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INTRODUCING INGENEERING AND PERT METHOD TO MANAGE DRILLING OPERATIONS IN ALGERIA FIELD

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A B S T R A C T

Drilling operations organization and time optimization represent a heart of cost-effective management system. Non-productive time (NPT) with their influences concerning delay in project delivery together with extra cost generated to recover the situation, leads to reconsider the method of carrying out drilling operations in terms of application and tenders. In order to achieve the project goals and overcome the complications encountered during the execution stage; a selection of problems using modified Pareto principal then an optimization of operations execution time by means of PERT method proposed. Application of the proposed techniques leads to point-outs the real main problems, which must focus on and the obstacles facing the smooth running of operations. Moreover, a method was presented to evaluate and set goals based on results and specific references. The results offer a great add value for the future drilling projects.

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1. INTRODUCTION

Engineering divided into two categories, industrial and research part. Research is oriented toward new technological apparatus and mechanism invention; creativity and development of new industrial solution represents the main task. Specialized research center equipped with the up-to-date laboratory instruments and high-qualified personnel are the success key. Differently, industrial engineering incorporated in company's production process, with available equipment and personnel to fulfill high quality production requirements. Well integrity represents the main subject in drilling and production field. Rather than drilling fluids and mechanical barriers, during production stage cement is the unique tool used to prevent formation fluids from leaks inside the hole. Cement bond low quality is essentially due to additives nature and state, program preparation and data gathering or way of execution (Mangadlao et al., 2015; Zhao et al., 2020). Cementing operations have an instantaneous aspect; implementation of decision-making process together with immediate positive reaction can remedy the situation.

This work is oriented to study industrial engineering organization in terms of structure, personal selection and subject dealing with. Generally, industrial problems find their solution through execution measures, operational decisions or engineering programs. Execution is sloping to leadership as collaborative interactive practices. Although leader ship has been presented as a decision-making tool (Davis & Eisenhardt, 2011). This is not the case while dealing with project engineering management, where cooperative will provide more accurate decision in short terms (Zerjav, 2021). Operational perspective is the research optimization level, in the case when execution crew cannot solve the problem; an operational research group is requested to examine larger aspect of working process. Operational research group is invited to organize presentations and brain storming briefings, to discuss originate of problem and propose the most adequate

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solution. Deeper in process analysis, if the execution and operational levels are passed without resolving the problematic, engineering is invited to elaborate an adequate diagnostic and recommend suitable solutions. Otherwise, engineering stage treats operational modifications or development and technological limitations.

Drilling operations begin by pre-spud operations to reach the completion / Abandonment stage and DTM. Operations in-between represent the main subject of project management strategy, analysis and optimization leads to a high level of control at all stages.

In the literature there are two different network approaches have been developed for arrangement, planning and monitoring such projects. PERT method which based on three times estimation model, whereas CPM is only one single time estimation model (Amariei et al., 2009; Tjusila, & Gozali, 2021; Wyrozębski & Wyrozębska, 2013; Yıldız, 2015). The Project constitute from tasks, each one characterized with early, late and acceptable time. predecessor and successor are the main limits that characterize the tasks and make possible to evaluate the chains then extract the optimal path.

Drilling Engineering process is oriented to treat new drilling processes and techniques to overcome operational difficulties. Directional Busahmin et al. (2021), Fernandes et al. (2024), under balance Fattah et al. (2011) and extended reach drilling (ERD) Gao et al. (2009) are all invented to overplay real problems encountered during drilling in specific areas or in order to successfully go to pay zone or finishing section unreachable via conventional methods. Essentially, engineering is divided into job organization, preparation and Post job knowledge gathering or lesson learned.

2. CATEGORIES OF ENGINEERING SYSTEM IN DRILLING OILFIELD

In the contest of post job operation, the strategy proposed to pass from simple positive individual actions to engineering solution. The three categories of engineering are described below.

2.1. Execution segment

Intervention during drilling operations running is a critical action, it may engender enormous cost influences and they are, in drilling field, commonly irrecoverable. Their role consists of project design planned and consigns into real tasks realized in the good way. Figure 1 includes the three stages of execution engineering in the first level.

Job begins by tasks preparing and planning, at this stage required performance tools and mechanisms are offered and checked. When equipment and personal are judged ready for the next step, operations start which my push some difficulties to initiate and dealing with them represents the real challenge at this level. At the end of work some points concerning job quality and overall environment must be extracted. If any situation or action selected as doubted, a notification to upper level (Operational) to clearly define the circumstances and suggest solutions.

2.2 Operational segment

If the action taken during job running is sufficient and adequate to resolve the problem, then register achievement as lesson learned. Otherwise, difficulties faced will not overcome, which means operation will be totally or partially interrupted. Results vary from total loss of objectives, repair required or unnoticed. If the problem persists a new goal is built, rather than job success, avoiding recurrence of the same phenomenon in other wells is vital for the company. Operational level is founded on optimization system; via analysis of operational parameters recorded together with typical designing system a new point of view toward the difficulty is achieved. Understanding the functionality of the problem represents the big part in decision making process. Figure1 include the three main parts of operational engineering in the second level.

Real time records together with way of execution are vital and indispensable for objective syntheses. The quality of job's information gathering represents the heart of the next stage. Examination will lead to find solution or transfer the problem to engineering stage, in case of technological limitations.

2.3 Engineering segment

If execution intervention could not overcome faced difficulties, and operational syntheses do not lead to describe or solve the challenging, engineering step will be invited to look for any technological limitation. By means of high qualified personal, up to date technological equipment with necessary other tools as software, engineering section represents the head or soul for any company. Due to high requirements in terms of crew selection and material used, impacts cost might be insupportable for all companies. This part is usually assigned to specialized corporation work for the benefit of multiple sectors, this later to cover elevated charges. Figure 1 include the three main parts of engineering segment in the third level.

As problem is noticed in engineering sector, an appropriate investigation initiates to check if any limitation is broken. At this level big part in solving approach is achieved, afterthought will focus on solution invented, tested and validated. At the end, a valued resolution will be accomplished. Consequently, similar critical situations will be passed without remarkable difficulties.

