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Driving Oil and Gas Well Delivery Performance with Value Creation Events

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Abstract:
Oil and gas well delivery involves the execution of well projects, with attention to safety, design specification, desired well objectives, planned time, and agreed budget. These projects involve drilling, completion, work-over, and decommissioning/restoration (also known as abandonment) activities.
Performance, with respect to the oil and gas well delivery process, is the result of comparing the actual versus plan of the above-mentioned indicators. This means, to obtain an accurate performance report, there must be benchmarks, clearly agreed upon, prior to the commencement of well execution. Plan-beating performance is not achieved without a deliberate strategy. One of the major contributors to such is the value derived from discussions about the well project. These discussions occur in what could be termed value-creation events.
Value creation events are simply discussion sessions organized with the intent to derive value that has the potential to improve well-delivery performance. Attendees are largely the stakeholders in the project, including the facilitator of the event. These value-creation events are classified based on the timing of the event relative to the project execution as pre-execution or post-execution events.
This paper discusses various value creation events under these classifications and how they are used to drive well delivery performance, with a focus on the value obtained to aid time and cost reduction and delivery of stated well objectives at the minimum.

Keywords: *Performance, oil and gas, well delivery, value-creation events*

1. Introduction

The term 'oil and gas' is used to refer to activities relating to the exploration, appraisal, development, and production of natural resources - petroleum oil and gas.

Driving oil and gas well delivery performance is a strategic process, which begins before the commencement of well execution (Pre-execution phase), continues during the actual drilling, completion, work-over, or abandonment of a well (execution phase), and continues even after a well has been delivered (post-execution phase). There are different methods of ensuring excellent performance, but a vital one is the facilitation of value-creation events. These events could be categorized into pre-execution and post-execution events.

These events are termed 'value-creation' because they create value translated to meet KPIs of oil and gas projects. The value added towards the improvement of time and cost performance will be illustrated here.

2. Discussion

2.1. Pre-execution Value Creation Events

These are events facilitated by performance and planning well engineers, during the planning phase of a well. They are characterized by discussions involving the well's KPIs, which typically involve the technical specifications, well objectives, safety goals, time, and cost limits. These events could be further divided into two categories:

- Office-based pre-execution value creation events
- Field-based pre-execution value creation events

2.1.1. Office-Based Pre-Execution Value Creation Events

These events are organized in town, either in the base office or in some other suitable environment, easily accessible from the office of the oil and gas company. They are attended largely by office-based staff, with the inclusion of a few field staff. They are typically 'Well on Paper' (well execution strategy) events such as:

- Drilling The Well on Paper (DWOP) – for drilling projects.
- Work-over The Well on Paper (WWOP) – for work-over projects.
- Completing The Well on Paper (CWOP) – for completing the projects.
- Abandon The Well on Paper (AWOP) – for abandonment (decommissioning and restoration) projects.

The well program is discussed in detail in these events, and effective ways of achieving the activities/tasks are deliberated. Lessons learnt from previous similar oil and gas well projects are a valuable resource for such events. The well-project KPIs are usually agreed upon by all key stakeholders in such meetings and properly documented. One of the main outputs of these events is a time plan, which contains the project timeline broken down into mini-activity time frames. This serves as a very valuable tool for performance monitoring and improvement during execution.

2.1.2. Field-Based Pre-Execution Value Creation Events

These events are organized at the well site and attended largely by field staff, with the inclusion of one or two office staff, who are usually the facilitators. These events are typically:

- Pre-spud meeting – for drilling and completion projects.
- Pre-reentry meeting – for work-over and abandonment (decommissioning and restoration) projects.

The KPIs agreed in Well on Paper events are cascaded to these meetings.

2.2. Post-Execution Value Creation Events

This is an event referred to as an After-Action Review (AAR). An AAR is a review of the whole well-delivery project after execution. It is typically facilitated by performance and planning well engineers. The purpose is to capture lessons learnt from the project and document them appropriately. The documented lessons learnt are valuable for the performance improvement of subsequent well-delivery projects.

In order to capture these learning points while they are still fresh, miniature AAR sessions are facilitated on the field by well site supervisors, just after sub-sections of the well project. These sessions are called hot-wash AAR. The hot-wash AAR document is used to kick-start the main AAR event, and at the end, a more robust AAR document is obtained.

