PROFESSIONAL TECHNICAL PAPER
ONLINE PRESENTATION
24 - 25 OCTOBER 2020

Boosting Value Creation of Mature Fields with Seismic Digitalization Ecosystem in Mahakam Area

Moch. Choirul Hadi[*1], Depi Restiadi[2] , Kelik Moersidin[3], Ronald Herbet[4]

[1]Geoinformation Management Engineer
[2]Head G&G Tunu Shallow Zone
[3]Head Geophysics Studies & Processing
[4]Senior Geophysicist

PT. PERTAMINA HULU MAHAKAM
* Email: Mochammad.choirul-hadi@pertamina.com

Abstract. Seismic has been largely used in the petroleum industry for some decades, from exploration phase to the latest stage of field development. It is true for the increasingly challenging in Mahakam fields area, especially to unlock the remaining hydrocarbon potential which requires a deeper analysis on seismic interpretation from collaboration of new ideas, technology, and digital processes. One of the key factors for the success is a good management on seismic database.

The aim of this paper is to describe how PERTAMINA Hulu Mahakam governs the seismic digitalization and to make the best practice for further field development, integrity of operation, enhance safety and environmental performances, and ultimately to optimize hydrocarbon recovery. The best practice methodology illustrates the benefit of cross functional collaboration, global standard data governance, and seismic data processing including ongoing Machine Learning's pilot project for maximizing Asset's performance.

The paper concludes by presenting the 5 critical success factors in implementing seismic digitalization using Sintegra's ecosystem in Mahakam area having range ~8.400 km^2 3D, 21.000 km 2D, over 2.000 wells, and high possibility that could be replicated to the other exploration or development fields.

Keyword: Seismic; Digitalization; Mature Field; Mahakam

1 Introduction

The oil and gas industry is taking increasing advantage of advances in digital and application technology to improve asset performance. While it is becoming trend today within the sense of disruption technology, pandemic situation, and oil gas challenges, but the level of study appears to have increased coincident with high speed digital computing, internet of thing (IOT), data science, and visualization.

Seismic data has been largely used for some decades in the petroleum industry including Mahakam assets. The growing interest in digitalization technology has spawned a number of workshop, conferences, and continuous improvement program in corporate level. PERTAMINA Hulu Mahakam (PHM) considers seismic digitalization as one of importance component of an overall approach to allows faster process in maturing well candidate selection and optimize field development plan.

This paper describes Mahakam's experience story on implementation of seismic digitalization and data management roadmap in variety of fields including machine learning pilot project to the seismic driven hydrocarbon anomalies zone.

2 Methodology

Along 50 years of operation, most of Mahakam reserves by textbook have been discovered. But refers to our recent studies, there are twenty thousand seismic driven hydrocarbon anomalies objects require a deeper analysis on interpretation with collaboration of new ideas, technology, and digital processes.

We believe it that deeper analysis is able to tackle this challenge with supported by reliable seismic data are built from foundational data management to advance data practices as illustrated on Figure-1, below.

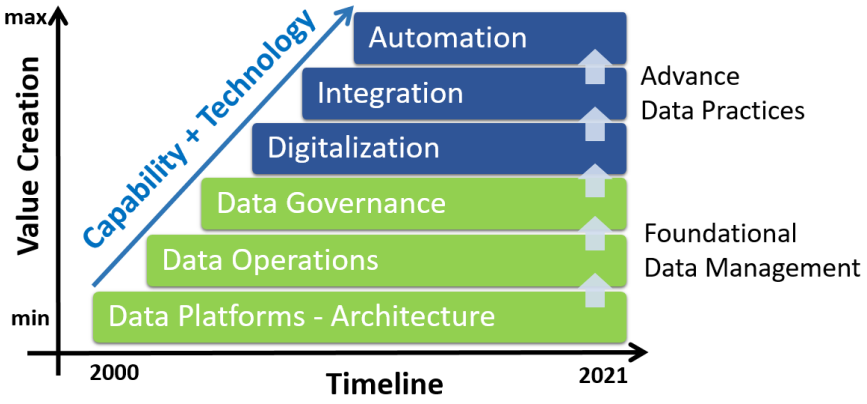

Figure-1. Roadmap of Mahakam data management deployment (Riswandi, 2020)

PHM chartered the effort to improve digital seismic began in 2018. Systematic assessment was performed and came up with fact findings that user spent extra time looking for and accessing data during deep study preparation. 73.2% portion of the bottleneck were caused by data searching result reliability, availability and duplication issues which was decreasing confidence level of user to area of interest.