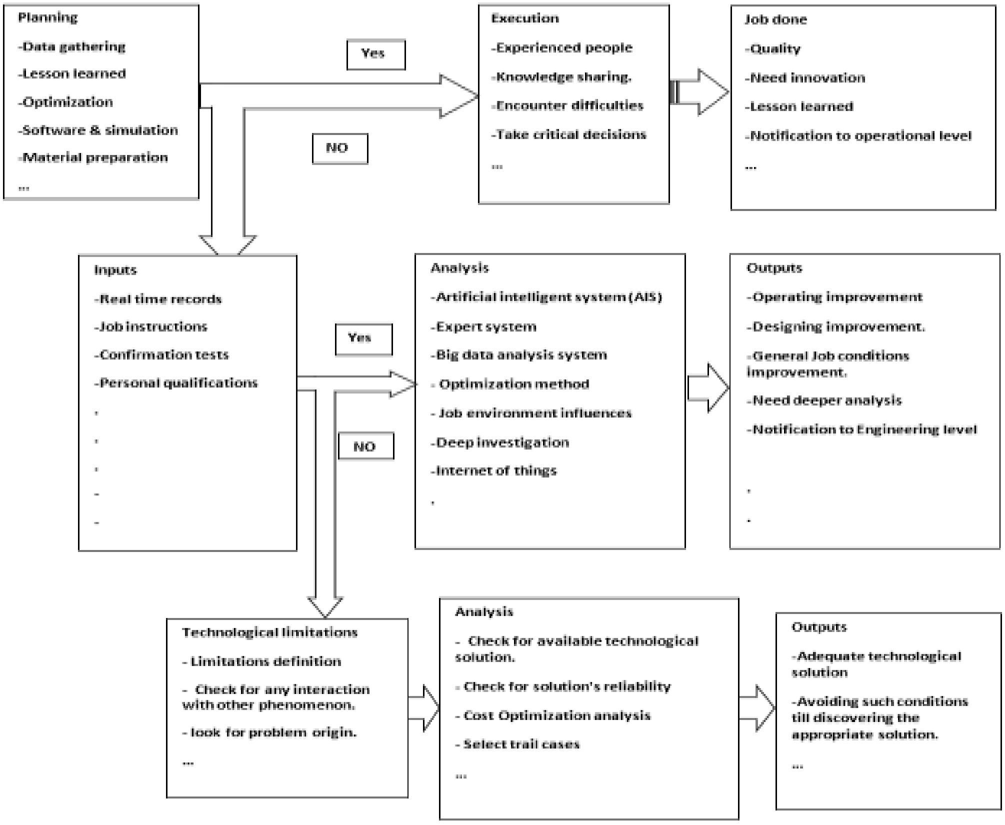


Figure 1. Drilling Engineering organization

2.4. Case Studies

Problem of CLIP (cement left in pipe).

During cement job and precisely while displacing slurry, some doubts are noticed by rig mud engineer about variations of pressure and volumes. Recheck of all backs and rig floor valves lead to discover that rig floor bleed-off valve is still partially open. Flowing system and volumes were accurately adjusted; accordingly, all job objectives were successfully attained. Notification was sent to operational engineering in order to clearly define the causes and suggest an appropriate solution. After examination of all circumstances, this misstep is classified as human error. In order to avoid the repetition of such situation, it was decided to connect all bleed-off pipes to unique box equipped by fluid level detector.

Problem of SPP (stand pipe pressure) rises while heavy slurry displacement.

During slurry displacement inside casing, pressure rises suddenly to reach casing limits without unplugging the itinerary. Casing column moved up and down, pressure chock and other attempts to terminate processes safely and accurately have been failed. Decision to stop tries, evaluates the situation and sends details to engineering, in order to initiate deeper analysis. Investigation leads to the origin of the problem via a simple check of products inventory. It has been confirmed that only half of retarder quantity has been used. As solution the same products quantity by sack will be sent to all sites with products check list.

Almost the same problem was registered in heavy sections.

SPP rise rapidly to reach casing/formation limits, enormous losses recorded before total plugging of system. Casing column movement and other tries to recover flowing without success, job was stopped before pumping the required displacement volume; almost all cement volume was left inside pipe. Overpriced operations were done to recover the system; in some cases, the objective of the well was lost. Execution part was overstepping without any positive action, at operational level a decision to displace cement at low flow rate in the objective to minimize pressure generation. This later resolution minimizes remarkably fluids losses, but the main problem persists. Deeper analysis of casing limitations as burst, collapse, ballooning and casing elongation during cement displacement inside and behind casing point out the real cause. As slurry pumped the hydrostatic pressure inside, reinforced by surface pressure needed to remain fluids in movement, rise significantly compared to outside one. Knowing that buoyancy force is calculated based on emerged fluid lifting capability. If inside hydrostatic equivalent pressure is much higher than outside, column will recover part of their weight. Accordingly, additional elongation will be generated and space out casing-total depth my closed. Solution proposed to pull-out column, while slurry displacing, to the required height without comeback down till passing the critical zone. Other solution proposes to select the accurate casing weight which their elongation, due to differential pressure, is covered by casing-TD space out.

Generally, executive stage represents the critical decision making, because cementing operations are irreversible (float shoe) and unstoppable process (plugs), any inadequate choice may change radically section objectives or even loose the well. A collaborative decision-making process must implant to react timely, efficiently and without complicating the situation. When difficulties encountered are decorticated efficiently a detailed report define obstacles, actions and results will be send to operational crew, in order to evaluate and propose eventual ameliorations. If actions during execution are not completely resolve the problem, then deeper investigations will initiate to exactly localize the obstacles. Operational engineering uses experienced crew, lessons learned from similar cases studies and more laboratory tests to define the situation conditions in the objective to get solutions. If the critical state continues, specialized researches will be invited.

3. DRILLING OPERATION MANAGEMENT

3.1. Operations description

Delivering a well in very good conditions to start production in short time without any extra work-over interventions, this is the critical objective of any drilling company.