2.3. Practical Application of Value Creation Events to Drive Well-Delivery Performance

Let us consider a simple drilling project for well number 10, in Alpha field, to be executed by a land rig Beta-007, with the following high-level summary of the program:

- Rig move and rig up.
- Drive 30-inch conductor to refusal depth of +/-350ftah.
- Spud well, clean out conductor, drill 17-1/2" hole to section TD of 5.000ftah and POOH.
- Run 13-3/8" casing to 4.995ftah and cement in place.
- Wellhead job, nipple up BOP, and pressure-test.
- Drill 12-1/4" hole to section TD of 9,000ftah and POOH.
- Run 9-5/8" casing to 8,990ftah and cement in place.
- Wellhead job, nipple up BOP, and pressure-test.
- Drill 8-1/2" hole to section TD of 10,000ftah and POOH.
- Run 7" liner to 9990ftah and cement in place.
- Drill 6" hole to final TD of 10,300ftah and POOH.
- Run lower completion.
- Run upper completion.
- Nipple Down BOP, nipple up Christmas tree, and pressure-test.

Kindly note that, for the purpose of this paper, the safety aspect and technical details of the well program have been left out, and the focus is on the delivery time (which ultimately affects cost) and well objectives.

During the DWOP, the program is discussed in detail, and time slots are allocated for every activity. A major deliverable of all DWOPs is a time plan.

2.3.1. Time Plan

A time plan is simply a representation of planned activities, the corresponding time allotted to each activity, and the total time planned for the project. An illustration is shown below, using the example well delivery project mentioned above.

TIME PLAN FOR ALPHA-010		
S/N	**Activity**	**Planned Time (Days)**
1	Rig move	10.00
2	Drive 30-inch conductor to refusal depth of +/-350ftah	2.00
3	Spud well, clean out conductor, drill 17-1/2" hole to section TD of 5,000ftah and POOH	6.00
4	Run 13-3/8" casing to 4,995ftah and cement in place	1.75
5	Wellhead job, nipple up BOP and pressure-test	1.00
6	Drill 12-1/4" hole to section TD of 9,000ftah and POOH.	4.50
7	Run 9-5/8" casing to 8,990 ftah and cement in place	2.25

TIME PLAN FOR ALPHA-010		
S/N	**Activity**	**Planned Time (Days)**
8	Wellhead job, nipple up BOP and pressure-test	1.00
9	Drill 8-1/2" hole to section TD of 10,000ftah and POOH	2.20
10	Run 7" liner to 9,990ftah and cement in place	1.50
11	Drill 6" hole to section TD of 10,300ftah and POOH	1.75
12	RIH lower completion	2.75
13	RIH Upper completion	3.25
14	Nipple Down BOP, nipple up Christmas tree and pressure-test	1.00
	Total	**40.95**

Table 1: Example Time Plan from Well on Paper Event

It is important to note that the planned time, as agreed by stakeholders in the event, is usually more stringent than what is contained in the well program. This encourages plan-beating performance and improves the possibility of meeting the well program time (and, by extension, cost) target.

During the pre-spud meeting, in addition to discussing the well program objectives, technical details, and safety considerations, the above time plan is presented to the rig site team, and they make a commitment to deliver the well within this time frame. This becomes a benchmark for tracking performance during execution.

2.3.2. On-site Performance Tracking

On-site performance tracking is done by the well site supervisor for each of the activities, and at the end of the well execution, a record of actual time (for each activity and cumulative) is obtained, as shown in table 2 below:

PLANNED VERSUS ACTUAL TIME FOR WELL ALPHA-010									
S/N	**Activity**	**Planned Time (Days)**	**Cumulative Planned Time (Days)**	**Actual Time (Days)**	**Cumulative Actual Time (Days)**	**Days ahead (-) or behind (+) (Actual – Plan)**	**Cumulative Days ahead (-) or behind (+)**	**Planned Depth (feet)**	**Actual Depth (feet)**
1	Rig move and Rig up.	10.00	10.00	8.75	8.75	-1.25	-1.25	0	0
2	Drive 30-inch conductor to refusal depth of +/-350ftah.	2.00	12.00	2.25	11.00	0.25	-1.00	350	340
3	Spud well, clean out conductor, drill 17-1/2" hole to section TD of 5000ftah and POOH.	6.00	18.00	4.8	15.80	-1.20	-2.20	5000	5000
4	Run 13-3/8" casing to 4995ftah and cement in place.	1.75	19.75	1.4	17.20	-0.35	-2.55	5000	5000
5	Wellhead job, nipple up BOP, and pressure-test.	1.00	20.75	1.2	18.40	0.20	-2.35	5000	5000
6	Drill 12-1/4" hole to section TD of 9000ftah and POOH.	4.50	25.25	4.50	22.65	0	-2.35	9000	9000
7	Run 9-5/8" casing to 8990 ftah and cement in place.	2.25	27.50	1.95	24.85	-0.30	-2.65	9000	9000
8	Wellhead job, nipple up BOP, and pressure-test.	1.00	28.50	0.8	25.65	-0.20	-2.85	9000	9000
9	Drill 8-1/2" hole to section TD of 10,000ftah and POOH.	2.20	30.70	2	27.65	-0.20	-3.05	10000	10000
10	Run 7" liner to 9,990ftah and cement in place.	1.50	32.20	1.4	29.05	-0.10	-3.15	10000	10000

