Application of Big Data Analysis and Deep Neural Network for Oil and Gas Production Enhancement

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Abstract

Most of Indonesia's major oil field are now entering marginal phase, characterized by lower production rate and rising number of production complications. Performing reservoir simulation in marginal field is not an effective way to increase production, as a lot of efforts has to be dedicated in matching reservoir performance with various attempts done in the wells, such as well stimulation, reperforation etc. Therefore, the abundance of data previously recorded during lifetime of wells in marginal field can be used as an asset to lift production without having to resort to resource-hungry reservoir simulation.

This research is based on an idea that a big cache of data from lifetime of a field can be analyzed using machine learning and deep neural network to pinpoint well problems, determine cause and effects of a certain treatment to a particular well, and mine valuable information from daily reports and other engineering related reports. The algorithm is first trained to recognize language input from reports, where for older wells many types of languages and idioms exist and has to be properly recognized. The second step is recognizing well problems based on diagrams or treatments, and the last step is determining clusterization or categorization of wells based on problems and estimation of productivity increase after treatment by engineers. It is hoped that this approach can be a solution to improve productivity of marginal fields without having to perform lengthy periods of trial and error in conventional reservoir simulation.

Introduction

PT Pertamina EP is a company that organizes business activities in the upstream sector of the oil and gas sector, covering exploration and exploitation. In addition, Pertamina EP also carries out other supporting business activities that directly or indirectly support the main business activities.

One way to increase Pertamina EP's production in 2018 is by drilling 83 development wells and 146 work over wells. To add to the other possibilities of the 146 work over wells, various other well candidates can be searched which can be enhanced by their ability to produce, by:
• Design smart systems for analysis of increasing oil and gas production at Pertamina EP
• Building Data Base for Pertamina EP's oil and gas production operations
• Analysis of the success and failure of Pertamina EP oil and gas production operations (Regionation)
• Recommendation on Pertamina EP's oil and gas production operations

Pertamina EP will implement 2 (two) pilot projects with machine learning-based software to provide solutions to Oil fields in Asset 3, namely

♣ Forgotten Oil Asset 3
Oil that has not been exploited due to technological limitations and economic past
♣ Fast & Intermediate Oil Analysis for Jatibarang Field
Analysis of production problems and efforts to optimize existing assets

Increasing well production and reactivating wells is an effort to increase company profits relatively easily with relatively low and fast costs. The FISH classification will provide stimulus to Pertamina EP in preparing an intervention plan to increase production in 2018 through Fast Oil, 2019 through Intermediate Oil, and 2020 through Slow Oil, with the FISH classification diagram as follows
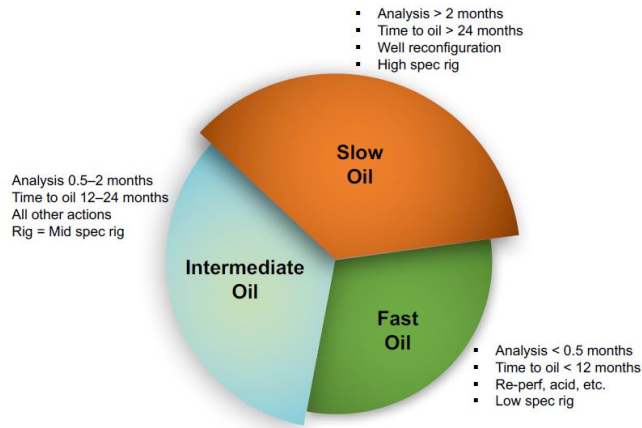
Figure 1 FISH Hydrocarbon Classification

Data and Method

The table below explains and describes the data needed to carry out the analysis in order to increase the acquisition in the Asset 3 field, i.e.

Table 1 Data Requirement for Fast Oil Analysis

No	Project	Data Requirement
1	*Fast Oil*	• *Mud log* and *cutting description* • *end of well report (well schematic)* • Petrophysics report • Drilling mud data & daily drilling report • Reservoir fluid report Well-based data: 1. Well log data • *Well tops* dan *markers* 2. Well deviation data

In contrast to other technical processes, Fast Oil is an effort by the LAPI ITB team to reopen the information and knowledge gathered by the Pertamina EP Asset 3 team collected in document form. The ability of Deep Search software in reading and studying information contextually which is assisted by input data from Pertamina EP Asset 3 and subsequently included in various categories prepared by the LAPI ITB team. This information will then be examined together with both parties to ensure that the data obtained is relevant and the well priorities will be established or problems that

will be addressed early, require further study or technically and non-technical alterations are no longer capable The working mechanism of the Fast Oil process can be summarized in the following pictures.
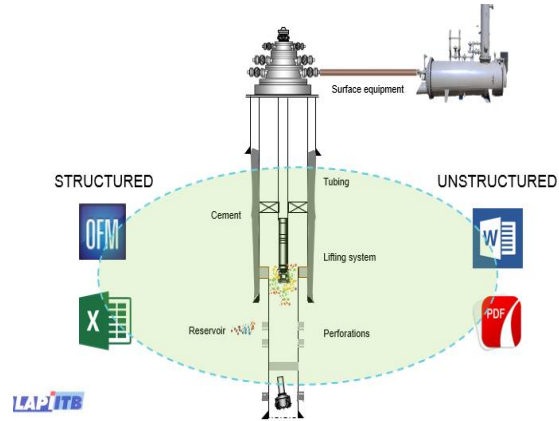