Generally, drilling operations consist of the sequences presented in Table1:

N°	Operation	Description
1	Pre-spud operations.	* Prepare drilling mud required volume. * Select and check the bit and the hole BHA. * Check to confirm the availability and conformity of equipment with all necessary materials.
2	Drilling surface hole section (26’’).	* Makeup drilling bit and run in the hole. * Start section drilling to casing point. * Pull out of the hole drilling string, rig down unnecessary materials. * Check the availability of casing and cement materials with components. *Prepare Power tong and other needed casing running equipment.
3	Run and cement surface Casing (18’’5/8)	*Run casing to TD. *Circulate to check itinerary way. *Pump and displace Cement into annulus.
4	Interphase (26’’-16’’)	*Pull out of the hole stinger with running DP. *Cut and bevel Casing. *Work on BOP.
5	Drilling Intermediate hole section (16’’)	*Run and cement Intermediate Casing (13’’3/8). *Interphase (16’’-12’’1/4). *Drilling Intermediate hole section (12’’1/4).
6	Interphase (12’’1/4-8’’1/2)	*Run and cement Intermediate Casing (9’’5/8). *Cut and bevel Casing. *Work on BOP.
7	Drilling Intermediate hole section (12’’ 1/4)	*Drilling Intermediate hole section (8’’1/2). *Run and cement Intermediate Casing (7’’).
8	Interphase (8’’1/2-6’’)	*Cut and bevel Casing. *Work on BOP.
9	Drilling Intermediate hole section (6’’)	*Drilling reservoir hole section (6’’). *Run and cement reservoir Casing (4’’1/2). *DST- Completion / Abandonment. *Work on well head / DTM

Table 1. Drilling operations description

These are ordinary processes that may assumed as the critical tasks, but in real conditions, Hidden operations could take places due to incidents as stack pipe, losses or fishing or additive operations as coring, change of scope or logging which may lead to significantly increase project completion time (Nasir et al., 2021; Asadimehr, 2024; Tunio et al. 2011). Generally, looking after problems occurrence and their influences is based on the value of NPT (non-production time) generated (Eren, 2018; Modak et al., 2017).

3.2. PERT (Project Evaluation and Review Technique)

PERT has been developed in 1957 by a division of US navy, in the aims to expect and manage chain of events in limited time (Wyrozębski & Wyrozębska, 2013; Yıldız, 2015). Generally, managing complex projects faces more difficulties in terms of tasks planning and operations execution. In drilling field, operations are almost similar during development operations. That's why makes a project diagram very useful to optimize the whole realization time, built a building, hospital or any infrastructure require an integrated program to clarify the goals and simplify the realization. In this work creating a pattern that organizes the various drilling works is the highest goal. Definition of the different drilling main operations, taking into account all the side operations that contribute to the success of the main processes.

In fact, looking for the critical path represents the main goal of any network model. We initially define all tasks via early/late start and end, which may give an overall estimation of the duration. Throughout the predecessor and successor technique, all chains will be arranged in a harmonious manner to form at the end the PERT diagram. The critical path is simply designed by the sum of tasks which does not increase without affecting the accomplishment time, or in other words, it is the sum of tasks that, if disrupted, delays the completion of the project.

Definition of early, normal and late in realization time.

The definitions of Early, Normal, and Late Operation clarify the situation as to what form of incentive should be applied.

Early: Regarding either the contract or the earliest similar operation.

Normal: Positioned after the end of early stage and before the beginning of Late stage.

Late: Selected either by the contract or latest operation realized.

When the operation classified in the early category, it may be selected for a possible Reward.

If the operation selected in the late class, it may be selected for a possible Punishment.

In drilling oil field, the main goal oriented toward the well realization time, which must be achieved in optimum period. The optimality necessitates an accurate time realization system, able to make judgments about whether the operation completion time is excellent, slow or generally acceptable. On this basis, the decision or judgment will be made on the quality of the work. Rewards and punishments are the two forms of incentives, which are usually provided by the group to the individuals to keep them on the right track and to utilize their capacities to the maximum.

Employee's motivation and guide represents the heart policy of any hopeful progress in the economic environment. Commonly, industrial companies' strategy oriented toward penalties rather than recompenses, which conduct employees to work in the objective to avoid consequences rather than achieve and realize good results. By leaning on the method PERT detailed above, together with the help of an optimization approach to achieve the most favorable project completion time.a definition of the objective for each level; rig/well (supervisor), few of rigs/wells (superintendent) and project. The classification of the timing intervals, starting with the best, which has the shortest completion time, to the slowest, which takes the longest. The goal will be simply the next interval in the upper side, if the arrangement is A-B-C-D and one supervisor (rig / Well) is classified as B, the goal will be to reach C. When the goal achieved or jump over to highest category the supervisor / superintendent will be rewarded. Inversely, when the crew results go down to a lower level, they will receive a sort of sanction as much as the recorded decline. Finely, when the level remains in the same place, they will be neither reward nor sanction.

3.3. Fourth industrial revolution (4IR)

Fourth industrial revolution represents the main challenge in the near future of drilling operations, surface or down hole operations are all invited to enter artificial intelligence through its wide door Castiñeira et al. (2018). Globally, there is great progress in this field, starting with the simplest surface operations and the more complex reaching the optimization-based solutions for the complicated problems Boukredera et al. (2023).

In Algeria the introduction of AI is in progress, begin by the implementation of real time together with optimization system Nour Elhouda and Khaled (2021). Sonatrach drilling area, the first step to switch into 4IR has been taken successfully, all rig records are conveyed to real time DATA collection & analysis center (Heddadi et al, 2021; Nour Elhouda & Khaled, 2021). The scope of the information collected has been expanded to include sub-processes as cementing job and other secondary operations. The next process after creating the database is to exploit it in the field of artificial intelligence. This is through the development of advanced software that enables the system to manage automatically all surface and downhole drilling operations. Currently, several researches are run to exploit the real time data in order to predict the reservoir porosity (Erinle et al., 2024; Ouladmansour et al., 2023).

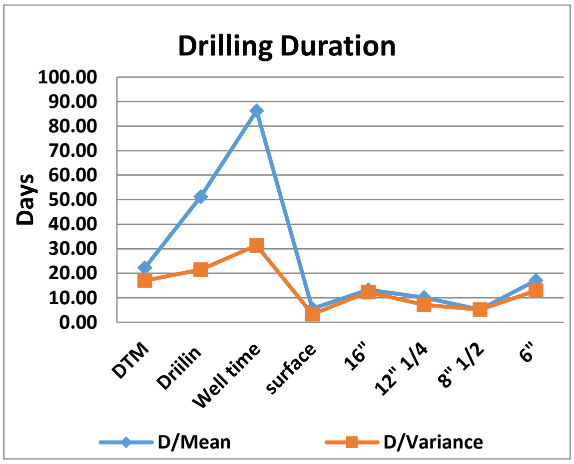
4. SIMULATION

A sample of 158 wells was analyzed to point out the main problems facing the realization of wells in Hassi Messaoud region. Operations from spud to DTM are detailed taking into count the nonproductive time generated during the realization of each operation. A statistical analysis carryout via the normal low ($N(\mu,\sigma^2)$ using the mean (μ) and standard deviation (σ, variance) as it is presented in the relation of normal density function below.

