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Value Engineering to Achieve Low Drilling Cost

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Abstract

After more than a century of fossil energy exploitation, the oil and gas industry is nowadays facing challenging period. There are unstable oil price evolution and only difficult & small-marginal reserves left to be developed.

Nevertheless, due to still high energy demand, a systematic structured breakthrough must be initiated to respond to this industrial volatile environment. One of the approaches is value engineering to lower down oilfield project cost. The foremost target is the reduction on drilling cost, knowing that this cost represents a significant portion, around fifty percent, of the oilfield development expenditure.

Value engineering identifies and eliminates unwanted costs/ operations, while continuing to improve the quality, safety and performance. By doing this, it could generate lower drilling cost and allows field development becoming profitable.

Drilling duration of 4000m Mahakam wells, improved from 24 to 15 days, is an example of utilizing the value engineering approach.

The value engineering methodology is divided into three steps job plan: identify opportunities, evaluate and then implement a new concept. In general, after analyzing and identifying unsatisfactory performance, brainstorming session should be carried out to capture new ideas. All ideas are evaluated, followed by the best ideas/ alternatives selection for further development. The best beneficial ideas are then implemented.

To give a maximum benefit, this value engineering has to be performed continuously, involving crossed-functional and experienced team. Successful value engineering could be indicated by having high performance culture among the team member such as: competent personnel, continue improving the efficiency, keep innovating, maintaining synergy and collaboration with others, and profitable growth.

Keywords: Push to the Limit, Industrialization, Best Composite, Brainstorming, Value Engineering, Zero Base Analysis

1. Introduction

Since the early 80's, the beginning of drilling operations in Mahakam, a tremendous work has been done to reduce the overall well construction cost without jeopardizing the operations safety and the wells productivity. The fundamental concept developed to achieve agreed target was the continuous improvement of overall well delivery process, the main leverages being the implementation of innovative well architectures, technology and the optimization of all operations using a statistical approach.

Cost in drilling operations mean/ correspond to the well duration or verso-versa.

Today, the average well duration Mahakam field is around 30% of well duration in the early 80's. The success of well construction performance improvement project lays in a

tailored innovative methodology and the performance culture implemented within the entire team.

2. Performance Improvement History

2.1. Well Design Optimization

At the beginning of Mahakam development, drilling performance and cost optimization was driven by well design optimization. Until late 90's, a heavy well architecture was systematically applied, characterized by utilization of liner and multiple production packers gave an average of 35 days well duration. The introduction of slimhole-tubingless allowed importance step change: slim well reduced well cost associated to consumable and steel utilization, whilst tubingless completion reduce the overall well duration, thanks to the cancellation of liner and production packers.

Design and operation simplifications are key in the well construction performance enhancement.

2.2. Push to the Limit

In early 2000, a well construction performance management was developed based on the technical limit concept which represent the time that would be required to carry out an operation without Non Productive Time (NPT) or trouble time, without delays, without mistakes and inefficiencies. It is what could be achieved in a flawless operation, with the best possible team available (both in term of manning and competency), the best preparation (time, engineering, procedures, training, etc) and the best technology available.

For a specific operation, the concept main purpose is to set a duration target do the team and a process to be followed in order to optimize the operation duration and come closer to the defined budget.

The continuous improvement process is based on 'improvement wheel' in the earliest organizational model, which consist of:

- Look for opportunity to improve
- Take reasonable risks
- Build on success
- Make sure to learn from mistakes

Although the above process fall under common sense, learning as an organization has proven to be much more difficult than learning as an individual. The improvement wheel cycle has helped organizations to take a rigorous approach in an attempt to structure, to standardize the process and to achieve more consistent results.

2.3. Best Composite and Industrialization

During 2005-2009 period, the concept of industrialization of Mahakam operations was introduced. The need of industrialization was felt necessary with the increasing well number to be delivered in an environment where the overall operation cost had to be optimized. This new approach was conducted on the overall well construction loop: geosciences, drilling, production, construction, planning, supply chain, logistics etc. All entities participating to the well delivery were challenged to review their internal working process.

The results associated to this initiative were excellent since the average well duration dropped to 24 days average in 2009. During this period, a huge performance database was built and a knowledge management system was implemented. The overall well duration decrease was partly linked to the robust technological improvement on drilling bits and directional drilling tools. Where a minimum of two bits we required in 2000 to drill the intermediate and final sections, the

one bit run per section was consistently achieved after 2005.

3. Value Engineering

By the end of 2009, the well construction performance level seemed to reach its limits. Despite of the continuous improvement process, a new process was felt necessary to bring up the operation excellence a step further.