PLANNED VERSUS ACTUAL TIME FOR WELL ALPHA-010									
S/N	Activity	Planned Time (Days)	Cumulative Planned Time (Days)	Actual Time (Days)	Cummu-lative Actual Time (Days)	Days ahead (-) or behind (+) (Actual – Plan)	Cumulative Days ahead (-) or behind (+)	Planned Depth (feet)	Actual Depth (feet)
11	Drill 6” hole to section TD of 10,300ftah and POOH.	1.75	33.95	1.5	30.55	-0.25	-3.40	10300	10300
12	Run lower completion.	2.75	36.70	2.5	33.05	-0.25	-3.65	10300	10300
13	Run upper completion.	3.25	39.95	3.2	36.25	-0.05	-3.70	10300	10300
14	Nipple down BOP, nipple up Christmas tree, and pressure-test.	1.00	40.95	0.75	37.00	-0.25	-3.95	10300	10300
	Total	40.95		37.00		-3.95			

Table 2: Example Planned Versus Actual Time Data with Calculated Performance

Looking at the 'Actual Time' column, line items 2 and 5 (numbers coloured red) over-ran the target time, while all other activities (numbers coloured green) were completed within the specified planned time.

The figures in the 'days ahead' column are obtained by subtracting the planned time from the actual time. A positive number denotes more time was used than planned, as seen in rows 2 and 5. A negative number is desired, as it means that the activity was achieved in less time than the plan, and all other rows depict this.

The cumulative 'days ahead' column is ahead all the way, despite the two overruns, as this margin was maintained by the remaining activities (apart from those in rows 2 and 5) being ahead.

A visual representation is more explicit on a time-depth plot.

2.3.2.1. Time-depth Plot

A time-depth plot is a graph of time (on the x-axis) against depth (on the y-axis). It is a simple time-performance monitoring tool that is used to track planned versus actual well delivery time during execution at the well site. This plot is mainly used for drilling projects. An example plot is shown in figure 1 below (This was plotted from table 2 data above).