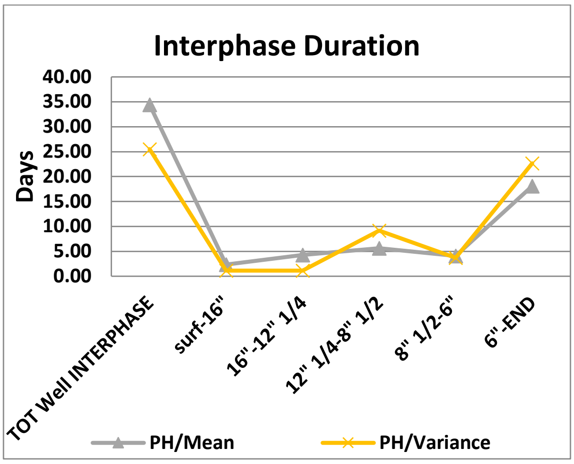
$$f(x;\mu,\sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(x-\mu)} \quad (1)$$

Generally, the variance indicates how the cases or points studied are arranged around the mean, more cases positioned close to the mean signify that the group is well sorted and inversely means not well sorted.

The simulation results for drilling and interphases sections throughout the years begin in 2000 to 2024 are presented in the figure 2.



a) Drilling duration

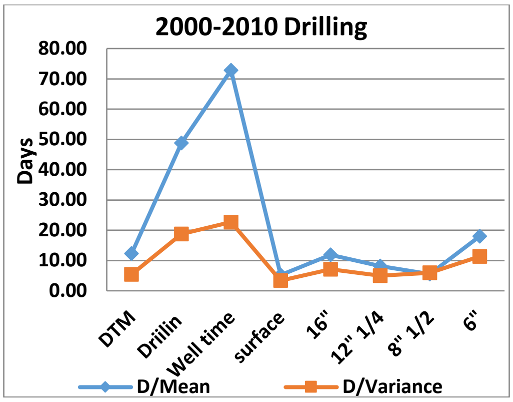


b) Interphase duration

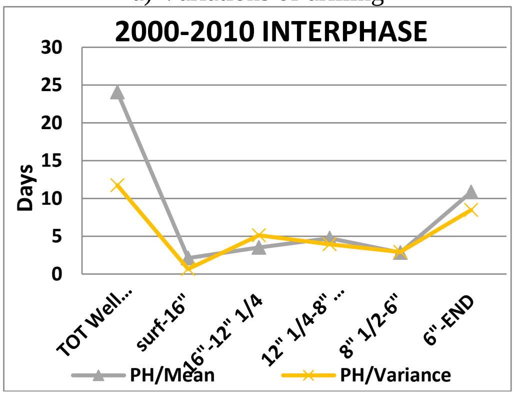
Figure 2. Presents the hole well operations duration either during drilling or interphase.

Figure 2 (a) the blue line presents the whole well mean execution time, which reach around 90 Days for the total well time; the remained values remain under 20 Days. The red line shows the variance and reach around 30 for the total well time, and the other values reach around 20 a maximum. Figure 2 (b) the gray line presents the mean value of the total well interphases, which reach 35 Days maximum, while all remaining values are almost under 5 Days except the last section when the duration rises to more than 15 Days. The yellow line presents variance variations of the group, following almost the same curve it reaches the maximum for the Total well interphase and the last section (6"-END) around 25 Days. The duration of all remaining interphases shall be less than 10 a maximum.

In order to go deeper in the investigation, a periodic analysis conducted. The selection of intervals related to convergence in terms of the achieved values, which makes them represent something like a single mass. The division will be based on the results obtained, where the first group [2000-2010]; the second group [2011-2015]; the third group [2016-2019] and the last group [2020-2024]. The figures 3, 4, 5 and 6 present the variation of total time compared to first the average and second to the variance of the normal law of drilling operations and interphase time distribution. Drilling operation /interphase time mean value presents the average value for each selected period, this gives us a general view of the time completion. Drilling operation /interphase time variance lets us know how close or far apart the values obtained for each specific time period are.

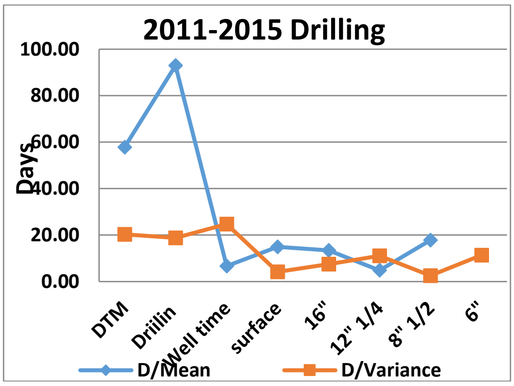


a) Variations of drilling

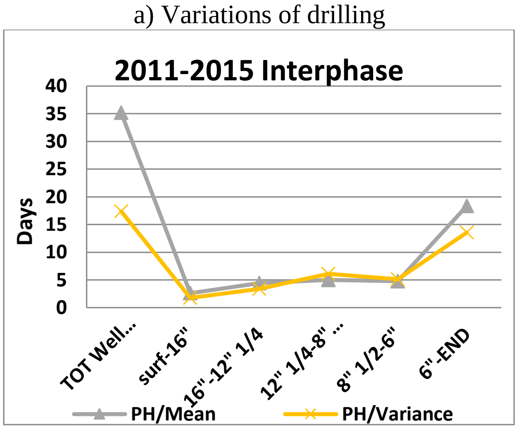


b) Variations of interphase

Figure 3. Variations of drilling/Interphase Mean and variance for the period 2000-2010.