Figure 2 Data Structure for Fast Oil Analysis

As shown in figure 2, fast oil analysis is done by compiling a database consisting of MS Excel, Word, and PDF files which will be re-examined using the OFM database which is a general benchmark in the oil and gas industry. The initial data obtained will be modified in the form of OCR so that it becomes a form of data that is recognized by the machine. Then the data is processed using a machine learning and contextual search approach which can be seen in Figures 3 and 4.
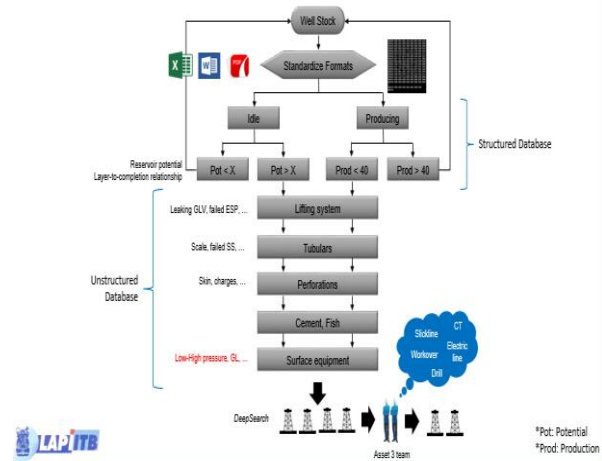

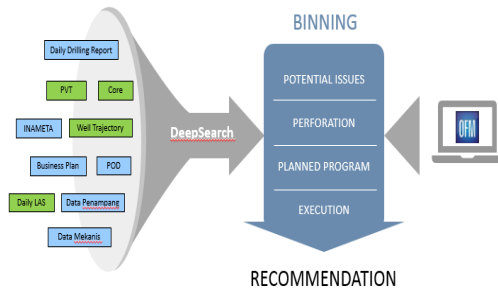Figure 3 Deep Search Candidate Process

Figure 4 Deep Search Workflow

Result and Discussion

Based on the data provided by Pertamina Asset 3, there are 38 structures in Jatibarang that have 474 wells with 168 wells producing wells, 38 well injection wells, and 268 wells that have not yet been produced and closed. The following table summarizes the status of the wells.

Table 2 Final Data Extraction from JTB Field

			Jumlah Sumur	Jumlah Field JTB
Sumur Penghasil	Sembur Alam	Minyak	12	168
		Gas	53	
	Sembur Buatan	ESP	34	
		HPU	2	
		GLV	67	
Sumur Injeksi		Aktif	28	
		Non-Aktif	10	
Sumur Tidak/Belum Menghasilkan/Ditutup		Ditinggalkan	26	306
		Pengamatan	12	
		Ditangguhkan	3	
		Tunggu Fas. Prod	8	
		Lain-lain	219	

DeepSearch will collect information with contextual searches based on words that can be a clue to problems in a well. Contextual searches conducted by DeepSearch require very fast time with only a matter of less than 5 minutes information about problems in the well can be given. The results of the information issued by DeepSearch will help the Engineer's work in determining the candidate wells to be selected to increase the production of the well. The following is an illustration of how

DeepSearch works and helps Engineers in their work to find candidates for wells.
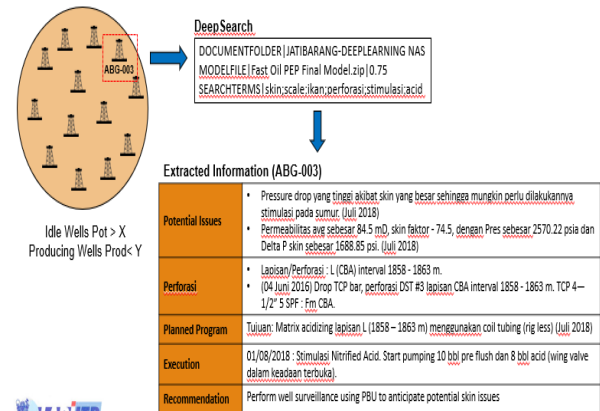

Figure 5 Deep Search Demo

After further research using the deep search and contextual search of 50,000 documents obtained from the archive of Pertamina EP Asset 3 (INAMETA) and data from OFM software, the LAPI ITB Team obtained candidates for the well for "Fast Oil" reviewed by Pertamina Asset 3 Team consists of 58 wells with the following well details:

Table 3 Final Well Classification

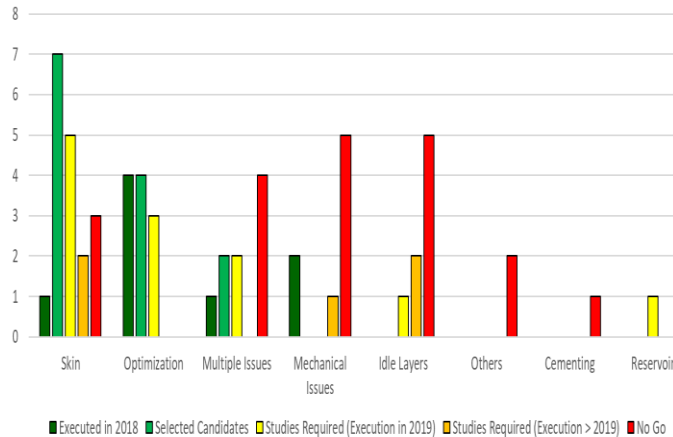| Categories	No. of Wells
Executed in 2018	8
Selected Candidates	13
Studies Required (Execution in 2019)	12
Studies Required (Execution > 2019)	5
No Go	20

3

Figure 6 JTB Field Problem Mapping

In this section the candidates obtained are wells that have been worked out and wells that have several recommendations for work that require a short period of study so that they can be carried out in 2018 and 2019 with the information summarized as follows:

Figure 7 Recommendation on Selected Well Candidates

No	Well	Job	Remarks	Year	Gain (bopd)
1	CMB-09	Stimulasi (Acid Frac)	w/ Rig TAYLOR-01	2018	15
2	RDU-01	Lifting Optimization	Irisan RK Existing EPT- FJTB & Deep Learning	2018	10
3	JTB-130	Lifting Optimization (Convert Lifting Gas lift – ESP low rate)	Irisan RK Existing EPT- FJTB & Deep Learning	2018	10
4	KRE-04	Pengambilan Well Data (PBU) 2019 : kandidat frac	Irisan RK Existing EPT- FJTB & Deep Learning (RIGLESS)	2018	-
5	RDG-56	Stimulasi (Acidizing)	RIGLESS	2018	15
6	CMB-08	Pengambilan Well Data (PBU)	RIGLESS	2018	-
7	JTB-144	Pengambilan Well Data (PBU)	RIGLESS	2018	-
8	JTB-163	Pengambilan Well Data (PBU)	RIGLESS	2018	-
9	JTB-143	Pengambilan Well Data (PBU)	RIGLESS	2018	-
10	CMS-11	Stimulasi Rigless	RIGLESS	2019	15
11	CMB-13	Optimasi Lifting	RIGLESS	2019	10
12	CMT-09	Low prior stimulasi	Akan diskusi kembali terkait rig	2019	15
13	KRE-04	PBU & Stimulasi	Akan diskusi kembali terkait rig	2019	15

Table 4 Field Results After Recommendation & Execution

No	Well	Job	Remarks	Year	Gain (bopd)
1	ABG-03	Stimulasi	Sudah dilakukan Mid Year 2018	2018	900 bopd
2	CMB-12	Optimasi Lifting	Sudah dilakukan Opt	2018	24 bopd
3	JTB-198	Stimulasi pd FL	Sudah dilakukan penggantian FL	2018	10 bopd
4	CMB-24	Optimasi Gas Injeksi	Sudah dilakukan Opt	2018	6 bopd
5	JTB-121	Optimasi Gas Lift	Sudah dilakukan Opt	2018	8 bopd
6	KDG-01	Bean Optimization	Sudah dilakukan bean opt	2018	15 bopd
7	JTB-091	Penggantian tbg scaling	Sudah dilakukan penggantian tbg	2018	2 bopd
8	XD-007	Well Service	Sudah dilakukan Well Service	2018	- (kembali ke prod awal 50 bopd)

Conclusions

Based on the results of the candidates' search, the conclusions are as follows:

1. DeepSearch search results show good results because searches that are only done briefly by the LAPI ITB Team using DeepSearch generate candidates who after being reviewed by Pertamina Asset 3 show that 38 of the 58 wells that are candidates can be done in 2018-2019 with 13 Wells, in 2019 as many as 12 Wells, and over 2019 a number of 5 Wells, and 8 wells have been worked on.

2. The presence of 8 wells that have been worked out is a sign that Deepsearch search results are in accordance with the candidates who are manually obtained by the Pertamina Asset 3 Team. So that the results that match this show the DeepSearch will help search for security properly.

3. The main diagnosis from the results of inspection data owned by Pertamina EP Asset 3, shows the production problems found in Pertamina wells Asset 3 Jatibarang field comes from skin problems, fish problems, scale problems, artificial lift optimization, cement problems, and also problems reservoir.

References

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