Put these issues on priority would reduce potential losses of cost at Rp.45 billion for 3D pre-processing and 2D processing expenditures and Rp.129 million project cost per year for data finding as figured out on Figure-2,

No	Priority Problem Analysis	Value Billions (Rp)	Freq. (%)	Cum. (%)
1	Users spent extra time look for data due to **unreliable result and duplication from data searching**	45	73.2	73.2
2	Limitation of well **log data**	5	14.1	87.3
3	Few legacy data remains on **analog format**	3	8.5	95.8
4	Limitation on **compatibility** of interpretation tools	1.5	4.2	100
	Total	54.5	100	

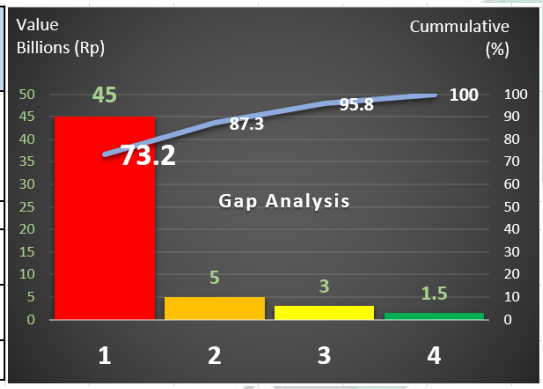

Figure-2. Identification potential loss of value during seismic study data provision (Arden, 2019)

Knowing more potential risk with Risk Matrix Analysis tool, we brook down it into quantification and controlling residual risk (i.e.: probability and impact) at minimum risk. Full of figures related to risk mapping analysis are figure out on the Table-1,

Table-1. Potential risks mapping during seismic study based on Risk Matrix Analysis (Arden, 2019)

Risk Category	Risk Event	Risk Agent	Symptoms	Positive Factors (Control)	Qualitative Impacts	Inherent			
						Quantitative Impacts (Billion Rupiah)	Probability	Impact	Risk Priority Index (RPI)
Study preparation	Repeating data processing	Previous full dataset not found	Dataset incomplete or unlikely	Manage data on fully integrated system	Less data accessibility and availability	45	Moderate	Catastrophic	High
	Getting data takes long time	1. Lack of integrated system	1. Hard to get good data	1. Knowledge Management					
		2. Historical data was mess up	2. Gap knowledge of Personnel	2. Seismic Data Integrator (SINTEGRA)					

Furthermore, PHM continued performing root cause analysis by using fish bone diagram to generated dominant factor of problem based on direct data correlation method. The result is seen on Pareto diagram Figure-3.

No	Root Cause Component	A. Revenue Losses	B. Freq	C. Completion Time	D. Difficulties Scale	Total	%	% Cum.
1	Lack of **seismic database integration**	15	20	20	20	75	72.82	72.82
2	Time consuming on Seismic Tape delivery due to **ineffective metadata searching**	1	1	5	5	12	11.65	84.47
3	**Knowledge gap** inter personnel	1	5	1	1	8	7.77	92.23
4	**One man show** for data management and history records to any sources	1	1	5	1	8	7.77	100.00

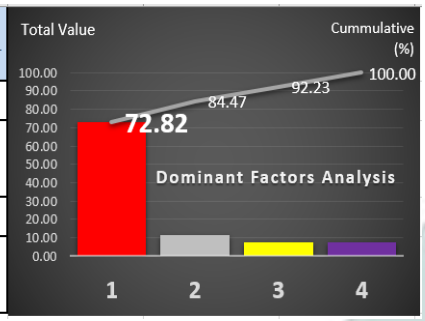

Figure-3. Root cause analysis to get dominant factor of problem (Arden, 2019)

