number\ of\ jobs - total\ non\ compliance\ incidents}{Total\ number\ of\ jobs}$$

11. Equipment Compliance (%):

100% compliance for all jobs is required. All the equipment is fully maintained and working operationally as per expectation during a job. It may or may not have any effect on the job such as broken guage etc. However such incident should be recorded as KPI reporting.

$$Equipment\ Compliance\ (\%):\ = \frac{Total\ number\ of\ Equipment\ incidents/failure\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

12. Non Conformance Reports:

a. <u># of NCRs/Job:</u> it is the ratio of total NCRs issued for a specific period to the total number of jobs performed for the specific period.

$$\#of\ NCRs\ per\ job\ = \frac{Total\ number\ of\ NCR\ issed\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

b. It is the ratio of total closed NCR to the total number of NCRs issued.

$$NCR\ Closure\ Rate\ = \frac{Total\ number\ of\ NCR\ closed}{Total\ NCRs}$$

Note: Ready to close NCR will be counted as closed NCR for KPIs purpose. All rejected NCRs will be removed from the total number of the NCRs.

13. CAR closure /Audit action closure: (%)

Corrective Action report after any audit or any failure is required to be closed within specific time period.

a. Number of CAR's closed within due time mentioned in CAR – Target 100%
b. Number of Critical CAR's closed within due time mentioned in CAR. Target 100%

$$CAR\ closure\ \% = \frac{Total\ CAR\ closed\ within\ due\ time}{Total\ CAR\ issued}$$

14. End of well/End of Job Report: (%)

End of well report/job report is required to be submitted within four weeks after the end of well review held or job is performed (which ever come first)

$$End\ of\ well\ report\ or\ job\ report = \frac{End\ of\ well\ report/job\ reports\ submitted\ within\ time}{Total\ jobs}$$

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

7. COILED TUBING KPIs

Coiled Tubing KPIs will be reported by Coiled Tubing companies working on ZADCO projects on a monthly and quarterly basis. UAE Industry is defined by the operations type and is to include jobs/operation conducted in UAE for all clients/operators including ZADCO. For KPIs that cannot be captured under UAE industry, entre NA (not applicable). KPI results will be provided by Service Companies and confirmed by ZADCO Performance Analyst/KM Engineer/Well Service Engineers.

1. Total Number of jobs and job success rates:

Total numbers of Coiled Tubing jobs performed within a stipulated period.

a. Conventional Coiled Tubing Jobs success rate: It is ratio of all successful Conventional Coiled Tubing jobs (flawless jobs) to the total number of Conventional Coiled Tubing jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all job parameters are acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

b. Advanced Coiled Tubing Jobs success rate: It is ratio of all successful Advanced Coiled Tubing jobs (flawless jobs) to the total number of Advanced Coiled Tubing jobs. A job will be considered as successful (flawless), if it is executed as per plan which includes all job parameters are acquired for all required depths as per plan and no NPT related with equipment operability etc. and all the objectives of the job are met successfully. In case 2nd run is required or current job/plan is abandoned or altered with a different way to proceed, the 1st job will be considered as a failure.

Advanced Coiled Tubing jobs are defined as job requiring specialized tools or techniques. Listed below are the some examples;

- advanced access tools for extended reach environments (Tractors, Vibrating tools, Friction reducers etc)
- pressure deployment operations
- fishing, milling, cutting operations
- Coiled tubing cement operations
- High Pressure / High Temperature operations

Note: All the changes to the original plan must be supported by ZADCO approved MOC, otherwise job should be considered as a failure.

Note: Actual calculation (actual successful runs/total number of runs) along with result in % is required. For example; if total 10 jobs were performed in a month and 9 jobs were considered as successful, then result should be shown as **9/10=90%** under the KPI.

Failure Classification Definition

- Class 0 : no failure
- Class 1 failure: pull out required or failure during surface testing (critical path)
- Class 2 failure: Keep continue the job but needs additional time and cost (NPT) to fix problem or to capture data later e.g., failure of a tool with NPT but the work is till continue.
- Class 3 failure: interruption of ordered service causing no immediate NPT cost e.g., e.g., failure of a tool with no NPT but the work is till continue.

- Class 4 failure: incidents that have no influence on the actual well but might on future wells; includes all problems or observations that could influence future work e.g., poorly prepared work plans; data not delivered as agreed; poor data quality; tool functions that were not ordered, but that came with the tool and failed.

Note: Report failure rate of each tool/service running within specifications separately for comparison purpose.

2. Overall Operating Efficiency (%):

It shows the overall performance comparing the effective operating time to the total operating time.

$$Overall\ Operating\ Efficiency = \frac{Total\ Operating\ Time\ related\ to\ CT\ activities\ -\ Total\ NPT\ hrs\ related\ to\ CT activities}{Total\ \ Operating\ Time\ related\ to\ CT\ activities}$$

Total rig/barge operating time is the time that a rig or barge is directly involved in handling CT services. All the off-line time, where rig is not part of any operation, will not be considered as operating time. Accurate reporting of total rig operating time is required. For rigless operations the operating time starts from the time X-Mass tree access to the commence rig up is granted until rig-down from the X-Mass tree is completed, allowing access for subsequent operations. Consider all disputed NPT as assigned NPT till a final singed NCR proving NPT is removed is issued. Revise and send the update KPIs data, if there is any change in NPT hours either assigned or removed.

Note: It is required to show the actual calculation along with result in %. For example; if total 100 hrs are reported as operating time in a month and 5 hrs are reported as NPT, then result should be shown as **95/100=95%.**

3. Mean Time Between Failures (hrs):

The Mean Time Between Failures (MTBF) is a mean operating time for error-free operation. It is mean operating time between one failure to another failure.

$$MTBF = \frac{Sum\ of\ operating\ times\ between\ failures\ for\ a\ specific\ period}{Total\ number\ of\ failures\ for\ the\ period}$$

4. Wellbore accessibility

The score for coiled Tubing accessibility will be calculated according to the percentage of coverage length in zone of interest to the Total planned length.

$$Wellbore\ accessibility = \frac{Total\ actual\ covered\ Length}{Total\ Planned\ length}$$

5. Unplanned runs (%)

This KPI compare the total number of the unplanned runs to the total number of the planned run. For example, if 10 runs were planned for the different wells in the period where the service provider was involved, but 14 run was actually occurred on these wells regardless of the reason , then % of unplanned run is 40% (4/10).

Note: Sometimes it is difficult to differentiate the reason of the extra run, so it is team KPI and can be discussed during KPIs review why the additional run was occurred.

6. Tool/Equipment/Personnel availability (%):

Number of the times the required tools/equipment/people are available to the total number of runs. Target is 100%. This KPIs measure the resources availability of a service company to assigned jobs.

$$Tools/Equipment/People\ Availability = \frac{Total\ Job\ performed\ -\ No.of\ times\ tools\ or\ equipment\ or\ people\ unavailable}{Total\ Job\ perfromed}$$

Any NPT related to the unavailability of tools/equipment or any change in plan due to unavailability of tools/equipment will count a single event.

Note: Report the Toole/equipment/people availability within contractual terms separately for comparison purpose.