The first wave of Value Engineering was launched in 2009. It is an organized approach to capture and analyze any "out-of-the-box" ideas allowing well cost/ duration reduction.

In brief, it was structured into three steps:

- Capture the opportunities/ ideas
- Evaluation
- Implementation

A brainstorming session involving drilling contractors and all service companies was organized. The main objective was to gather technical ideas to be implemented in order to reach the overall well duration target beyond 18 days.

Interesting technical outcomes were discussed and studied, sometime with assistance from related service company before fully implemented.

Although required more detail study and taken longer preparation, the result was very satisfied. The average well duration reduced from 24 days/well to 15 days/well in 2013. This well duration optimization was realized due to the maximizing hidden/ offline operations during batch drilling such as: offline cementation, offline X-mass tree installation, WOC without diverter in place, etc.

Beside successful value engineering process, two aspects also contributing to Mahakam continues improvement cycle are longterm partnership and performance culture.

3.1. Longterm Partnership

The contractual strategy to drilling contractors and service companies plays an important role, i.e. systematically maximizes the contract duration depending on the stakes associated to the provided service or the foreseen workload. Detailed and accurate performance targets are set in our contract to protect us from unsatisfactory results. A longterm partnership fosters mutual trust and respect between company and its contractors.

3.2. Performance Culture

The success of a performance improvement project lays in the mindset of the personnel involved in the operation preparation and execution. A performance culture has to be developed within the team so that the overall group behavior permanently considers the performance at planning and execution stages.

At execution stage, a slightly difference remains in case the operation deviates from the original plan, a proper management of changes has to be set and respected to avoid any decision potentially compromising the operation safety.

This performance culture must be endorsed by all company, contractor and service companies personnel.

The entire team needs to take full responsibilities of the commitments and achievements. The performance culture will then help the team to build on successes by delivering as per commitment so that self-motivation is enhanced.

4. Zero-Based Analysis Value Engineering

Combination of unstable oil price and only small-marginal reserves left to be developed in most of oilfield nowadays requires

excessive cost reduction to make the project becoming economic.

The second wave of Value Engineering using Zero-Based analysis approach may overcome this challenge.

It is an organized creative approach which proposes the efficient identification of unnecessary cost (or operation), i.e. cost providing neither quality, nor function, nor appearance.

4.1. Methodology

Zero-based philosophy is to identify the most costly functions, then scouting implementing a creative solution to improve its functions.

A formalized method is started with the critical functions selection (pareto), to quantify value and to analyze benefits to costs. Once targeted functions selected, alternative solution has to be discussed/ proposed and to focus on this action. Further exercise can be organized for the second priority functions.

Step-by-step are as follows,

1. Information Gathering Step
   - What functions are being provided?
   - What do the functions cost?
   - What are the functions worth?
   - What functions must be accomplished?
2. Creativity & Idea Generation
   - What else will perform the function?
   - How else may the function be performed?
3. Analyze Ideas/Evaluation & Selection
   - Will each idea perform the required functions?
   - How might each idea be made to work?
4. Development of Proposal
   - How will the new idea work?
   - Will it meet all the requirements?
   - How much will it cost?
5. Presentation/ implementation & Follow-up
   - Why is the new idea better?
   - Who must be sold on the idea?
   - What are the pros/ cons and specific benefits!
   - What is needed to implement the proposal?

4.2. Zero-Base VE Study Case

Zero-Base analysis was experienced on an onshore development including a total of 541 wells (358 oil producers plus 183 water injectors) which were distributed on 73 well pads.

The project was initially budgeted up to $7.7 billion and considered not 'flying'.

This methodology was successfully applied to identify $1.56 billion of theoretical Zero-Based opportunity as the first priority, mainly coming from several areas: well pads, wells and surface network.

Meanwhile the second priority of 8 remaining opportunities with a total of $1.1 billion in theoretical Zero-Based opportunity, could be exercised to later.

Area	Total CAPEX ($MM)	Theoretical Zero-Based Opportunity ($MM)	Opportunity / Group	Zero-Based theoretical opportunity ($MM)[3]	Target realisation ($MM)
Wells	1470	670	Surface and Sub-surface sand management and fouling	180	
			Pad layout & civil	200	
Pads	1266	570	Well labour	136	Target realisations TBD
			Injection pipeline fouling	100	
Gathering Network	291	120	Well pattern (sub-surface)	130	
			Alternatives for MPFMs at every pad	44	
Production Economics		206[4]	OD1/2/3	101	
			Production economics (Wells, Pads & Gathering)	215[4]	
	Tota	1566	Tota	1106	

5. Conclusion

Value engineering contributes significantly on improving performance and well economic. It also encourages team member to think, to use their creativity abilities, to effectively communicate with each other and improving the profitability of the company.