Based on result above, lack of seismic database integration problem was becoming dominant factor. In addition, time consuming in searching data, knowledge gap personnel and experienced person centric were also other bottlenecks to be resolved. A solid solution is designed to adapt above common problems by developing SINTEGRA ecosystem (Seismic Data Integrator) which has key features and value creation based on PERTAMINA's 5 top quality values (PANCA MUTU) that are Quality, Cost, Delivery, HSSE and Morale.

3 Result and Discussion

Digital SINTEGRA Ecosystem

Incorporating with real user expectation such as searching data rapidly, delivering integral information, innovative and connected anywhere, then PHM has successfully revamping existing seismic data flow into new Sintegra ecosystem (see Figure-4).

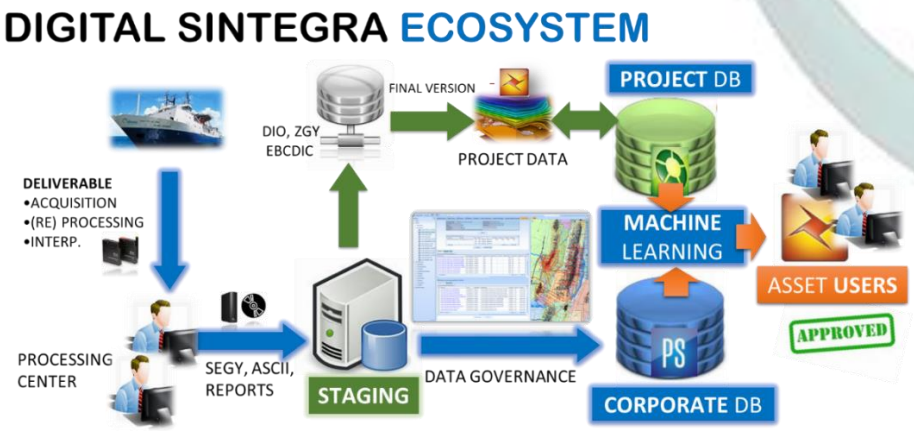

Figure-4. Seismic digital ecosystem revamping result (Choirul, 2019)

Seismic Data Reliability and Performance

Based on performance test result, it is proven that Sintegra ecosystem is managed to boost data performance delivery to the users from days into hours until second depending onto delivery service type, as described on Table-5.

Table-2. Sintegra ecosystem Performance Test before and after deployment (Arden, 2019)

No	Performance Test Parameters	BEFORE (man hours)	AFTER (man hours)	KPI Result
1	Database Searching untill Reporting	12 days	5 sec	Expected
2	Tape Delivery	10 days	48 h	Expected
3	Database Classification	10 days	10 sec	Expected
4	Header Creation until Display	6 days	1 h	Expected

Similar to the risk index, Sintegra ecosystem is shifting higher to lower risk index after deployment in term of occurrence and risk value where event (A) is risk event related to man hours' effort for searching seismic information and (B) is risk event related potential loss of expenditure of pre-processing seismic data repetition. See Figure-6 (a) and (b),