7. Data Acquisition system:

This KPI is linked with the operability and accuracy of the Coiled Tubing Data Acquisition System. Supporting documents may be required to verify KPIs are met, including calibration certificates, preventative maintenance records and any inspections where applicable.

a. Sensors Calibration: All the sensors are calibrated and tested as per Original Equipment Manufacturers guidelines and no malfunction linked to sensors calibration / data accuracy is reported during the job. It is the ratio of the jobs with no calibration issues to the total number of jobs.

b. All parameters monitored and recorded: This KPI is linked to the data availability, its presentation and usability during and after the job. Parameters such as pressure, depth, volume, rate etc are available during the job and recorded for analysis and tracking purposes. It is the ratio of the total parameters monitored, recorded and presented to the total number of parameters requested for the job.

8. Personnel Compliance (%)

100% compliance for all jobs is required. All Crew are trained and competent to work on ZADCO rigs. People are competent and approved as per each ZADCO specific rig requirements.

It can be captured by comparing the total number of incident where 100% personnel compliance are met to the total number of the jobs.

9. Equipment Compliance (%):

100% compliance for all jobs is required. All the equipment is fully maintained and working operationally as per expectation during a job. It may or may not have any effect on the job such as broken guage etc. However such incident should be recorded as KPI reporting.

$$Equipment\ Compliance\ (\%):=\frac{Total\ number\ of\ Equipment\ incidents/failure\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

10. Non Conformance Reports

a. # of NCRs/Job: it is the ratio of total NCRs issued for a specific period to the total number of jobs performed for the specific period.

$$\#of\ NCRs\ per\ job\ =\frac{Total\ number\ of\ NCR\ issed\ for\ a\ specific\ period}{Total\ \#\ of\ the\ jobs\ for\ the\ specific\ period}$$

b. It is the ratio of total closed NCR to the total number of NCRs issued.

$$NCR\ Closure\ Rate\ =\frac{Total\ number\ of\ NCR\ closed}{Total\ NCRs}$$

Note: Ready to close NCR will be counted as closed NCR for KPIs purpose. All rejected NCRs will be removed from the total number of the NCRs.

11. CAR closure /Audit action closure: (%)

Corrective Action report after any audit or any failure is required to be closed within specific time period.

a. Number of CAR's closed within due time mentioned in CAR – Target 100%
b. Number of Critical CAR's closed within due time mentioned in CAR. Target 100%

$$CAR\ closure\ \% = \frac{Total\ CAR\ closed\ within\ due\ time}{Total\ CAR\ issued}$$

12. End of well/End of Job Report: (%)

End of well report/job report is required to be submitted within four weeks after the end of well review held or job is performed (which ever come first)

$$End\ of\ well\ report\ or\ job\ report = \frac{End\ of\ well\ report/job\ reports\ submitted\ within\ time}{Total\ jobs}$$

Note: KPIs Targets will be revised by the ZADCO Drilling Management. Different KPIs target can be set for different service companies.

8. KPI Scoring Calculation

For each service, KPIs will be scored from 0-10 scale. Below is the method to calculate KPIs score for each services.

1. HSE KPI Scoring

Report the KPI score quarterly as per below method;

Score = {LTIF (0=1, >0.04 = 0) x 2 + TRIR (0=1, >0.30=0) x 2 + Environment Incidents (0=1, >0=0) x 2 + ZADCO Golden Rules of Safety followed + Stop cards/Observation per person per day* + Line Management rigsite visit (3or >3=1, 0=0) + Number of LOPC (0=1, >0=0) + Close-Out of Incident Investigations Within 6 Weeks + RigSite Safety Inspections (3or >3=1, 0=0) + Equipment Certification followed}/13 x 10

*If the value is more than 100%, use 100%.

2. Directional Drilling & Measurement KPIs Scoring

Report the KPI score quarterly as per below method;

Score = {RSS Success rate + Downholemotor Success rate + MWD Success rate + LWD success rate + Overall Operating efficiency + (1-Unplanned runs %*) + Tool/Equipment/Personnel Availability % + Data Turn Around time (Field print x Provisional Print x Final Print) + Data gathering (50% Data Recovery + 50% Data Quality) + Personal Compliance + Equipment Compliance + NCR closure + CAR closure + End of well report }/14 x 10

*If the value is more than 100%, use 100%.

3. Drilling Fluids KPIs Scoring

Report the KPI score quarterly as per below method;

Score = {Waterbase Fluid success rate + NAF success rate + RDF Success rate + Completion Fluids/Breaker success rate + (1- Service Quality Incident %*) + Planning Index + Tool/Equipment/Personnel Availability % + Daily Mud Report + Personal Compliance + Equipment Compliance + NCR closure + CAR closure + End of well report }/13 x 10

*If the value is more than 100%, use 100%.

4. Cementing KPIs Scoring

Report the KPI score quarterly for Directional Drilling & Measurement as per below method;

Score = {Primary Cementing Success rate + Kick-off plug Success rate x 0.5 + Other cement plug/squeeze Success rate x 0.5 + Overall Operating efficiency + Density Control + Tool/Equipment/Personnel Availability % + Data Turn Around time (50% Pressure match + 50% Post Job Analysis) + Data Acquisition System (50% Sensor calibration + 50% Parameter recorded) + Personal Compliance + Equipment Compliance + NCR closure + CAR closure + End of well report}/12 x 10

5. Wireline KPIs Scoring

Report the KPI score quarterly as per below method;

Score = {Cased Hole Success rate + Openhole Success rate + Overall Operating efficiency + Wellbore accessibility + Pipe Recovery success rate + (1-Unplanned runs %*) + Tool/Equipment/Personnel Availability % + Data Turn Around time (Field print x Provisional Print x Final Print) + Data gathering (50% Data Recovery + 50% Data Quality) + Personal Compliance + Equipment Compliance + NCR closure + CAR closure + End of well report }/14 x 10

*If the value is more than 100%, use 100%.

6. Coiled Tubing KPIs Scoring

Report the KPI score quarterly for Directional Drilling & Measurement as per below method;

Score = {Conventional CT Success rate + Advanced CT Success rate + Overall Operating efficiency + wellbore accessibility + (1-Unplanned runs %*) + Tool/Equipment/Personnel Availability % + Data Turn Acquisition System (50% Sensor calibration + 50% Parameter recorded) + Personal Compliance + Equipment Compliance + NCR closure + CAR closure + End of well report}/12 x 10

*If the value is more than 100%, use 100%.

9. APENDIX

ZADCO HEALTH, SAFETY, ENVIRONMENT (HSE) KPIs FOR SERVICE COMPANIES

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

Key Performance Indicators	Target	M1		M2		M3		Q	
		ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry
SAFETY, HEALTH & ENVIRONMENT	**KPI Score**	--/10		--/10		--/10		--/10	
1. LTIF (Lost Time Incidents Frequency)*	<0.04								
2. TRIF (Total Recordable Incidents Rate)*	<0.3								
3. Number of the Hurt Levels	Actual								
Level 5 - Multiple Fatalities	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
Level 4 - Fatalities	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
Level 3 - Severe Hurt	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
Level 2 - Moderate Hurt	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
Level 1 - Minor Hurt	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
Level 0 - No Hurt	Actual	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)	AHL(PHL)
4. Environment Incidents	0								
5. Number of LOFC	0		NA		NA		NA		NA
6. ZADCO Golden Rules of Safety followed (1- total violations/days onsite)	100%		NA		NA		NA		NA
7. Stop cards/Observation per person per day	1.0		NA		NA		NA		NA
8. Line Management rigsite visit	3								
8. Close-Out of Incident Investigations Within 6 Weeks	100%		NA		NA		NA		NA
9. RigSite Safety Inspections	3								
10. Equipment Certification followed (%)	100%		NA		NA		NA		NA
11. Turnover Rate	Actual								