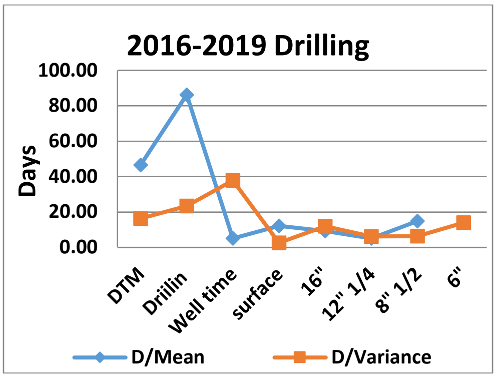


a) Variations of drilling

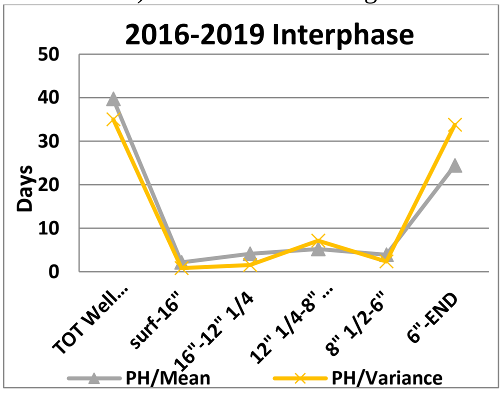


b) Variations of interphase

Figure 4. Variations of drilling/Interphase Mean and variance for the period 2011-2015.

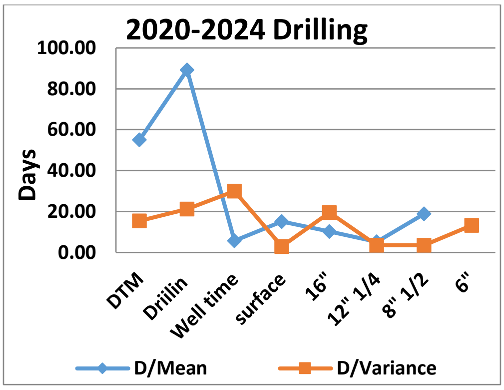


a) Variations of drilling

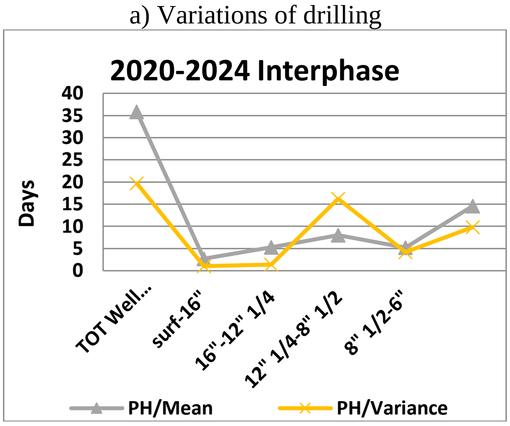


b) Variations of interphase

Figure 5. Variations of drilling/Interphase Mean and variance for the period 2016-2019.



a) Variations of drilling



b) Variations of interphase

Figure 6. Variations of drilling/Interphase Mean and variance for the period 2019-2024.

A quick look at the graphs 3; 4; 5; 6 above shows the following:

-The total well Mean time should be as low as possible in the period extending from 2000 to 2010 (around 70), and reach their max during 2011-2015 (almost 100).

- Following the same pattern, the variance goes down to the lowest level in the period from 2000 to 2010 (below 15), and reach their max during 2016-2019 (almost 35)

-The total interphase Mean time should be as low as possible in the period extend from 2000 to 2010 (around 25), and reach their max during 2016-2019 (around 40).

- Following the same pattern, the variance goes down to the lowest level in the period from 2000 to 2010 (around 20), and reach their max during 2016-2019 (almost 40)

From the above we can conclude that the general graphs Figure 2 was hiding a lot of information, which was clarified in the graphs containing the values of the segmented periods. This will help us estimate the time required to complete each stage of oil well drilling, as well as estimate the longest and shortest possible or acceptable time. This is the key and foundation of any project management process, especially in the well drilling sector, where the costs of completion reach millions of dollars in total.

On the other hand, analyzing NPT can yield significant benefits in terms of time savings and reduced implementation costs.

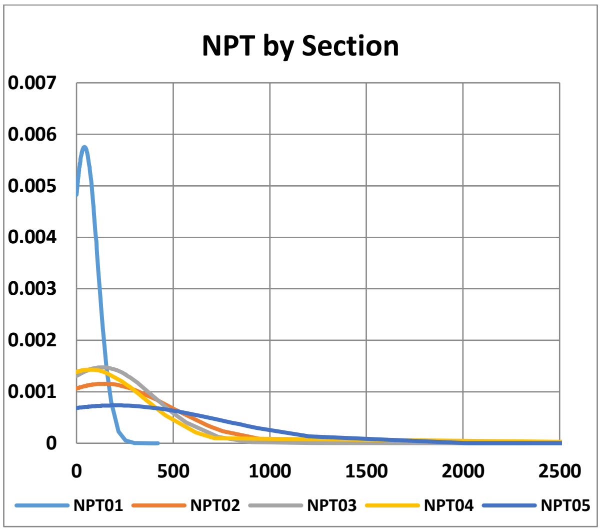


Figure 7. NPT distribution generated during drilling according to normal low.

According to Figure 7 the NPT01 generated through surface section is close to the mean value, which means that the values are nearby the optimum. The results for 16" (NPT02), 12" 1/4 (NPT03), 8" 1/2 (NPT03) are generally similar and remarkably grand orientate us to focus on to minimize the overall oil well drilling project time. With greater importance and more influences, we find 6" (NPT05) section causes more flatten Normal low graph than all the previous sections. This means that the distribution range of points around the mean value is very wide. From all of the above we conclude that except the surface section, all other sections need further scrutiny to reach the optimum execution time. Exceptionally the last section where the variance is greater, which requires special care and the imposition of a strict working method to achieve very good results at the level of project completion time.

In order to have a clear vision of how the execution times are distributed around the mean value, the normal low for each period is given below.

The selection of optimum well duration achieved after analysis of the wells and sections execution time throughout chosen periods. The shortest well duration is 43 Days and longest is 291, the time consumed to accomplish the whole operations affected by several factors as the well objective, the problems occurred…. This study orientates to deal with group of wells in different periods of time biggins from2000 to present, results are distributed on periods as 2000- 2010; 2011-2015; 2016-2019; and finely 2020-2024. Using the shortest well realization time (43 Days) will not be the accurate choice because of specificity of each well in terms of objectives, achievement factors and complications faced. Another method is used based on statistical method, using the normal low for each period of time, the mean and variance of group of wells extracted (Figure 2-6).

To achieve the model or prototypical well for selected field, a normal low will be applied for different periods. Based on the comparison of mean value together with the arrangement of population around the mean value interpreted by the variance value the analysis will carry out. The min well time among the mean well times for all periods represent the typical well for all periods and the variance gives us a general view on how the population is close to the mean.