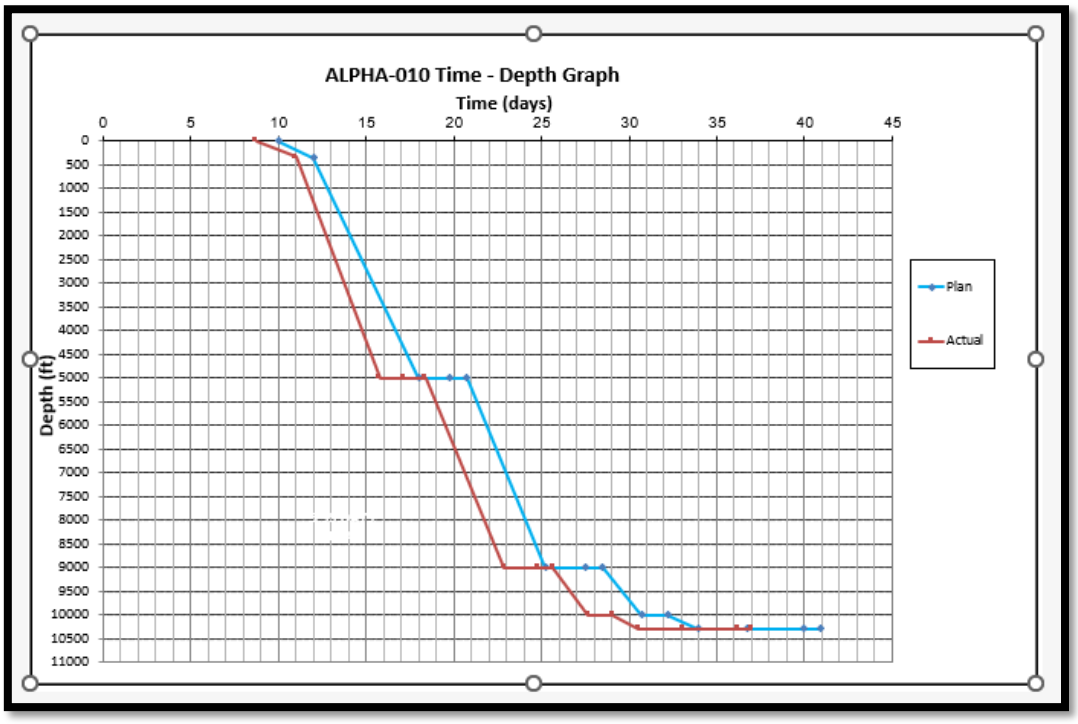

Figure 1: Example Time-Depth Plot

The overall project was executed 3.95 days ahead of the plan. This means cost savings of approximately four times the daily rig spread. Assuming Beta-007, a land rig, has a daily rate of $30,000 and an additional average daily spread of $10,000, which means the above performance amounts to savings of approximately $160,000. This performance is driven largely by the value obtained from both post-execution value creation events of previous projects, pre-execution value creation events of this project, and on-site performance tracking to ensure proper implementation of a documented strategy. The learning points of this project will also be properly documented at the end, after an AAR session, and this will be ploughed back into subsequent projects for performance improvement. An example AAR for this scenario is illustrated in table 3 below. The AAR below, though fictitious, is a good representation of what an actual AAR report looks like.

AFTER-ACTION REVIEW FOR ALPHA-010							
S/N	**Operational Phase**		**Highlights**	**Lowlights**	**Improvement Plan**		
	Plan - What did we plan to do?	**Actual - What did we do?**	**What went well?**	**What did not go well or can be improved upon?**	**Improvement action items**	**Action Party**	**Close-out Date**
1	Rig move and rig up in 10.00 days.	Rig move and rig up in **8.75** days.	Robust inspection of all heavy-duty and lifting equipment and portacabins prior to rig move.	Late arrival of food for crew on day 1.	Investigate reason for late meal and how to prevent re-occurrence.	Lead Well Engineer	26th March 2023.
2	Drive 30-inch conductor to refusal depth of +/-350ftah in 2.00 days.	Drive 30-inch conductor to refusal depth of +/-350ftah in **2.25** days.	Two welders were mobilized to ensure seamless operation without over-working personnel.	Piling hammer broke down for about 12 hours.	Prepare standard for detailed QA/QC on piling hammer to be done on future jobs prior to conductor piling operation.	QA/QC engineer and conductor piling contractor	27th March 2023.
3	Spud well, clean out conductor, drill 17-1/2" hole to section TD of 5000ftah and POOH in 6.00 days.	Spud well, clean out conductor, drill 17-1/2" hole to section TD of 5000ftah and POOH in **4.80** days.	BHA POOH was mostly slick because of adequate hole cleaning and regular pumping of sweeps while drilling.	Unavailability of wash gun on site made it more difficult to mitigate the blinding of the shaker screens.	Functional wash gun and spare to be supplied to rig site before next well is spud.	Well Engineer	28th March 2023.
4	Run 13-3/8" casing to 4,995ftah and cement in place in 1.75 days.	Run 13-3/8" casing to 4,995ftah and cement in place in **1.40** days.	Casing RIH was slick because of adequate circulation done prior to POOH 17-1/2" BHA.	Poor alignment of TDS to the rotary table caused the initial RIH to be quite slow.	Ensure proper alignment is done for subsequent wells	Well site supervisor and rig manager	Prior to spud.
5	Wellhead job, nipple up BOP, and pressure-test in 1.00 day.	Wellhead job, nipple up BOP, and pressure-test in **1.20** days.	Test pump was made prepared for the job in advance.	Spent some time to change a leaking stand-pipe valve.	Comprehensive maintenance is to be done for all valves during rig move.	Rig manager	Prior to spud.
6	Drill 12-1/4" hole to section TD of 9,000ftah and POOH in 4.50 days.	Drill 12-1/4" hole to section TD of 9,000ftah and POOH in 4.50 days.	Bit was checked in advance and dressed with appropriate nozzles.	Intermittent mud pump failure resulted in 12 hours of cumulative NPT.	Mud pump is to be checked regularly, adhering to rig PMS.	Well site supervisor and rig manager	During operations.