*Incident rate per 200,000 man hour

ZADCO DIRECTIONAL DRILLING & MEASUREMENT (DD/LWD/MWD) KPIs

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

			Q1		Q2		Q3		Q4	
Key Performance Indicators		Target	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry
DIRECTIONAL DRILLING & MEASUREMENT (DD/LWD/MWD)		KPI Score	--/10		--/10		--/10		--/10	
1	Total Number of Jobs									
	a. RSS Success Rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	Failure rate of RSS running within specifications	Actual	Y/B=Z%	Y/B=Z%	Y/B=Z%	Y/B=Z%	Y/B=Z%	Y/B=Z%	Y/B=Z%	Y/B=Z%
	Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
	Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
	Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
	Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
	b. Downhole Motors Success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	Failure rate of Downhole motors within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
	Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
	Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
	Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
	Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
	c. MWD success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	Failure rate of MWD running within specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
	Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
	Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
	Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
	Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
	d. LWD success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	Failure rate of LWD running within specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
	Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
	Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
	Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
	Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
2	Overall Operating Efficiency	Actual	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %
3	Footage Between Failure (FBF)	Actual	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C
4	Mean Time Between Failure (MTBF)	Actual	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C
5	NPT hours per 1000FT	Actual	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C	A/B=C
6	Landing point location (No deviation in Original Plan)	100%		NA		NA		NA		NA
7	Unplanned runs (%)	Actual	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %
8	Tool/Equipment/Personnel availability (%)	100%		NA		NA		NA		NA
	Avaibility within Contractual terms	100%		NA		NA		NA		NA
9	Data Turn Around Time			NA		NA		NA		NA
	a. Field Print (within 24 hrs)	100%		NA		NA		NA		NA
	b. Provisional Print (within 3 days)	100%		NA		NA		NA		NA
	c. Final Print (within 4 days after QC remarks)	100%		NA		NA		NA		NA
10	Data Gathering (%)			NA		NA		NA		NA
	a. Data Recovery (%)	Actual		NA		NA		NA		NA
	b. Data Quality (%)	Actual		NA		NA		NA		NA
11	Personnel Compliance (Training & competency)	100%		NA		NA		NA		NA
12	Equipment Compliance	100%		NA		NA		NA		NA
13	Non-conformance Reports	Actual		NA		NA		NA		NA
	a. # of NCRs / Job	Actual		NA		NA		NA		NA
	b. NCR Closure Rate (%)	Actual		NA		NA		NA		NA
14	CAR closure/Audit action closure	Actual		NA		NA		NA		NA
15	End of well/End of Job Report	100%		NA		NA		NA		NA

ZADCO DRILLING FLUIDS KPIs

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

	Key Performance Indicators	Target	Q1		Q2		Q3		Q4	
			ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry
	DRILLING FLUIDS	KPI Score	--/10		--/10		--/10		--/10	
1	Total Number of Jobs	Actual								
	a. Water Base Fluids Success Rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	b. NAF Success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	c. RDF Success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	d. Completion fluids/breaker success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
2	Average NPT (Non-Productive Time)	Actual								
3	Number of Service Quality incidents (%)	Actual								
4	Actual Cost vs plan (ASME calculation)	Actual		NA		NA		NA		NA
5	Planning Index	Actual		NA		NA		NA		NA
6	Tool/Equipment/Personnel availability (%)	Actual		NA		NA		NA		NA
	Availability within Contractual terms	100%		NA		NA		NA		NA
7	Daily Mud Report Accuracy	100%		NA		NA		NA		NA
8	Personnel Compliance (Training & competency)	100%		NA		NA		NA		NA
9	Equipment Compliance	100%		NA		NA		NA		NA
10	Non-conformance Reports	Actual		NA		NA		NA		NA
	a. # of NCRs / Job	Actual		NA		NA		NA		NA
	b. NCR Closure Rate (%)	Actual		NA		NA		NA		NA
11	CAR closure /Audit action closure	Actual		NA		NA		NA		NA
12	End of well/End of Job Report	100%		NA		NA		NA		NA

ZADCO CEMENTING KPIS

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

	Key Performance Indicators	Target	Q1		Q2		Q3		Q4	
			ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry
	CEMENTING	KPI Score	--/10		--/10		--/10		--/10	
1	Total Number of Jobs									
	a. Primary Cementing Success Rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	b. Kick-off Cement Plugs Success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
	c. Other Cement Plugs/Squeeze Success rate	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
2	Overall Operating Efficiency	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
3	Density Control (% of the slurries within design limits)	Actual		NA		NA		NA		NA
4	QA/QC of the Cementing fluids & Cement Blend	Actual		NA		NA		NA		NA
5	Tool/Equipment/Personnel availability (%)	100%		NA		NA		NA		NA
	Availbility within Contractual terms	100%		NA		NA		NA		NA
6	Data Turn Around Time			NA		NA		NA		NA
	a. Pressure match Analysis (within 12 hrs)	100%		NA		NA		NA		NA
	b. Post Job Analysis (within 2 days)	100%		NA		NA		NA		NA
7	Data Acquisition system			NA		NA		NA		NA
	a. Sensors Calibration	Actual		NA		NA		NA		NA
	b. All parameters monitored and recorded	Actual		NA		NA		NA		NA
8	Personnel Compliance (Training & competency)	100%		NA		NA		NA		NA
9	Equipment Compliance	100%		NA		NA		NA		NA
10	Non-conformance Reports	Actual		NA		NA		NA		NA
	a. # of NCRs / Job	Actual		NA		NA		NA		NA
	b. NCR Closure Rate (%)	Actual		NA		NA		NA		NA
11	CAR closure /Audit action closure	Actual		NA		NA		NA		NA
12	End of well/End of Job Report	100%		NA		NA		NA		NA

ZADCO WIRELINE (E-LINE) KPIs

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

Key Performance Indicators	Target	Q1 ZADCO	Q1 UAE Industry	Q2 ZADCO	Q2 UAE Industry	Q3 ZADCO	Q3 UAE Industry	Q4 ZADCO	Q4 UAE Industry
WIRELINE (E-LINE)	**KPI Score**	--/10		--/10		--/10		--/10	
1 Total number of Jobs	Actual								
a. Case Hole Jobs success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failures Within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
b. Open Hole Jobs success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failures Within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
c. Coiled Tubing convey jobs success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failure Within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
d. Tractor convey jobs success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failure Within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
e. Drill Pipe convey jobs success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failure Within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
2 Operating Efficiency	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
3 Wellbore accessibility (Open hole & Cased hole) %	Actual		NA		NA		NA		NA
4 Mean Time Between Failure (MTBF)	Actual								
5 Pipe Recovery Success rate	Actual								
6 Unplanned runs (%)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
7 Tool/Equipment/Personnel availability (%)	100%		NA		NA		NA		NA
Avaibility within Contractual terms	100%		NA		NA		NA		NA
8 Data Turn Around Time			NA		NA		NA		NA
a. Field Print (within 24 hrs)	100%		NA		NA		NA		NA
b. Provisional Print (within 3 days)	100%		NA		NA		NA		NA
c. Final Print (within 4 days after QC remarks)	100%		NA		NA		NA		NA
9 Data Gathering (%)			NA		NA		NA		NA
a. Data Recovery (%)	Actual		NA		NA		NA		NA
b. Data Quality (%)	Actual		NA		NA		NA		NA
10 Personnel Compliance (Training & Competency)	100%		NA		NA		NA		NA
11 Equipment Compliance	100%		NA		NA		NA		NA
12 Non-conformance Reports	Actual		NA		NA		NA		NA
a. # of NCRs / Job	Actual		NA		NA		NA		NA
b. NCR Closure Rate (%)	Actual		NA		NA		NA		NA
13 CAR closure /Audit action closure	Actual		NA		NA		NA		NA
14 End of well/End of Job Report	100%		NA		NA		NA		NA