Using only the total well time as a selection factor, the optimum well time will be 86.28 Days and the variance is 31.38. Going deeper searching for model well throughout periods will leads to a model with total time of 72.83 Days and variance of 22.69 found in the interval 2000-2010. To achieve the typical well via sections selection strategy the tables 2, 3 will give the optimal value of the mean and variance through periods and for different sections.

First drilling phases

Optimal	**DTM**	**Surface**	**16"**	**12" 1/4**	**8" 1/2**	**6"**	**Total time (Days)**
Mean (Days)	12.30	5.07	11.83	8.19	4.82	14.86	**32.47 (44.77: with DTM included)**
Variance	5.45	2.59	7.06	4.99	2.56	13.99	

Table 2. Drilling operation execution time

Second the interphases

Optimal	**Surf to 16"**	**16"-12" 1/4**	**12" 1/4-8" 1/2**	**8" 1/2-6"**	**6" to End**	**Total time (Days)**
Mean (Days)	2.11	3.53	4.72	2.83	10.86	**24.05**
Variance	0.66	5.14	3.93	2.94	8.48	

Table 3. Interphase realization time

As it presented in the total time for both drilling and interphase, the new well optimal time is the sum of the two results, which will equal to **68.82** Days without including the DTM and **81.12** Days as DTM included.

This the perfect results, which mean without taking into count the influence of nonproductive time (NPT). The global mean total NPT for both drilling and interphase is **32,26** Days, which is a remarkably greater and should be reduced. To go deeper in this analysis a detailed investigation via section results will carry out.

The results of analysis of NPT by section and periods presented in the Table 4.

First drilling and interphase

NPT	**Surface (hrs)**	**16"(hrs)**	**12" 1/4(hrs)**	**8" 1/2(hrs)**	**6" to End(hrs)**	**TOT Days**
Min (mean)	**1,48**	**5,8**	**8,35**	**1,15**	**16,66**	**1.4**

Table 4. Non production time duration

Compared to the NPT generated by means of global wells (**32.26** Days) which engender a very long mean well time of **113,38** Days, the new assumption uses the minimum of the mean value among periods which gives **1.4** Day NPT and leads to mean well time of **82.52** Days (70.22Days with DTM not included). Following almost the same way of calculation to attain Tasks time of PERT method as it mentioned in table 5. The earliest and latest times calculate using the variance that gives the greatest density of the probability around the mean.

Operations approximation time and tasks that preceded.

Operations	**Tasks that preceded**	**Earliest time**	**Most Likely time**	**Latest time**	**NPT (Hrs)**
A-DTM	-	6.85	12.30	17.75	-
B-Spud (Surface)	A	2.48	5.07	7.66	1.48
C- INT: Surf to 16"	B	1.45	2.11	2.77	
D- Drilling 16"	A; B	4.77	11.83	18.89	5.8
E-INT: 16"-12" 1/4	D	2.17	3.53	4.89	
F- Drilling 12"1/4	E; D	4.68	8.19	11.7	8.35
G-INT: 12" 1/4-8" 1/2	F	0.79	4.72	8.65	
H- Drilling 8"1/2	G; F	2.26	4.82	7.38	1.14
I- INT: 8" 1/2-6"	H	0.5	2.83	5.16	
J- Drilling 6"	I; H	3.51	14.86	26.21	16.67
K-INT: 6" to End	J	2.38	10.86	19.34	
Total Project time	-	31.84	81.12	130.4	33.44
Project Time – DTM		24.99	68.82	112.65	33.44

Table 5. Drilling operation description and time realization estimation.

Valuing drilling work in terms of results concerning section, well or project (group of wells) is a difficult matter See Appendix Table **A- Drilling operations with DTM included evaluation** and Appendix Table **B- Drilling operations with DTM non-included evaluation**. The main goal of the modified PERT study focuses on the extract of model that used to evaluate all wells belonging to the same field See appendix **Figure C-Drilling operations pay charts with and without DTM included evaluation,** and Appendix Table **D- Evaluation of drilling operations per well.**

In order to go further in research and analysis, we call the statistical examination method called PARETO. The PARETO law or 80/20 law is simply states that 20% of operations consume 80% of the budget Persky (1992). This principal is used to analysis any distribution in order to pinpoint toward the essential or important sections, which we should focus on.

The table 6(a) below contains the mean value of operations held during the completely well life. The table 6(b) contains a redistribution of numbers in accordance with the needs of the crisis to extract the graph or statistic according to the PARETO law or 80/20 law.

N°	Duration
Surface	19,64
26" &interphase	5,02
16" Drilling	13,38
12" 1/4 Drilling	10,18
8" 1/2 Drilling	5,19
6" Drilling	17,11

a) Mean value of operations held during the completely well life

N°	Descending	cumulative	Cost (million)	cumulative Cost	% cumulative
1	19,64	19,64	0,5892	0,5892	27,85
2	17,11	36,75	0,5133	1,1025	52,11
3	13,38	50,13	0,4014	1,5039	71,09
4	10,18	60,31	0,3054	1,8093	85,52
5	5,19	65,5	0,1557	1,965	92,88
6	5,02	70,52	0,1506	2,1156	100,00

b) Redistribution of numbers in accordance with the needs of the crisis to extract the graph or statistic according to the PARETO law or 80/20 law.

Table 6. Drilling operations arrangement according to PARETO distribution

The table 7(a) below contains the mean value of NPT occurred during the whole well life. The table 7(b) contains a redistribution of NPT's in accordance with the needs of the crisis to extract the graph or statistic according to the PARETO law or 80/20 law.

N°	NPT
26" & Surface	42,87
16" Drilling	143,95
12" 1/4 Drilling	134,48
8" 1/2 Drilling	72,04
6" Drilling	211,22

a) Mean value of NPT occurred during the whole well life

N°	Descending order	cumulative	Cost	cumulative cost	% cumulative
1	211,22	211,22	264025	264025	34,94
2	143,95	355,17	179937,5	443962,5	58,75
3	134,48	489,65	168100	612062,5	80,99
4	72,04	561,69	90050	702112,5	92,91
5	42,87	604,56	53587,5	755700	100

b) Redistribution of NPT's in accordance with the needs of the crisis to extract the graph or statistic according to the PARETO law or 80/20 law.

Table 7. Non production time arrangement according to PARETO distribution.

Finley, the figures 8 and 9 illustrate the general appearance of the PARETO law, which leads us to the main points that we must focus on to either reduce the well realization time or minimize the non-productive time (NPT).