AFTER-ACTION REVIEW FOR ALPHA-010							
S/N	**Operational Phase**		**Highlights**	**Lowlights**	**Improvement Plan**		
	Plan - What did we plan to do?	**Actual - What did we do?**	**What went well?**	**What did not go well or can be improved upon?**	**Improvement action items**	**Action Party**	**Close-out Date**
7	Run 9-5/8" casing to 8,990 ftah and cement in place in 2.25 days.	Run 9-5/8" casing to 8,990 ftah and cement in place in **1.95** days.	Casing threads are properly cleaned and inspected before a job—no recorded case of cross-threading while RIH.	Casing string landing had slight delays because the crane and forklift were busy in the mud chemical area.	Additional crane and forklift are to be made available, especially during critical phases of the operation.	Lead Well Engineer	4th April 2023.
8	Wellhead job, nipple up BOP, and pressure-test in 1.00 day.	Wellhead job, nipple up BOP, and pressure-test in **0.80** day.	Pneumatic wrench used instead of manual one.	N/A	Ensure pneumatic wrench is used for subsequent wells. Get a back-up wrench	Well site supervisor and rig manager	5th April 2023.
9	Drill 8-1/2" hole to section TD of 1,000ftah and POOH in 2.20 days.	Drill 8-1/2" hole to section TD of 1,000ftah and POOH in **2.00** days.	Connection time was monitored and reduced to the barest minimum to prevent differential sticking.	TDS breakdown resulted in an NPT of 4.5 hours.	TDS to be checked regularly, adhering to rig PMS.	Well site supervisor and rig manager	During operations.
10	Run 7" liner to 9,990 ftah and cement in place in 1.50 days.	Run 7" liner to 9,990 ftah and cement in place in **1.40** days.	An efficiency test was performed on the mud pump prior to the job.	N/A	Perform efficiency test for all the mud pumps, in subsequent wells and report value.	Well site supervisor and rig manager	When 7" liner has been run to bottom and circulation is in progress.
11	Drill 6" hole to section TD of 10,300ftah and POOH in 1.75 days.	Drill 6" hole to section TD of 10,300ftah and POOH in **1.50** days.	Mud weight and viscosity in/out were measured and recorded every 30 minutes.	N/A	Record mud weight and viscosity in/out on rig every 30mins. Announce values via PA system	Well site supervisor and mud engineer	While drilling 6" hole.
12	Run lower completion in 2.75 days.	Run lower completion in **2.50** days.	Completion sub-assemblies were strapped, and tally prepared ahead of time.	Only one well-site completion supervisor performed the operation and was over-worked.	Mobilize two completion supervisors to cover the day and night shifts.	Well completions engineer and well site supervisor	Two days before future completions operations
13	Run upper completion in 3.25 days.	Run upper completion in **3.20** days.	Personnel and equipment were mobilized ahead of time.	N/A	Mobilize contractors and personnel on time	Well engineer / Well site supervisor	Two days before completions.
14	Nipple down BOP, nipple up Christmas tree, and pressure-test in 1.00 day.	Nipple down BOP, nipple up Christmas tree, and pressure-test in **0.75** day.	The compatibility of the tubing hanger and X-mas tree was checked ahead of the operation.	N/A	Check compatibility of tubing hanger and X-mas tree ahead of operation	Well site supervisor and well head service contractor field supervisor	Three weeks before this operation commences.

Table 3: Example After-Action Review Report

3. Recommendations

- Well on paper events should be organized way ahead of execution time for all oil and gas well delivery projects.
- Pre-spud or pre-reentry meetings should be organized at the well-site, just before the commencement of execution for all well-delivery projects.
- Minutes of Well on paper events should be effectively captured and duly shared on-site during pre-spud or pre-reentry meetings.
- AARs for well delivery projects should be broken into sub-sections, and hot-wash AARs organized at the well site after each section.
- An AAR should be organized after the execution of all oil and gas wells, and this should capture and properly document all learning points for the project.
- Learning points from AAR documents for previous well projects should be discussed in detail during well on paper events.

4. Conclusion

Value creation events are great tools for driving well-delivery performance. These include pre-execution (Well on paper and pre-spud) events and post-execution (AAR) events. In addition to safety, technical design, and well-objective controls, these events focus on improving well delivery time, which has a direct impact on cost. Besides value from a technical review of the well project, huge cost savings can be achieved from the proceeds of these events, and this is directly proportional to the amount of project time reduction.

5. Abbreviations

AAR – After-Action Review
AWOP – Abandon the Well on Paper
CWOP – Completing the Well on Paper
DWOP – Drilling the Well on Paper
WWOP – Workover the Well on Paper
KPI – Key Performance Indicators
NPT – Non-productive Time
POOH – Pull Out of Hole
PMS – Preventive Maintenance System
TD – Target Depth
TDS – Top Drive System

6. References

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