ZADCO COILED TUBING KPIS

KEY PERFORMANCE INDICATORS

***** Show the information for the four most recent quarters, with the most recent quarter in far right columns *****

Note: KPIs should be tracked and reported monthly monthly basis for high volume services

Key Performance Indicators	Target	Q1		Q2		Q3		Q4	
		ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry	ZADCO	UAE Industry
COILED TUBING	KPI Score	--/10		--/10		--/10		--/10	
1. Total Number of Jobs									
a. Conventional CT Operations Job success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failure rate conventional CT running within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
b. Advanced CT Operations Job success rate (Class 0)	Actual	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%	A/B=C%
Failure rate of Advanced CT rnling within Specifications	Actual	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%	X/B=Z%
Class 1 failure	Actual	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA	D/B=E%	NA
Class 2 failure	Actual	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA	F/B=G%	NA
Class 3 failure	Actual	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA	H/B=I%	NA
Class 4 failure	Actual	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA	J/B=K%	NA
2 Overall Operating Efficiency	Actual	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %
3 Mean Time Between Failure (MTBF)	Actual								
4 Wellbore accessibility	100%								
5 Unplanned runs (%)	Actual	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %	A/B=C %
6 Tool/Equipment/Personnel availability (%)	100%		NA		NA		NA		NA
Avaibility within Contractual terms	100%		NA		NA		NA		NA
7 Data Acquisition system			NA		NA		NA		NA
a. Sensors Calibration	100%		NA		NA		NA		NA
b. All parameters monitored and recorded	100%		NA		NA		NA		NA
8 Personnel Compliance (Training & competency)	100%		NA		NA		NA		NA
9 Equipment Compliance	100%		NA		NA		NA		NA
10 Non-conformance Reports	Actual		NA		NA		NA		NA
a. # of NCRs / Job	Actual		NA		NA		NA		NA
b. NCR Closure Rate (%)	Actual		NA		NA		NA		NA
11 CAR closure /Audit action closure	Actual		NA		NA		NA		NA
12 End of well/End of Job Report	100%		NA		NA		NA		NA

APPENDIX G

Performance Incentive Bonus Scheme

شركة تطوير حقل زاكوم (زادكو)
Zakum Development Company (ZADCO)

ZADCO PERFORMANCE INCENTIVE BONUS SCHEME FOR DRILLING & COMPLETION SERVICES CONTRACTORS

Guidelines and Approval Process

Scheme Owner: DR-DCO, DR-DCE

Approved by the Chief Executive Officer (CEO)

SAIF N. AL SUWAIDI
June 2015

ZADCO Performance Incentive Bonus Scheme for Drilling & Completion Services Contractors

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ZADCO Performance Incentive Bonus Scheme for Drilling & Completion Services Contractors

1. PURPOSE

The purpose of these Guidelines is to establish a methodology to pay an incentive bonus to Drilling and Completion services contractors after the delivery of a high Performance Quality Well. A detailed performance Incentive bonus Scheme is prepared considering days saving and provided such saving has been achieved without ignoring or contravening any standing regulation, exposing the operations or personnel to risk or compromising on quality of work. The performance incentive bonus scheme guidelines provide the calculation details of the incentive bonus for each service contractors based on days saving against the approved AFE.

Ownership: DR-DCE and DR-DCO are master owners of the Performance Incentive Bonus Scheme and shall be responsible in leading and endorsing the performance incentive bonus scheme.

Responsibility: Well Engineer of the well or assigned Engineer of the well will prepare the Performance Incentive Bonus Scheme. Master Owner of this incentive scheme, DCO and DCE shall be responsible for the correction of the incentive scheme by entering correct data in the openwells. DR- PBIPS will assist in extracting the data from the openwells, if it is required.

Stakeholders: Drilling

Functional Support: will be provided by DR-PBI.

2. PERFORMANCE INCENTIVE BONUS SCHEME

Performance Incentive Bonus Scheme is an authorization of funds to be paid as performance incentive bonus to the service contractors based on days savings, overall HSE performance and achieving Well KPIs. Further it provides the details on bonus distribution and its calculation based on each service contractor's performance such as low NPT and job objectives are met.

Payment of the Performance Incentive bonus is based on Drilling Management discretion and can be stopped anytime, for any rig and for any service contractor without providing any reason.

Performance Incentive Bonus Scheme will be prepared only for the well having less than 1.00 Drilling & Completion Efficiency (Actual day vs Planned days excluding WOW & Scope Change (Additional & cancelled operations)). Performance Incentive Bonus Scheme will be prepared after the End of well review is conducted.

3. BONUS CALCULATION AND DISTRIBUTION DETAILS

Key elements in bonus calculation and its distribution among service contractors are described below in detail including approval process.

Actual Duration: These are the actual well days calculated from the day rig is off from previous location (Well first date as per Well AFE) to the day when rig is off from the current location (Well last day as per AFE) excluding only WOW (Wait on Weather) days. Wait on Daylight for rig move will be included in the Actual Days.

$$Actual\ Duration = Total\ days\ (rig\ release\ to\ rig\ release) - Wait\ on\ Weather\ Days$$

Adjusted Planned Duration: The Adjusted planned durations will be obtained after adjusting the days for scope change (additional operations) and cancelled operations in the original AFE.

$$Adjusted\ Planned\ Duration = Planned\ Days + Unplanned\ Addtional\ Days - Cancelled\ Days$$

Saved Duration: These are the days saved due to good performance of the service contactors. Saved days will be calculated by deducted the actual well duration from the adjusted planned duration. Saved Days will be used for bonus calculation using Rig Spread Rate

$$Saved\ Duration\ = Adjusted\ Planned\ Duration - \ Actual\ Days$$

Saved Duration after NPT optimization: All AFEs have 15 % built-in NPT. Optimum NPT is considered 10% for a well for 2014 and so on unless it is revised and will be applied to the Saved Duration.

$$Adjusted\ Planned\ Duration\ with\ optimum\ NPT = \frac{Planned\ Duration - Cancelled\ Days}{1.15(Built\ in\ NPT\ in\ AFE)} * 1.10(Optimum\ NPT)$$

$$Saved\ Duration\ after\ NPT\ Optimization = Adjusted\ Planned\ Duration\ with\ optimum\ NPT - \ Actual\ Days$$

Note: In case 15% NPT is not applied in any AFE, Days saved will be calculated without adjusting 10% optimum NPT. **Optimum NPT number can be revised any time by ZADCO.**

Rig Spread Rate: This includes the rig hire daily rate, daily rented equipment and services charges. Service charges include, Mud engineer services, Completion running services, Wireline services, Air loop services and Casing Services. Rig Spread Rate will be provided by DR-BPIDP, once the well is completed.