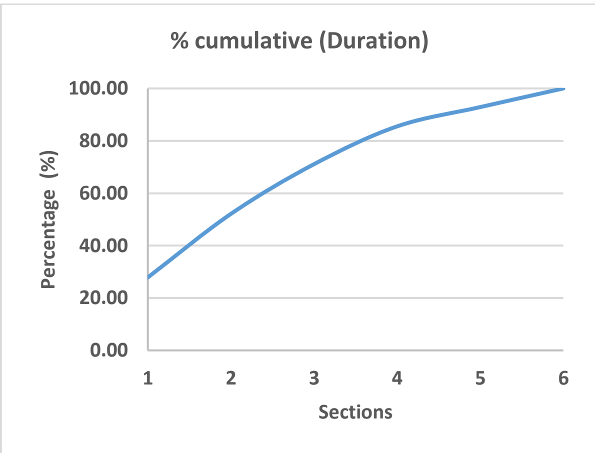


Figure 8. Drilling operations PARETO low

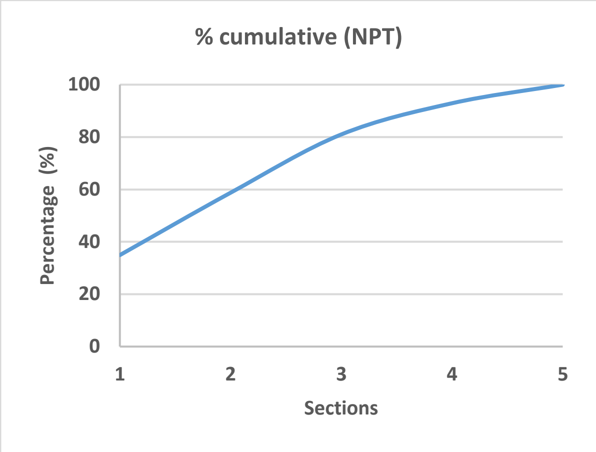


Figure 9. Non production time PARETO low

As it is clearly mentioned, in drilling operations the largest amount of time, approximately 80%, is consumed in three stages: surface, 6" section and 16"section Figure 8. Regarding NPT's, 6" section, 16" section and 12" 1/4 section generate around 80% of the total well lost time Figure 9.

The combination of engineering organization proposed with the PERT operation planning method, used to enhance project performance in terms of problems analysis and effective realization time See Appendix, Figure **E- Drilling project management via PERT diagram**. PARETO law used to analyze the extracted data in order to identify areas of deficiency that must addressed in order to accelerate the rate of well accomplishment.

5. CONCLUSION

Drilling project management practices have become essential tools for enhancing service quality, ensuring continuous improvement, and maintaining competitive advantage. In this study, the engineering organization segments are presented and detailed with cases studies to present the advantages of tasks distribution and risks analysis. PERT project planning established based on over than hundred wells in order to extract the overall project time and estimate the short or objective for each section. A global PERT diagram including different time limits, presenting maximum and minimum running time for each job. The elaboration of an evaluation system to classify operations execution time based on reference model achieved.

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Appendix

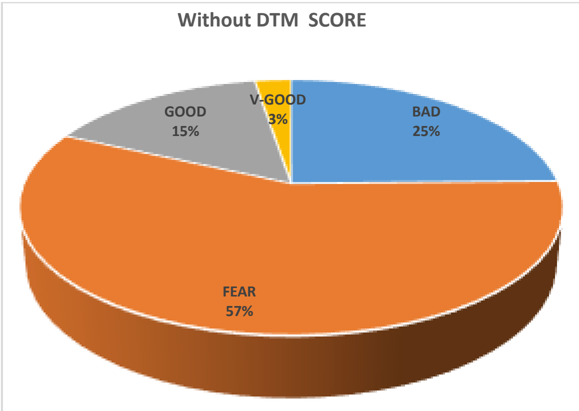
-A- Drilling operations with DTM included evaluation

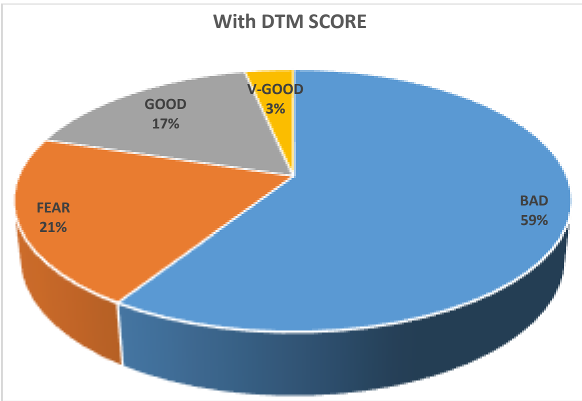
evaluation scale	Evaluatio With DTM					
Section/ collor	1	2	3	4	5	6
A-DTM	x<6,85	/	6,85<x<12,3		12,3< x<17,75	x>17,75
SB-pud	x<9,33	9,33<x<11,92	11,92<x<17,37	17,37<x<22,82	22,82<x<25,41	x>25,41
Surf-16"	x<10,78	10,78<x<14,03	14,03<x<19,48	19,48<x<24,93	24,93<x<28,18	x>28,18
16"drill	x<15,55	15,55<x<25,86	25,86<x<31,31	31,31<x<36,76	36,76<x<47,07	x>47,07
16"-12 1/4INT	x<17,47	17,47<x<29,39	29,39<x<34,84	34,84<x<40,29	40,29<x<52,21	x>52,21
12 1/4Drll	x<20,67	20,67<x<37,58	37,58<x<43,03	43,03<x<48,48	48,48<x<65,39	x>65,39
12 1/4-8 1/2INT	x<21,46	21,46<x<42,3	42,3<x<45,75	45,75<x<53,2	53,2<x<74,04	x>74,04
8 1/2Drill	x<23,72	23,72<x<47,12	47,12<x<52,57	52,57<x<58,02	58,02<x<81,42	x>81,42
8 1/2-6"INT	x<26,44	26,44<x<49,95	49,95<x<55,4	55,4<x<60,85	60,85<x<84,36	x>84,36
6"Drill	x<27,31	27,31<x<64,81	64,81<x<70,26	70,26<x<75,71	75,71<x<113,21	x>113,21
6"-to End	x<29,69	29,69<x<75,67	75,67<x<81,12	81,12<x<86,57	86,57<x<132,55	x>132,55