On Mahakam case, the drilling performance improvement is more than ever the stake to be considered of the essential of field development. The excellent achievements obtained until 2009 by implementation of a robust performance management system. In 2010, a new approach had to be considered to push furthermore the operation excellence by adopting value engineering concept to organization. Today, although the well construction achievements are outstanding, the challenges require more aggressive cost reduction approach. Zero-Based value engineering maybe exercised.

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7. References

[1] Fata Yunus, Tunu-18 Project: Ideas Screening and Feedback, Technical Report, 2009.

[2] Samir Oumer et al., Outstanding Well Construction Industrialization Bringing Tunu Field Production to New Perspectives, SPE 164163 (2013)

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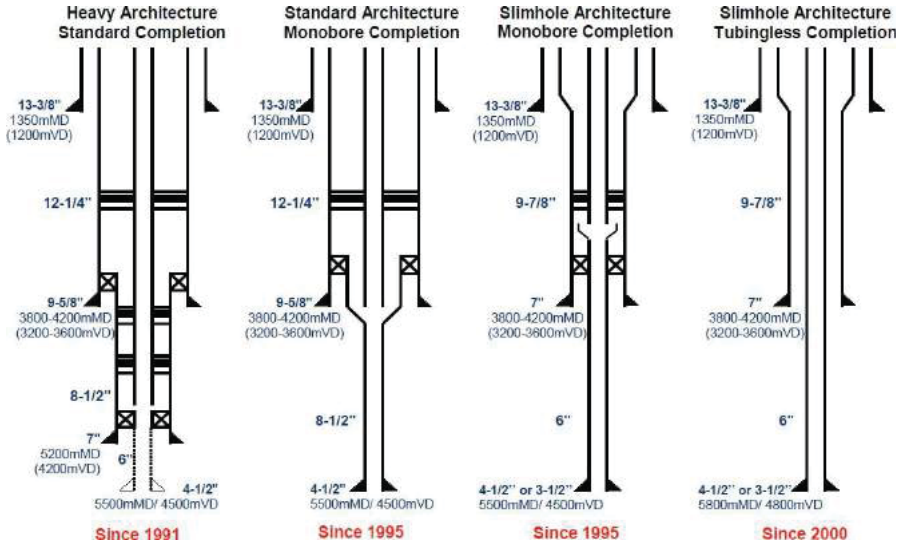