Base Cost Saving: These are total saving based on saved days for a specific rig.

$$Base\ Cost\ Saving\ = Saved\ days * \ Rig\ Daily\ Operating\ Rate$$

Total Bonus Available: This is the total bonus available based on days saved before applying HSE and Well performance. Total bonus Available is the 20% of the base cost savings calculated based on rig daily operating rate. **Total Bonus is capped to a maximum amount 120K (USD).** In case the total bonus exceeds the 120K (USD), the available total bonus will be only 120K (USD)

$$Total\ bonus\ availbable\ = 20\% * \ Base\ Cost\ Saving$$

Maximum Bonus Available: It is the amount which is available to distribute among the service contractors after considering HSE performance, Well Performance and % total NPT of the well.
HSE Rig Score will be provided by the DR-HSE based on rig current HSE performance. In case the current HSE rig score is not available, a previous HSE score can be used with Sr. Manager DCO approval. In case of any recordable incident on the rig, any contravene to standing regulations such as environmental spill, HSE Rig Score will be considered "0" and no bonus will be paid.
Note: DCO Sr. Manager is authorized to revise the HSE rig score for any rig after assessing actual HSE performance for the rig.
Below is the calculation for Maximum Bonus Available

$$Maximum\ Bonus\ Available\ = \ Rig\ HSE\ Score * \ Well\ Delivery\ KPI * (1 - Total\ NPT\ \%) * Total\ Bonus\ Available$$

Note: Total NPT % is percentage of the total NPT of the well to the total operating time of the well excluding WOW. It is calculated by DR-PBIPS after finishing a well.

Service Qualification for Incentive Bonus: Well Engineer will finalize the list of the service contractor worked on the specific well and will determine the services entitlement as per contract (Note: ZADCO employees are not entitled for the Performance Incentive bonus). Well Engineer will confirm the achievement of job objectives of each service provided by the service contractor. Job Objective for the service will be also verified with the Well Delivery KPIs. *In case job objectives are not achieved for certain job, service contractor for the job is not eligible for the incentive bonus.*

NPT Criteria for bonus payment per Service: If the % SC NPT (ratio of total NPT caused by the service contractor to the total days of the service contractor on location) exceeds the 10%, no incentive bonus will be paid. If the % SC NPT (ratio of total NPT caused by the service contractor to the total days of the service contractor on location) more than 5% and less than 10%, 50% (half) bonus of the total assigned bonus to the Service contractor will be paid. If the % SC NPT (ratio of total NPT caused by the service contractor to the total days of the service contractor on location) is less than 5%, a full bonus of the total assigned bonus to the service contractor to distribute among its personnel will be paid as per performance incentive bonus scheme.

Incentive Bonus Distribution among service contractors: Maximum Bonus available will be distributed among each service contractors based on number of days spent by their personnel on the rig. Total man-days can be calculated from daily drilling reports and a % man-days distribution will be prepared for bonus distribution for each service contractor.
Note: Drilling Management can increase or decrease the distribution of the Incentive bonus of a service contractor. In this situation, incentive bonus distribution among service contractors will be added manually based on Drilling Management's recommendations.

Net Incentive Bonus and Distribution: Net Incentive Bonus is the net bonus to be paid by ZADCO to each entitled service contractor based on contractual entitlement on performance incentives.
Distribution percentage of incentives payments among the personnel who worked on the well and the support personnel will be as per contractual guidelines of each contract. Contractor will make sure that performance incentive to his personnel and his sub-contractors' personnel who worked on the relevant well irrespective of their positions is distributed equally. For rig contractors, catering & cleaning crew at rig during the relevant well are also eligible of the incentive payment equally. ZADCO has the right to carry out the audit to ensure that incentive bonus is paid as per guidelines to contractor's personnel and sub contractors' personnel equally.

Entitled Contractors: Entitled contractor for the incentive bonus payment are the contractors where the contracts with ZADCO has the performance incentive clause. Any contract which does not has any performance incentive clause; such contractors are not eligible for the incentive payment till the contracts are amended to pay incentive bonus.

PERFORMANCE INCENTIVE BONUS SCHEME Distribution: Approved Copy of performance incentive bonus scheme (see example Performance Incentive Bonus Scheme in Appendix) will be retained with DR-PBIDP who will contact the Entitled Contractors with bonus details. *Final & approved copy of Performance Incentive bonus scheme will not be distributed to any Contractor.*

PERFORMANCE INCENTIVE BONUS SCHEME Approval: Final Approval authority is the VP-DR. Each performance incentive bonus scheme must be approved by VP-DR for the payment to be released to Service Contractor. Original Signed and Approved performance incentive bonus scheme along with necessary supporting documents must be retained with DR-PBIDP to tally with Contractor(s) invoices.

Net Incentive Bonus Payment to Service contractors: The payment of Net Incentive Bonus to service contractors will be as per contracts terms & conditions. A call of order (COO) will be issued to pay the performance incentive bonus payment to the eligible service contractors. Service contractor will submit the invoice to ZADCO for payment of performance bonus.

Example PERFORMANCE INCENTIVE BONUS SCHEME (UA068)

شـركة تطـوير حقـل زاكـوم [زادكـو]
Zakum Development Company [ZADCO]

Zakum Development Company (ZADCO)

Performance Incentive Bonus Scheme for Drilling & Completion Services Contractors

From: VP-DR **To:** All Listed Below

As a recognition of the Outstanding Performance achieved in the successful completion of this well, ZADCO is pleased to share the savings accomplished from this well with your Crew who has shown excellent dedication and commitment to service and HSE. ZADCO congratulates your Crew members who where involved in this well. We are confident that the Team Spirit, Cooperation and Commitment of your crew will continue to deliver high Performing Quality Wells in the future.

1) a) Well Duration:

Well No.	Well Type	Rig Name	(i) Rig Spread Rate (USD)	Rig ready to move Date (dd/mm/yy h:mm)	Rig Release Date (dd/mm/yy h:mm)	(ii) Actual Duration excluding WOW (Days)
UA068	New Well	AL ITTIHAD	102,494	29/10/2013 19:00	15/01/2014 12:00	70.98

b) Base Incentive: Qualification Factor, Efficiency

(iii) Planned Duration (AFE) (Days)	(iv) Additional Operation (AFE) (Days)	(v) Cancelled Operation (AFE) (Days)	(vi) WOW Days (Wait on Weather)	(vii) Adjusted Planned Duration (Days) (iii) + (iv) - (v)	(viii) Saved Duration (Days) (vii) - (ii)	(ix) Saved Duration after NPT Optimization (Days)
78.00	0.00	0.00	6.73	78.00	7.02	3.63

Notes:
1- Well Duration and Base Incentive is prepared by Well Engineer.
2- Rig Spread Rate (i): Rig Spread Rate includes the rig hire daily rate, daily rented equipment and services charges. It will be provided by DR-PBIDP.
3- Actual Days (ii): Actual days are counted from the day rig is off from previous location (Well first date as per AFE) to the day rig is off from the current location (Well last day as per AFE) excluding WOW (Wait on Weather) days. Note: Make sure Wait on Daylight are not included in WOW days.
4 - Total Bonus Available is the amount available to pay as bonus and equal to 20% of the Base Cost Saving. Total Bonus Available is capped to 120,000 USD
5-NPT optimization will be applied to saved duration for bonus calculation

Remarks:

2) Well Qualification for Incentive Bonus:

Incentive Qualification Terms:

(viii) Base Cost Saving (USD) (ix) X (i)	(ix) Total Bonus Available (USD) 20% of (viii)	(x) HSE Rig Score (Owner: DR-HSE) %	(xi) NPT % (NPT Tot./ Actual Well Duration) %	(xii) Well Delivery KPI Achieved %	(xiv) Maximum Bonus Available USD	(xv) Total Bonus Paid USD
372,432	74,486	85.0%	6.6%	96%	56,847	49,636