-B- Drilling operations with DTM non-included evaluation

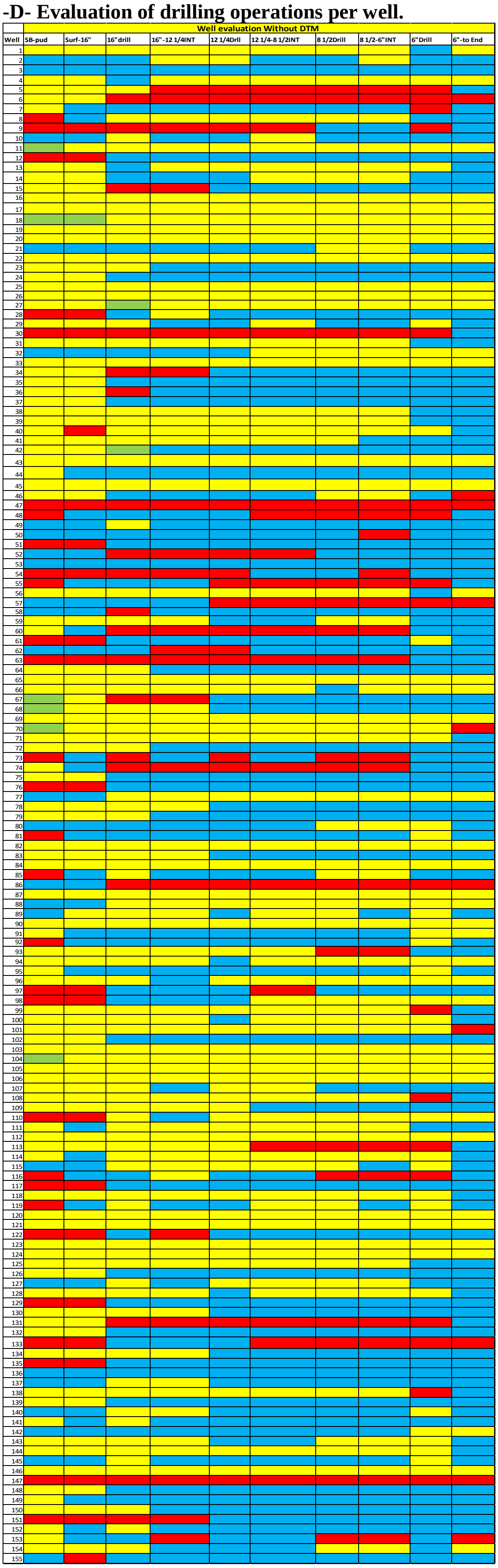
EvaluationWO-DTM				
Section/collor	1	2	3	4
SB-pud	x<2,48	2,48<x<5,07	5,07<x<7,66	x>7,66
Surf-16"	x<3,93	3,93<x<7,18	7,81<x<10,43	x>10,43
16"drill	x<8,7	8,7<x<19,01	19,01<x<29,32	x>29,32
16"-12 1/4INT	x<10,62	10,62<x<22,54	22,54<x<34,46	x>34,46
12 1/4Drll	x<13,82	13,82<x<30,73	30,73<x<47,64	x>47,64
12 1/4-8 1/2INT	x<14,61	14,61<x<35,45	35,45<x<56,29	x>56,29
8 1/2Drill	x<16,87	16,87<x<40,27	40,27<x<63,67	x>63,67
8 1/2-6"INT	x<19,59	19,59<x<43,1	43,1<x<66,61	x>66,61
6"Drill	x<20,46	20,46<x<57,96	57,96<x<95,46	x>95,46
6"-to End	x<22,84	22,84<x<68,82	68,82<x<114,8	x>114,8

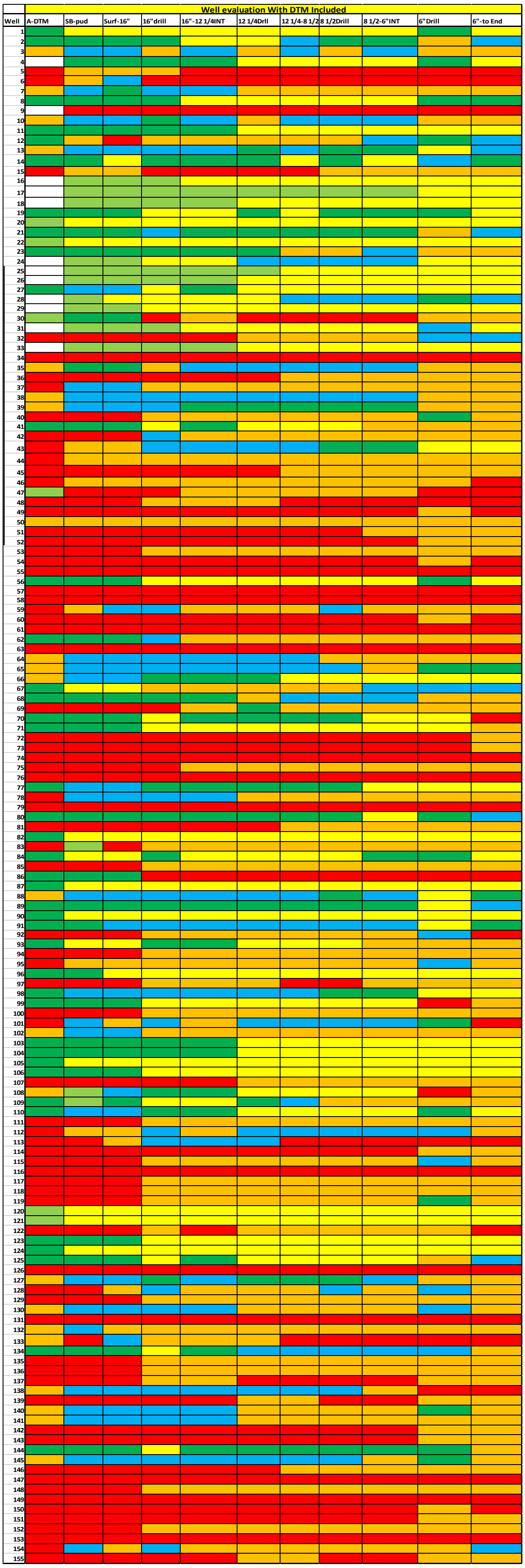
-C- Drilling operations pay charts with and without DTM included evaluation





-D- Evaluation of drilling operations per well.





E- Drilling project management via PERT diagram