Figure 1. Mahakam Well Architecture

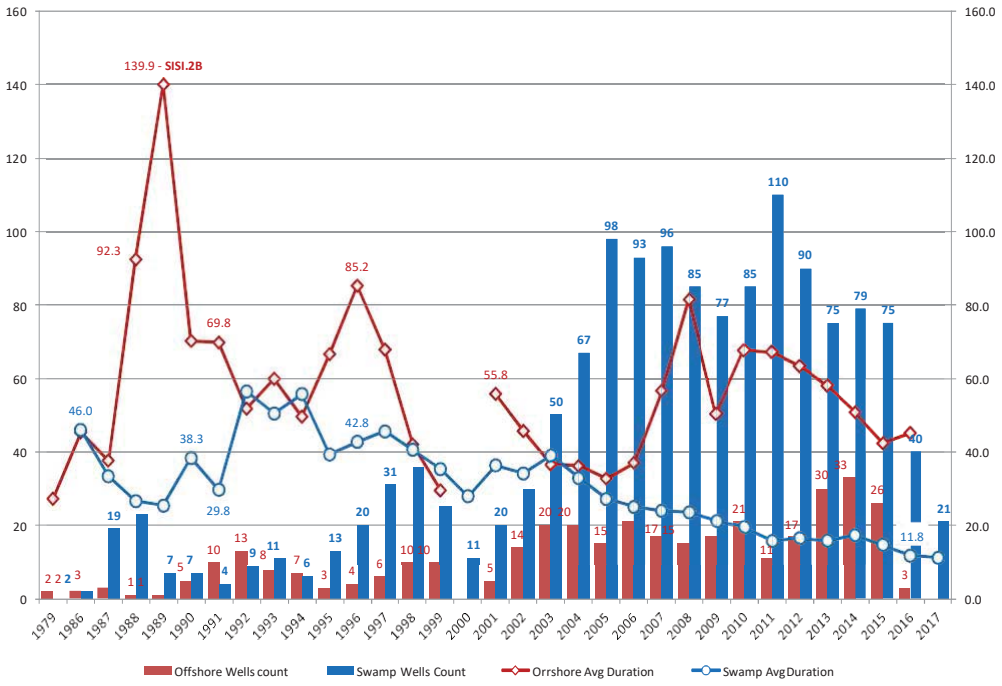

Figure 2. Mahakam Well Duration Evolution

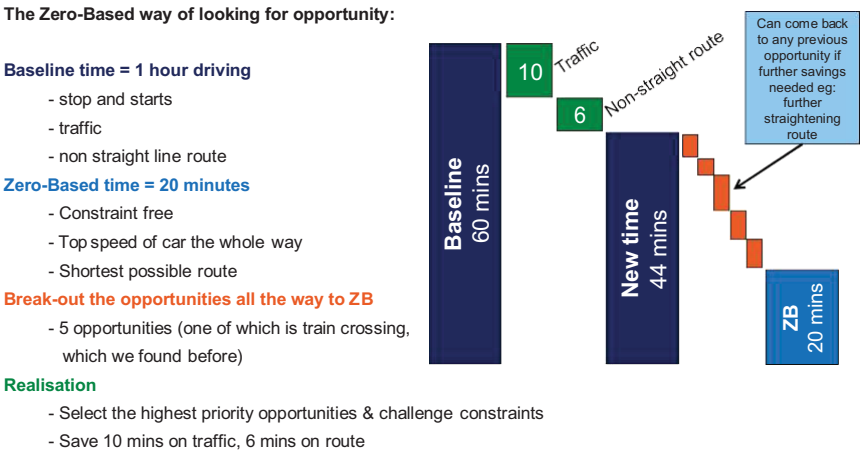

Figure 3. Zero-Base Value Enginering Philosophy – *An Example*

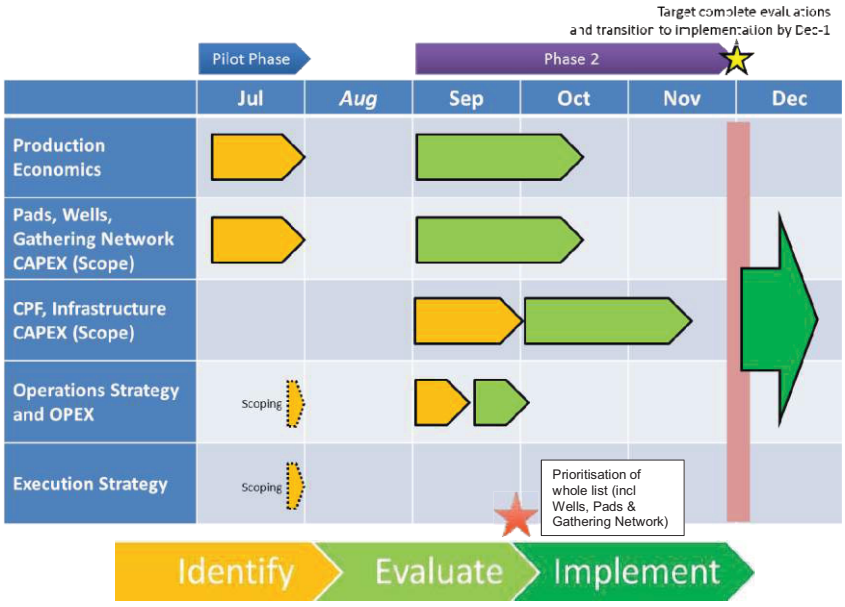

Figure 4. Zero-Base Value Enginering Plan (Typical)