Notes :
1- DR-HSE, Owner of HSE rig inspection Score to complete these sections. Supporting documents to be attached. Copies of summary reports: last HSE Rig Inspection score, Oil Spill or Gas Flaring and Fatalities, LTI or recordable incidents.
2- Supporting documents to be attached are summary report copies of: Well Delivery KPI and NPT summary report including WOW from DIMS. Well Engineer will collect the data from PBIPS.
3- Max. Bonus Available (xiv) = Max. Bonus this well is qualified considering HSE performance. NPT% and Well Delivery KPIs
4- Total Bonus Paid (xv) is the Actual Bonus Paid for this well.
5- As Master Owner of this incentive scheme, DCO and DCE shall be responsible for the correction of the incentive scheme by entering correct data in the openwells. PBIPS will assist in extracting the data from the openwells, if it is required.
6- Owners to complete relatives sections. Supporting documents to be attached:
a- AFE copy including additional or cancelled operation.
b- Last daily drilling report copy

3) Service Qualification for Incentive Bonus:

Entitled Contractor (Yes/No)	Services	Contractors	Job Objectives Achieved: Yes = 100% No = 0%	Job Objectives Achieved: Actual	% SC NPT (NPT: Days on Rig) 0-5%=100% >5%<10%=50% >10%=0%	Maximum Bonus % New Well	Actual Bonus % New Well	Net Incentive Bonus USD	Net Incentive Bonus AED (USD X 3.67)
No	Welding	ADOS	Yes	0%	0.0%	0.13%	0.00%	0	0
Yes	Tool Rental	AL AHLIA	Yes	100%	0.0%	0.60%	0.60%	339	1,244
No	CSG Handling	AL GAITH	Yes	0%	3.9%	2.42%	0.00%	0	0
No	Air Loop	AL MASOOD	Yes	0%	0.0%	1.06%	0.00%	0	0
No	7" Liner	BAKER	Yes	0%	0.0%	0.08%	0.00%	0	0
No	Wellhead	FMC	Yes	0%	0.0%	0.28%	0.00%	0	0
Yes	GYRO	GYRODATA	Yes	100%	0.0%	0.17%	0.17%	94	345
Yes	Drilling	HALLIBURTON	Yes	100%	5.1%	4.77%	2.38%	1,356	4,975
No	Other Service	MSE	Yes	0%	0.0%	0.65%	0.00%	0	0
Yes	Rig Contractor	NDC	Yes	100%	0.2%	84.17%	84.17%	47,848	175,600
No	Cementing	SCHLUMBERGER WELL SERVICES	Yes	0%	0.0%	2.73%	0.00%	0	0
No	Logging	SCHLUMBERGER WIRELINE	Yes	0%	0.0%	1.80%	0.00%	0	0
No	Other Service	SIGMA	Yes	0%	0.0%	0.56%	0.00%	0	0
No	Wellhead	VAM	Yes	0%	0.0%	0.15%	0.00%	0	0
No	Wellhead	VETCO GRAY	Yes	0%	0.0%	0.33%	0.00%	0	0
No	Tool Rental	WEATHERFORD	Yes	0%	0.0%	0.20%	0.00%	0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
						100.00%	87.32%	49,636	182,164

Comments:

Terms :

1- NPT Criteria per Service:
Full Payment if %NPT < 5 %, 50% Payment if >5 %NPT < 10%, Nil Payment if NPT > 10 %. NPT is calculated out of total operating time of the well.

2- NPT optimization: All AFEs have 15 % built-in NPT. Optimum NPT should be 10% for a well and will be applied to the Saved Duration. Optimum NPT number can be revised any time by DR-VP

Note: Any AFE where 15% NPT is not applied, Days saved will be calculated based on 15% NPT in original AFE and 10% optimum NPT in adjusted planned days

3- Incentive Distribution:

Distribution percentage of incentives payments among the personnel who worked on the well and the support personnel will be as per contractual guidelines of each contract. Contractor will make sure that performance incentive to his personnel and his sub-contractors' personnel who worked on the relevant well irrespective of their position is distributed equally. For rig contractors, catering & cleaning crew at rig during the relevant well are also eligible of the incentive payment equally. ZADCO has the right to carry out the audit to ensure that incentive bonus is paid as per guidelines to contractor's personnel and sub contractors' personnel equally.

4- Job Objectives for each service to be measured and evaluated based on whether these Objectives got Achieved or Not. Full Payment if Objectives got Achieved and Nil if Not.

5- Net Incentive bonus to be distributed to each service contractors to pay to their employees who were involved onsite directly or indirectly to the well performance. Bonus will be distributed equally among onsite employees for the well duration. Rig contractor will distribute the net incentive bonus to all employee assigned to the rig equally including catering & cleaning crew.

6- PIBS Distribution: DR-PBIDP will contact the contractors individually who are eligible for bonus payment. Original PIBS will not be distributed to Entitled Contractors.

7- PIBS Original Signed and Approved along with necessary supporting documents must be retained with DR-PBIDP to tally with Contractor(s) invoices.

8- Attachments: NPT report from OPENWELLS, AFE last report copy, Daily Drilling first and last day reports, NPT per service report from openwells, Fatality/LTI/Spill/Flaring report, HSE supporting documents, Well Delivery KPIs.

9- Owners are responsible to complete their own sections and provide related supporting documents minimum mentioned. DR-DCE and DR-DCO is Master Owner of Performance Incentive Bonus Scheme.

10- DR-DCE and DR-DCO will be the Custodian of the performance incentive bonus scheme, looking after its functionality and dealing with any suggestions or recommendations deem necessary.

Approvals:

	Prepared By:	Reviewed By:				Endorsed By:		Approved By:
Signature:								
Name:								
Title:	Well Engineer	HSE Manager	PBIPS Manager	DCE Manager	DCO Manager	Sr. Manager DCE	Sr. Manager DCO	VP-DR
Date:								

APPENDIX H

Drilling Data Integrity – Current Practices and Future Needs

Drilling Data Integrity; Current Practices and Future Needs

Faisal Rashid , ADNOC Offshore

Data Integrity

Data integrity is the Maintenance of, and the Assurance of the *ACCURACY* and *CONSISTENCY* of, data over its entire life-cycle, and is a critical aspect to the design, implementation and usage of any system which stores, processes, or retrieves data.

(Wikipedia)

Data integrity is the overall completeness, **accuracy** and **consistency** of data.