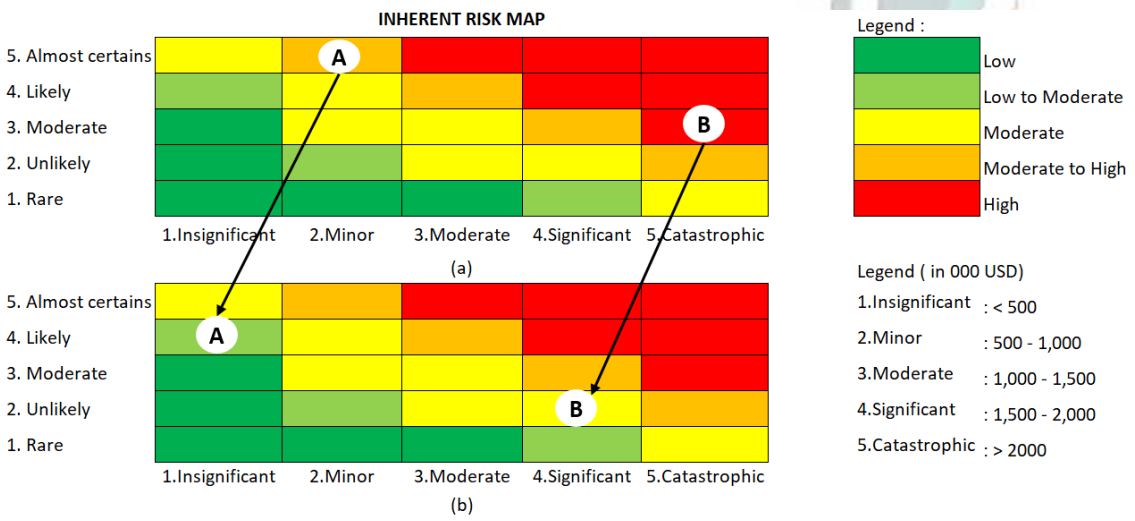

Figure-6. (a) Inherent Risk Mapping before deployment (Arden, 2019); (b) Inherent Risk Residual Mapping after deployment (Arden, 2019);

Now on, PHM is more confidence to boost data value because the seismic data become more reliable in quality, faster in accessibility, effective in resources and low risk in HSSE.

4 Conclusion

PERTAMINA Hulu Mahakam believes a digital seismic as one of importance component of an overall approach to unlock remaining hydrocarbon potential in mature fields. It has identified and is pursuing good Seismic Data Integrator ecosystem to deploying digitalization in Mahakam based on the application of five critical success factors:

1. Knowing end user expectation before creating solution
2. Setup the target of value creation based on PERTAMINA's five top quality value (PANCA MUTU)
3. Systematically select and deploy the right applications to the right solution
4. Implement standard corporate data governance and global best practice
5. Think out of the box and adaptive to disruption technology

Looking to the future, to get success story in evaluating seismic driven hydrocarbon anomaly objects using machine learning technology.

References

[1] Arden S, I Made P, Choirul M, Herbet R, and Thaha H. 2019. Integrasi Akses Data Geofisika Dengan Pengembangan Aplikasi Berbasis Web Terintegrasi (SINTEGRA) di Wilayah Blok Mahakam. Presented at Continuous Improvement Program 2019 Forum (Silver medal award), PERTAMINA HULU INDONESIA, Balikpapan, Indonesia.

[2] Choirul, M. 2020. Sintegra, Gain New Oil in Big Data Digitalization. Presented at Exploration & Development Sharing Session with SKK MIGAS, PT. PERTAMINA HULU MAHAKAM, Balikpapan, Indonesia

[3] Choirul, M. 2020. Mahakam Living Digital, A Journey to Unlock Hidden Oil. Presented at Knowledge Sharing Session with SKK MIGAS, PT. PERTAMINA HULU MAHAKAM, Balikpapan, Indonesia

[4] Herbet, R and Choirul, M. 2018. Geophysical Data Nomenclature. Memorandum No 12/GSR/GPH/2018-S1, PT. PERTAMINA HULU MAHAKAM, Balikpapan, Indonesia

[5] Hacker, JM. ExxonMobil Upstream Research Co. 2008. An IOC's Experience in Implementing Digital Oilfield Technologies. Paper SPE-117837. Presented at 2008 Abu Dhabi International Petroleum Exhibition and Conference, Abu Dhabi, UAE

[6] Riswandi. 2020. Data Management and Digitalization in Mahakam. Presented at Exploration & Development Technology Day, PT. PERTAMINA HULU MAHAKAM, Balikpapan, Indonesia

[7] CMMI. 2014. Data Management Maturity Model. CMMI Institute.