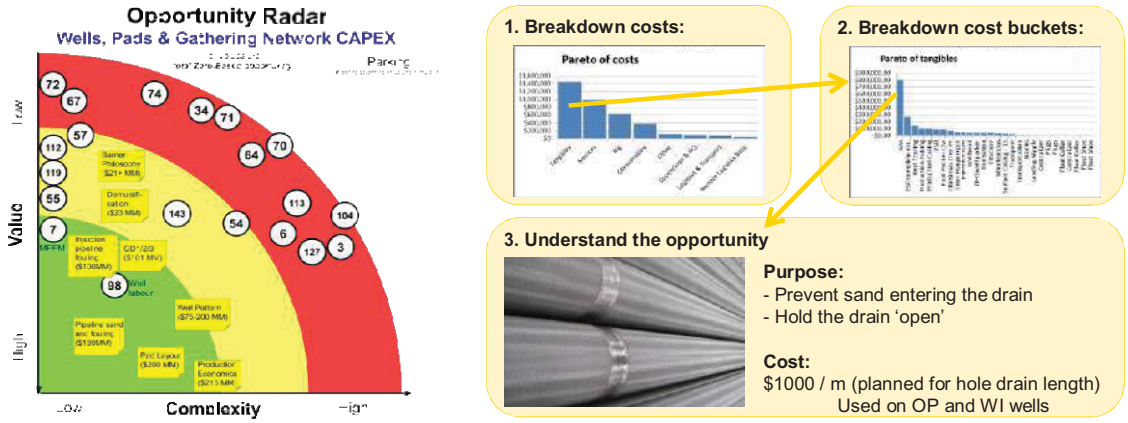

Figure 5. Example of Opprtunity from Wells

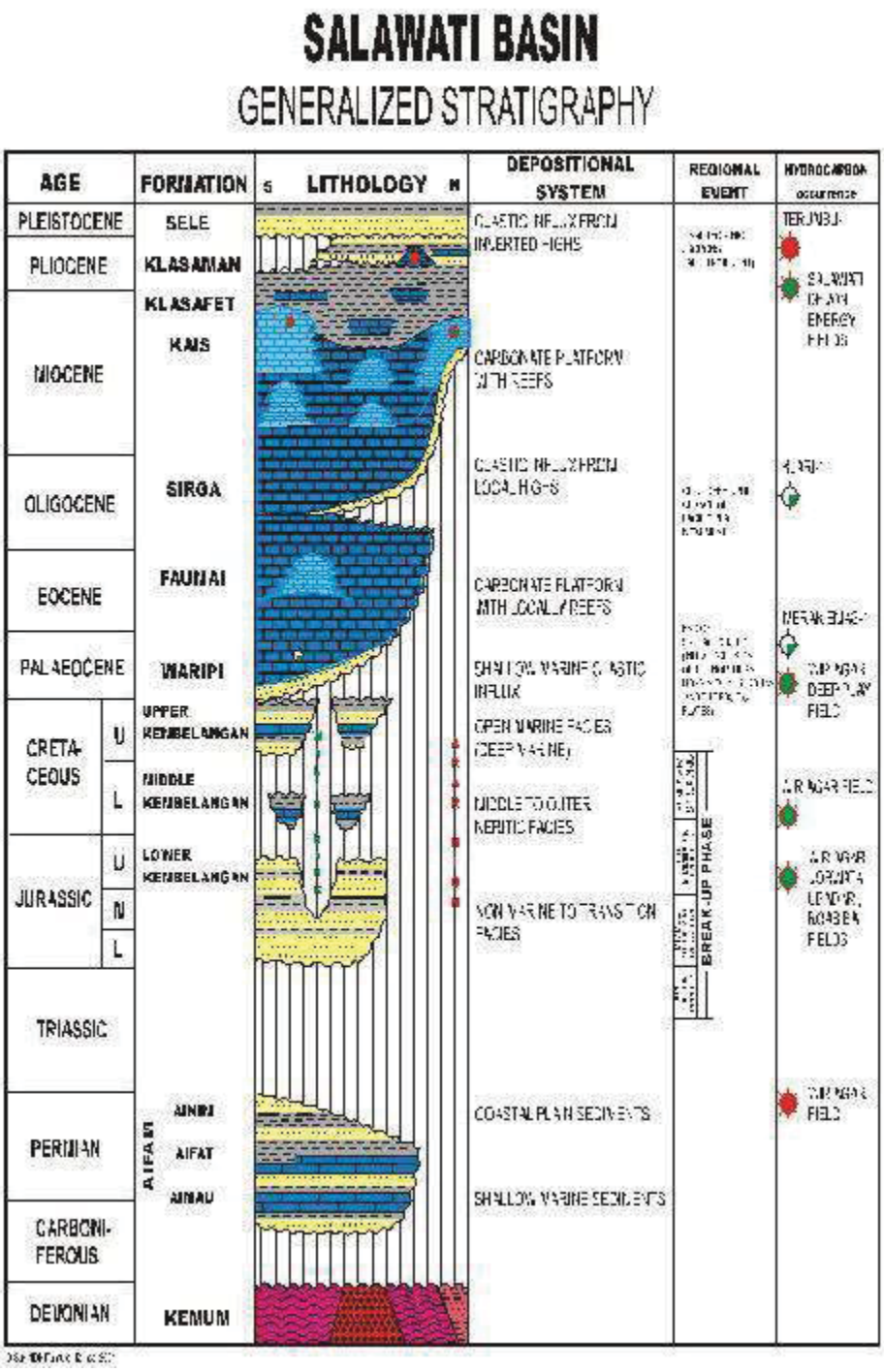

Figure 4 Well X-25 Stratigraphy