(Techopedia)

Ensuring Data Integrity in Drilling

- Developing Drilling Data Integrity Practices
- Data Categorization & Standardization
- Historical Data Correction (QA/QC)
- Data Clean-Up
- The Complex Environment

Drilling Data Integrity Practices

- Data Entry
- Data Assurance
- Missing Data
- Data Validation
- Data Analysis

Data Entry	**Data is entered in OpenWells** All data as listed above will be entered at rigsite every day before 06:30am. Rig supervisor is responsible for data entry. Note: For quantitative analysis, a pop-up message is set-up for Rig Supervisors to check the missing data.	(Daily)	Rig Supervisor
Distribution	**DDR will be generated in required format and will be distributed as per distribution list** Report is generated for each rig of previous day activities based on data entered and will be distributed by 07:00am each day to the approved distribution list by system Analyst	(Daily)	System Analyst
Data Assurance	**Each Data Entry will be checked for accuracy and missing information** Well Engineer will check at daily basis each data entry in OpenWells for accuracy and will make sure that no necessary data is missing. If any data entry is missing or need more information, He will inform the rig supervisor. Note: For quantitative analysis, a pop-up message is set-up for engineers to check the missing data.	(Daily)	Well Engineer
Missing Data Input & Data Correction	**Missing Data is entered and corrected** Rig Supervisor will add the missing data and will correct the data at daily basis, if any, as per Well Engineer's request. Note: If the missing data is not entered timely or data is not corrected timely as per Engineer's request, Well Engineer can raise the issue to Rigs Operations Manager or higher level	(Daily)	Rig Supervisor
Data Validation & Approval	**Each Data Entry will be validated for accuracy and approved** After all necessary information entered the DDR, Well Engineer will validate each data entered in OpenWells for accuracy and approve the DDR.	(Daily)	Well Engineer
Locking	**Each DDR will be locked in OpenWells** Once DDR is filled with required information, DDR will be locked by Well Engineer after approval to avoid any changes to the DDR. Note: Each DDR should be locked before the New DDR is issued. It is part of DDR KPIs.	(Daily)	Well Engineer
DDR Analysis (KPI Reporting)	**DDR data is checked and Analysis for KPIs** System Analyst will run queries to analyze DDR data, will prepare KPIs reports and will distribute at a regular intervals (monthly and weekly basis).	(Weekly)	System Analyst (DR-PBI)

Data Categorization & Standardization

- Code Of Practice are prepared to have standardize Operations and NPT codes with Enhancement

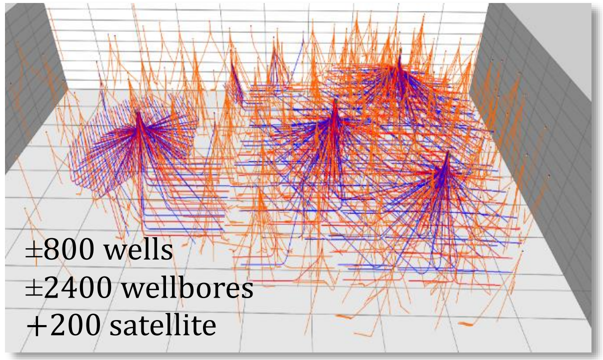
- Limited Events (10)
  - Does not cover all drilling of Drilling & Completion Events
  - Events are not defined further
- Number coding
  - Difficult to memories and no relation
- Operation Type has only NPT no Scope of Change
- Sub Codes (~178)

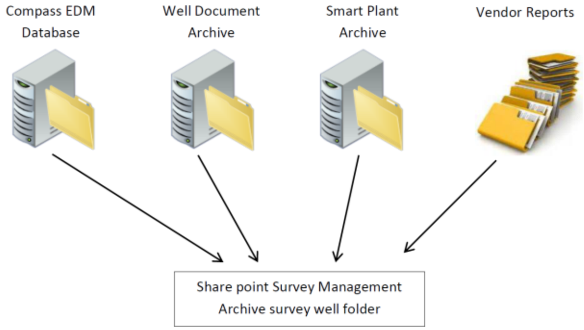
- More Events (~18)
  - Does cover all most type of the Drilling and Completion Events
  - Events are further defined with objectives (202) –cover all type of wells
- Code use abbreviations
  - Easy to remember and understand
- Operation Type has NPT and Scope of Change
- More Sub-Codes (+346)

Historical Data Correction

QA/QC on a well by well basis and commend correction to ensure a high confidence in the data existing within Drilling Database

- Inaccurate usage of IPM models
- Survey data not matching with vendor survey reports
- Inconsistent tie on points and definitive surveys
- Missing Casing information
- Missing Wellbores
- Missing Survey Data
- Incorrect application of tool codes
- Lack of IPM mapping





188658-MS SPE Conference Paper – 2017
"4-Tier Anti-Collision Policy Adapted in a World Class ERD/MRC Drilling Project Covering Satellite Platforms and Artificial Islands for Collision Free and Optimum Wellbore Placement"

Data Clean-Up

Ultimate Data Cleaning requirements due to non-standardized practices. It helps facilitating better centralized well planning work;

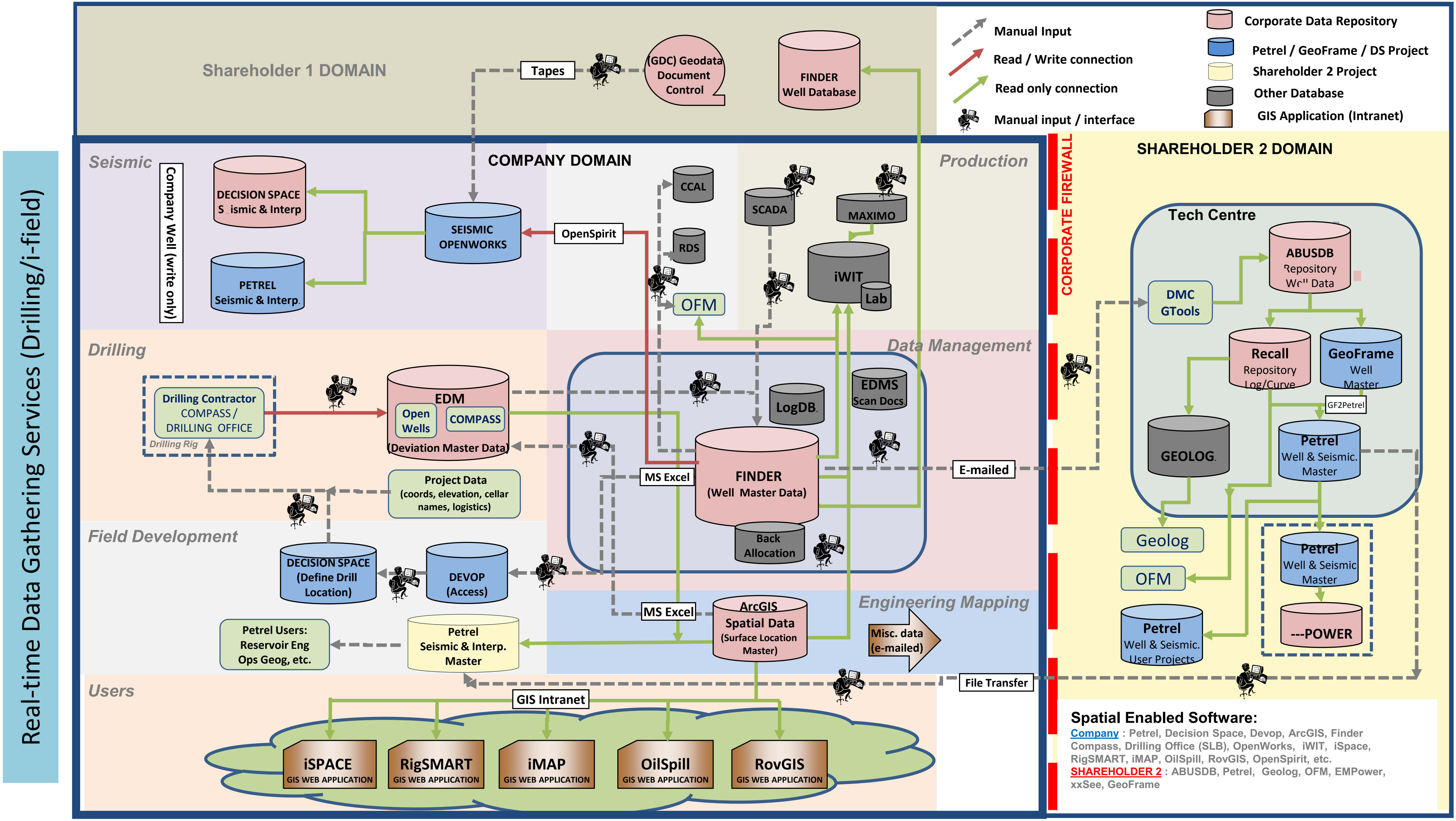
- 7578 prototypes/orphans dada removed
- Data Clean-up Practices ware developed

Database upgrade to accommodate the future enhancements;

- Data Storage Practices checked – data counts re-verified
- Picklist upgrade to better data selection

The Complex Environment

Data Flow


Real-time Data Gathering Services (Drilling/i-field)
Shareholder 1 DOMAIN
Tapes
(GDC) Geodata Document Control
FINDER Well Database
Manual Input
Read / Write connection
Read only connection
Manual input / interface
Corporate Data Repository
Petrel / GeoFrame / DS Project
Shareholder 2 Project
Other Database
GIS Application (Intranet)
COMPANY DOMAIN
Seismic
Company Well (write only)
DECISION SPACE Seismic & Interp
PETREL Seismic & Interp.
SEISMIC OPENWORKS
OpenSpirit
CCAL
RDS
OFM
SCADA
MAXIMO
iWIT
Lab
Production
Drilling
Drilling Contractor COMPASS / DRILLING OFFICE
Drilling Rig
EDM
Open Wells
COMPASS
(Deviation Master Data)
Data Management
LogDB
EDMS Scan Docs
FINDER (Well Master Data)
Back Allocation
MS Excel
E-mailed
Project Data (coords, elevation, cellar names, logistics)
Field Development
DECISION SPACE (Define Drill Location)
DEVOP (Access)
Petrel Users: Reservoir Eng Ops Geog, etc.
Petrel Seismic & Interp. Master
MS Excel
ArcGIS Spatial Data (Surface Location Master)
Engineering Mapping
Misc. data (e-mailed)
File Transfer
Users
GIS Intranet
iSPACE GIS WEB APPLICATION
RigSMART GIS WEB APPLICATION
iMAP GIS WEB APPLICATION
OilSpill GIS WEB APPLICATION
RovGIS GIS WEB APPLICATION
CORPORATE FIREWALL
SHAREHOLDER 2 DOMAIN
Tech Centre
ABUSDB Repository Well Data
DMC GTools
Recall Repository Log/Curve
GeoFrame Well Master
GF2Petrel
GEOLOG
Petrel Well & Seismic. Master
Geolog
OFM
Petrel Well & Seismic Master
Petrel Well & Seismic. User Projects
---POWER
Spatial Enabled Software:
Company : Petrel, Decision Space, Devop, ArcGIS, Finder Compass, Drilling Office (SLB), OpenWorks, iWIT, iSpace, RigSMART, iMAP, OilSpill, RovGIS, OpenSpirit, etc.
SHAREHOLDER 2 : ABUSDB, Petrel, Geolog, OFM, EMPower, xxSee, GeoFrame

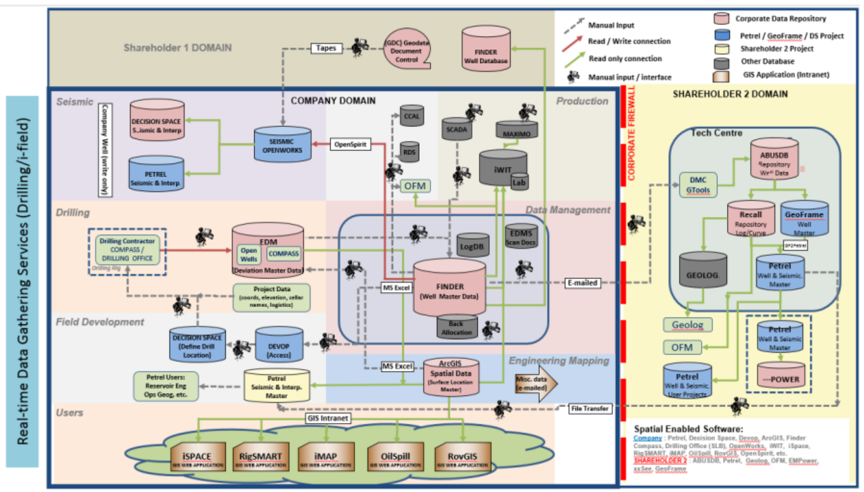
Complex Environment

Applying the data Integrity definition

Data integrity is the <u>Maintenance</u> of, and the <u>Assurance</u> of the *ACCURACY* and *CONSISTENCY* of, data over its **entire life-cycle**, and is a critical aspect to the design, implementation and usage of any system which stores, processes, or retrieves data.

(Wikipedia)

- Too many Interfaces
  - Different UOM
- Manual Data Entry
- Excels inputs/Personal Judgements
- Different vendors – Different Quality check
- Irregular Data Flow

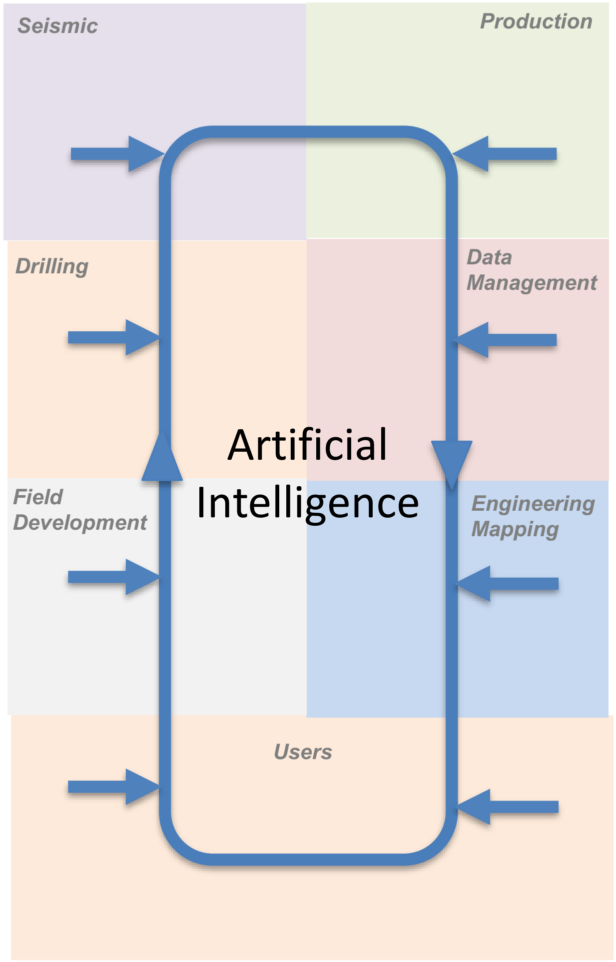


1% Garbage in = Garbage out 100%

Needs

Applying 4th Industrial Revolution

- Connecting Internet of Things/Humans in Real-time
- Unified/Standard Model/Interface
- Standardize Vendors Interfaces
- Introduction of AI (minimization of manual interaction)
- Integrated Real-time data transmission



Industry leaders to Invest in data Integrity

- Clouds based solutions

Thank you

Questions?